



**How to Increase Your Crop Yield and Quality, Restore Your Soil's Fertility, and Ensure Food Security With the Biotechnology of the 100% Organic, Liquid Bio-fertilisers, Bio-Plant and Pro-Plant.**



**Bio-Plant and Pro-Plant  
100% Organic, Microbial, Liquid Bio-Fertilizers**

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## Section 1

### Introduction



Dennis Obeto, President and CEO of Salad Greenhouse Worldwide Ltd. (left), and Peter McAlpine, Marketing Manager of Artemis & Angel Co. Ltd. (right) with His Excellency, The Emir of Bida in Bida, Niger State (centre).

## **Part 1**

### **Company Profile**

#### **1. Salad Greenhouse Worldwide Ltd.**

- Salad Greenhouse Worldwide Ltd. is a privately-owned company registered with corporate affairs commission in Nigeria and the Canadian Revenue Agency with a goal of providing farm products, services and equipment in the agriculture and technology sectors, including haulage logistics solution, fertilizers, computerized new age equipment, mechanized farm equipment, the import and export of cash crops, as well as manpower and consultancy services.



Dennis Obeto, Chairman and CEO



Aliyu Ibrahim, Executive Director/Technical

#### **1.1 Our Declaration**

- We are committed to the development of Nigeria's Agriculture and Technology sectors by providing high quality products and services, which will alleviate poverty; make farmers richer; consumers healthier; and ultimately make the Agriculture sector a significant portion of Nigeria's Gross Domestic Product (GDP). We also want to become the most trusted supplier of agricultural products to the farmers of Nigeria.

#### **1.2 Background**

- Salad Greenhouse Worldwide Ltd comprises of a group of highly experience business professionals, technology and agricultural experts with a vast knowledge of the international business environment. The establishment of our new Canadian office shows our commitment to bringing Nigeria closer to the North American markets and vice versa. Our company is creating a niche in the areas of agriculture, haulage, and agriculture business consultancy.

#### **1.3 Our Mission**

- Salad Greenhouse Worldwide Limited's mission is to provide affordable, one-stop, agricultural, logistics, oil, and gas services throughout the Federation of Nigeria.

#### **1.4 Our Vision**

- Our vision is to build the most successful Agriculture and Logistics company in Nigeria and to continually improve our market share by offering competitive rates in conjunction with superior services, optimal use of available resources, innovation, and cost saving initiatives.

#### **2. Artemis & Angel Co. Ltd. Company Profile**

- Artemis & Angel Co. Ltd. is Thailand's leading company for producing advanced bio-technology, liquid, 100% organic bio-fertilizers. The company produces 100% organic and chemical-free products, which are marketed by Salad Greenhouse Worldwide Ltd., namely Bio-Plant and Pro-Plant (liquid, 100% organic bio-fertilizers), Belta Probiotic (for animals and poultry), Bio-Utility (waste water treatment), and prawn farming products.

- Artemis & Angel Co. Ltd. was founded in 1984 by the company President, Somkiet Panjanapongchai. The main office is in central Bangkok while the production facilities are outside the city area. The company has agents in countries in Africa, South America, and South East Asia.

### **3. The Products**

#### **3.1 Bio-Plant and Pro-Plant**

- These are advanced bio-technology, 100% organic, liquid, microbial bio-fertilizers, which enable a country to phase out chemical agriculture and replace it with 100% organic farming.
- Bio-Plant and Pro-Plant are the result of research in bio-technology, which the company President, Somkiet Panjanapongchai, has carried out over many years. He has discovered new processes that make it possible to put the micro-organisms and fungi groups, and major and minor minerals of fertile soil into a very concentrated liquid form and thereby to create a pair of synergistic, microbial, 100% organic bio-fertilizers, which restore the fertility of soil by infusing it with a huge concentration of micro-organisms; increase crop yields above what chemical agriculture can achieve; lower the cost of food production; reduce and eliminate crop disease; and produce healthy, chemical-free food.
- In bio-chemical farming the bio-fertilizers enable farmers to halve the amount of chemical fertilizers they use in the first season while still increasing the crop yield. The rest of the chemicals can be phased out over the following 2 years, which is a pace of change that chemical farmers generally can accept.

#### **3.2 Bio-Utility**

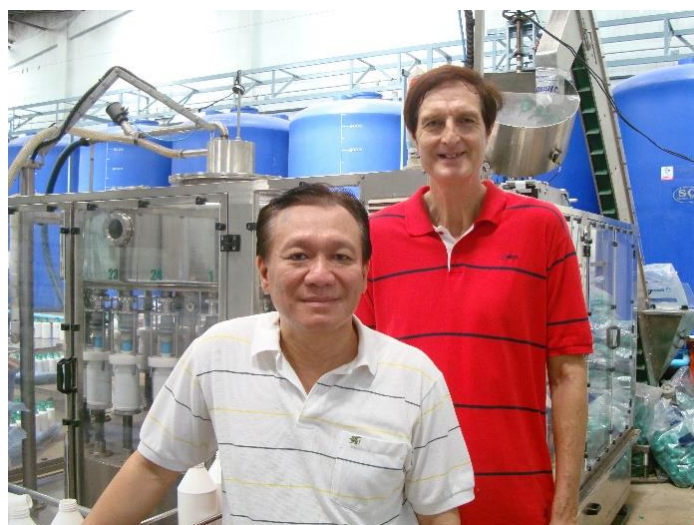
- For the treatment of rubbish dumps; and municipal, sugar mill, and distillery waste water. The water can be used afterwards in agriculture. Bio-Plant can also be used very effectively for these purposes.

#### **3.3 Belta Probiotic**

- Belta Probiotic is a very high quality probiotic product that improves the digestion of livestock and poultry, such as cows, buffalos, chickens, sheep, and pigs, so that they absorb more protein, minerals, etc. Their weight increases noticeably more quickly than in animals not taking Belta Probiotic. They become healthier and their immune system is strengthened so that they are much less liable to fall ill.

#### **3.4 Prawn Farming Products**

- Over 50 bio-technology prawn farm products for prawn farmers to raise prawns and operate a prawn farm.



Somkiet Panjanapongchai (President of Artemis & Angel Co. Ltd., front)  
and Peter McAlpine (Marketing Manager, back)



## **Section 2**

### **The Nature and Benefits of Bio-Plant and Pro-Plant**



**The Effect of Using the Bio-fertilizers on the Soil**

## **Part 2**

### **The Facts People Should Know About Chemical Fertilizers**

#### **1. Nitrogen is Nitrogen is Nitrogen?**

- The whole idea is that there is a difference between an organic source of Nitrogen and a chemical source of Nitrogen. Urea (when it was discovered that it could be made from inorganic (non-living) compounds and that chemically it was identical to its natural cousin Urine) was proclaimed as an important tool in growing more food to help feed the world's growing population. This is still the current logic that chemical companies would like you to believe. The American idea that a little is all right, but a lot is better, is quite wrong.

#### **2. Positives about Urea**

- It makes a lot of money for anyone selling it.
- Are there any other positives? ... No, none.

#### **3. Negatives about Urea**

- a. Rapid growth pushes plants to grow too fast.
- b. Plants grow fast but are very weak.
- c. Promotes stress.
- d. Destroys soil organisms.
- e. Increases pest activities.
- f. Increases disease activities.
- g. Urea breaks down into various compounds some of which can inhibit plant growth.
- h. Eventually decreases plant production.
- i. Decreases nutritional values of plants to humans while increases nutritional value to pests.
- j. The carbon in Urea-based fertilizers is chemically converted to CO<sub>2</sub> and lost to the atmosphere. Carbon is energy to plants and soil micro-organisms.

#### **4. More is Better?**

- It is a mistaken idea that more Nitrogen is better than less. What you must understand is how Nitrogen is available in nature and how plants and soil micro-organisms use it. Nitrogen is produced freely in nature by various mechanisms found in nature. The most obvious sources of Nitrogen is animal manure. Another source is bacterial action. The bacteria produce Nitrogen in a form available to the root hairs (through which it is absorbed into the plants) as well as through a variety of other nutritional sources. Chemical fertilizers and sprays kill the micro-organisms that can provide Nitrogen naturally to the plants. As the micro-organisms are killed, the plants receive less Nitrogen, and so the farmer has to buy more Urea and NPK to provide the Nitrogen that the plants need.

#### **5. Why Urea Causes Stress**

- Plants can absorb Nitrogen directly from the air as well as from the soil, but they can also absorb it directly through their leaves. A basic problem with Urea-based products is how it is available to plants. Natural sources provide plants with Nitrogen as they need it and when they want it as opposed to chemical Nitrogen, such as Urea, which is absorbed by the plants in very large amounts whether it needs it or not. This is where stress comes in. By force-feeding your plants this chemical Nitrogen, you are causing stress in the plants. Stress is also caused by the fact that Urea kills off all beneficial soil bacteria which are needed to breakdown the nutrients needed by plants. As the soil becomes less and less alive, the plants become increasingly dependent on the straight shots of 'food' it gets from the chemical fertilizer you are using.

## **6. Some Factors That Cause Stress in Plants**

1. Dead soil.
2. Low nutrition levels.
3. Low mineral levels.
4. Planted in wrong environment.
5. Wrong variety planted.
6. Other chemical-use, such as herbicides, pesticides, etc.

## **7. What Urea Does to the Soil**

- There are two ways to sterilize the soil, using chemicals and using heat. Urea is a chemical that sterilizes the soil by killing off all the good bacteria normally found living in the soil. Urea, because of its identical molecular structure, is mistaken by bacteria and plants as a food source. Because Urea is a much more concentrated source of Nitrogen, the bacteria are not fed but are actually destroyed, leaving behind a mutated form of bacteria which the plants cannot use. Slowly, plants find themselves weakening, starving from lack of proper nutrition, and stressed out. Their root systems no longer function as they should. They depend more and more on their chemical ‘hit’ to provide nutrition for them. The soil’s natural bacterial system is converted into one that cannot be used by a plant’s root systems for food absorption, and instead, the bad bacteria themselves begin to feed off the plants!

## **8. What Urea Does to the Plants**

- The plants get an immediate ‘relief’ when you apply or spray fertilizers based on Urea or some other chemical form of high Nitrogen, but as it wears off the plants return to their weakened state and become even more stressed. This process is repeated again and again.
- Less soil bacteria and less root hair equal less food being absorbed by the plants which means less energy, less minerals, and more stress. Many chemical fertilizers are now using timed-release fertilizers that release their ‘hits’ over a time, thus reducing down time. However, this is not the case at all, and instead, the timed-release fertilizers merely increase stress. Now plants are stressed out all of the time!
- Fertilizer companies are also adding more nutrients to their Urea-based fertilizers to help plants last longer, as well as systemically to fight off pests and diseases. Plants thus stressed out are more inclined to disease and pest attacks than organically grown plants.

## **9. What Urea Does to Diseases**

- The very same bacteria that are normally present in the soil die and are replaced by a different type of bacteria. Some of the bacteria are of the “bad” type. This is to say, the bacteria are of the fungal disease type and are all soil-born. They can establish themselves in the soil if certain conditions are right for them; the main condition being the lack of the “good” bacteria.

## **10. What Are the Perfect Conditions for Diseases to Occur?**

### ***a. Dead Soil***

- Chemical over-use destroys all soil bacteria, except for a few specific types of bad bacteria that depend on these conditions to grow. Urea when used over many years destroys this balance of good and bad bacteria.

### ***b. Stressed Plants***

- Dead soil increases the plant's stress levels due to bad conditions for plant growth.

### ***c. High Nitrogen***

- High Nitrogen causes rapid growth. Rapid growth without proper nutrition causes more stress which in turn restricts more nutrition from being absorbed by plants. High Nitrogen also attracts insects that have mutated to handle plants that have such rapid growth. High Nitrogen also mutates bacteria into rapid growth cycles.



- Environmental stress can be caused by improper watering or weather cycles with too much rain or drought.
- Biological considerations. Planting the wrong variety or type of plant in the wrong environment will certainly cause major stress to plants and all involved.
- Over-chemical use of any type from pesticides to herbicides, etc., will cause major damage to the soil's eco-system and disrupt nutritional levels.

#### **11. What Now?**

- Feed the bacteria first and let the bacteria feed the plants.
- Use organic sources of Nitrogen only.
- Never use Nitrogen sources only but combine with minerals and bacteria.
- Provide minerals in amounts needed by soil and plants.
- Encourage high bacterial count by increasing use of compost-based products, or make your own compost.

#### **12. Final Reminder: The Negative Effects of Chemical Fertilizers**

- Apart from wearing out the soil over time, the biggest issue facing the use of chemical fertilizers is groundwater contamination. Nitrogen fertilizers break down into nitrates and travel easily through the soil. Because it is water-soluble and can remain in groundwater for decades, the addition of more Nitrogen over the years has an accumulative effect.
- At the University of Wisconsin, Madison, they discovered the effects of chemical fertilizers are compounded when mixed with a single pesticide. They discovered altered immune, endocrine and nervous system functions in mice, as well as influence on the development of neurological, endocrine and immune systems in children and fetuses. These influences affect the ability to learn and cause patterns of aggression.
- Urea produces ammonia emanation, contributes to acid rain, groundwater contamination and ozone depletion due to release of nitrous oxide by denitrification process. With its increased use and projections of future use, this problem may increase several-fold in the coming decades.
- Groundwater contamination has been linked to gastric cancer, goitre, birth malformations, hypertension; testicular cancer, and stomach cancer.

#### **13. General Reasons Why Chemical Fertilizers Are Bad**

- We are familiar with the fact that the common commercial fertilizers are ultimately bad for the soil, but just why are they bad? Briefly, the whole NPK approach is in error. Von Liebig simply drew the wrong conclusions and unfortunately his work became the word of the day. Dislodging his errors is difficult. Part of the problem is the materials used to obtain the nitrogen, potash and potassium, which while they might facilitate the release of immediate energy for the use of plants, actually destroy the soil organisms that, along with the minerals, sunlight, air and water are the digestive system of plants.
- 45 kgs. of muriate of potash per acre releases the equivalent of 380 litres of Clorox sprayed over the same soil — to name only one. The soil organisms have no a chance against such an onslaught.
- When the soil flora and fauna die, they are no longer there to flocculate or loosen the soil. As their numbers fall, the soil degrades and compacts. The lack of bacteria results in lower humus, the soil becomes so hard that it is nearly impossible to plough and finally, the field is abandoned to be scoured by wind and rain.

#### **14. Why Using Chemical Fertilisers Attracts Insects**

*"No method of insect control will ever work as long as poisoned crops outgas ethanol and ammonia in small parts per million. Those two powerful fermentation chemicals are the mark of a dying, decaying plant and serve as attractants to all plant-eating insects."*  
 Professor Philip Callahan

- At death, all living creatures go through several stages of decomposition until they “return to dust”, as the bible states. As decomposition sets in, fermentation causes ethanol and ammonia to be produced which is the attractive state that brings hoards of nature’s garbage scavengers, disease, and insects to feed.
- Prof. Phil Callahan has written that when he was studying under Prof. Reginald Painter of Kansas State for his PhD. His job was to discover why certain plants were resistant to disease and insects. After forty years, he “discovered that unhealthy plants from “sick,” poison-fed, soil give off slightly higher ethanol and ammonia infrared signals than healthy plants.”
- Modern farms have extended the use of urea fertilizer, which is an ammonia source of nitrogen. One of Prof. Callahan’s many discoveries was that insects communicate by infrared radiation which their magnetic antennae or sensilla use to focus and concentrate the signals. When farmers use too much urea on their fields they are attracting the insects to come and feed, because the insects are attracted to the stronger ammonia frequency.

#### **15. Adverse Effects of Salt**

- Salt fertilizers kill the microbes, rendering the soil dead. It becomes a wasteland, just as how Rome salted the agricultural fields of ancient Carthage thus destroying a competitor. A good example of this salting is potassium 0-0-60, or by its chemical name – Muriate of Potash (MOP) or (KCI Potassium Chloride).vIn agriculture it is the most common source of potassium, some 95% of all potash used worldwide. Its composition is potassium = 50% and chloride = 46%.
- The most chloride a soil for farming can tolerate is 63 kgs/acre. But farmers often apply much more than this. It is no wonder that the microbial life is dying each year.

#### **16. The Balance of Potassium and Calcium**

- Excessive use of potassium fertilizer causes potassium to replace calcium and can launch plant diseases. The farmer then adds more potassium to fix the problem, but makes the situation worse. Potassium is essential for growth, but it is easy to use too much.
- Micro-organisms in the soil regulate the ratios of calcium to potassium. But when our chemicals, such as MOP fertilizer, NPK, Urea, herbicides, and insecticides kill off those micro-organisms in the soil, we set ourselves up for horrible consequences.
- When plants cannot get enough calcium, they substitute potassium, but too much potassium causes severe health problems in animals and humans who eat those damaged crops.

#### **17. Living Soil Needs Humus**

- A living soil, an ideal soil would be 5% humus, 45% mineral, 25% air and 25% water. It would be easy to plough or till, spongy to walk upon and would hold large amounts of water with little run off.
- Micro-organisms, which cover a large spectrum of bacteria, actinomycetes, fungi, algae, protozoa and nematodes, are essential for breaking down minerals and other nutrients for plant roots to absorb, as well as producing vitamins, amino acids, enzymes, hormones and antibiotics.
- This soil contains organic matter, from various sources and humus. Humus differs from organic matter in that it is the final result after bacteria have digested or composted the organic matter, and it does not normally leach from the soil.
- Carbon is necessary in that active carbon — that is, humus — can hold four times its weight in water. Soils with 6% humus can hold two inches of rain with a minimum of erosion. It also fixes nutrients in the soil and regulates the magnetic flow across a field, stabilizes it, and keeps it from flowing too fast, which affects pH.
- Chemical farmers do not make compost in order to provide the humus and to regenerate the microbial life of the soil. Consequently, the soil is essentially dead and farmers need to keep adding more and more chemical fertilizer to get the same yield as before while attracting more pests, which results in the use of more micro-organism-killing chemical sprays.

#### **18. Weeds Indicate a Soil Imbalance**

- Weeds, like insects, are excellent indicators of imbalance. If a farmer has problems with weeds, instead of using a herbicide, which kills the soil's microbial life, he should restore the mineral and microbial imbalance and deficiencies in the soil. Weeds love a lot of nitrates.
- An Amish farmer, confronted by a pasture overgrown with spiny jimson weed, added a foliar spray of 8 litres each of liquid calcium and blackstrap molasses, some soil conditioner, and 5 kgs. of a dry soluble fertilizer, and almost completely eliminated the problem.

#### **19. Only Unhealthy Plants Are Attacked**

- Dr. Callahan studied insects and found that the antennae on insects actually pick up radiation and infrared signals from plants. Infrared signals are emitted naturally by all living things, and from the gaseous emissions from all life forms.
- Each insect is geared toward certain plants by the shape of their antennae, thus the alfalfa weevil is attracted to alfalfa but not to apple trees. When a plant deviates from its genetic potential, the infrared signals given off by the plant will change and become more attractive to insect pests.
- We can observe this using a refractometer and taking a brix reading, finding that the sucrose in attacked plants is lower than plants not being attacked.
- Healthy plants are not attacked by insects. By attacking unhealthy plants the insects are actually doing humanity a favour by pointing out to us which plants lack the ability to properly nourish our bodies. Too bad that these plants are the ones most commonly found in our shops.

## Part 3

### The Advantages of 100% Organic Farming

#### 1. Consumer Benefits

##### 1.1 Higher Nutritional Value

- The nutritional value of food is largely the result of its vitamin and mineral content. In this regard, organically grown food is dramatically superior in mineral content to that grown with chemical fertilizers and sprays.
- Because it improves the microbial life of the soil, organic farming increases the amount of nutrients the roots of plants can get from the soil.
- Healthy plants mean healthy people, and better nourished plants provide better nourishment to people and animals alike.



Rice grown with Bio-Plant and Pro-Plant has more grain on the heads. The quality is higher and there are fewer broken grains than in the case of chemical rice. Farmers can sell it as mother seeds for higher price.

##### 1.2 Organic Food is Poison-Free

- A major benefit to consumers of organic food is that it is free of health-harming chemicals, such as chemical pesticides, fungicides and herbicides.
- As you would expect of populations fed on chemically grown foods, there has been a profound upward trend in the incidence of diseases and cancers associated with exposure to toxic chemicals.
- Thousands of tons of pesticides are sprayed on chemical crops each year alone. The general population is exposed to pesticides via residues in and on food, pesticides in the air, as a result of spraying in fields, pesticides applied to road sides to control weeds, and even pesticide contamination of drinking water. As well as the active ingredients there are also likely to be chemicals used to help the stickiness and consistency of the pesticide.
- PAN UK (formerly the Pesticide Trust) cites studies that have shown the following:
  - 93% of non-organic oranges analysed contained pesticide residues
  - 78% of apples analysed contained pesticide residues
  - 43% of all fruit and vegetables analysed had detectable levels of pesticides
  - 50% of lettuce contained residues from 7 or more chemical
  - 71% of cereal bars contained residues
  - 83% of oily fish showed pesticide residues
- Similar kinds of statistics can be found around the world. Looking at the health risks of pesticides is difficult because many of the risks may be long term and these can be difficult to establish. There is also the problem of pesticide interaction, and the interaction of pesticides with other chemicals encountered in the environment.
- There are two basic types of pesticides:
  - a. **Organochlorides** kill pests by attacking their central nervous systems. Linked to cancer, birth defects and genetic changes in animals. They are fat-soluble and stored in body fat. They are far more persistent than organophosphates.
  - b. **Organophosphates** interfere with nerve conduction in pests. They are the most common pesticides used today. They are water-soluble and break down rapidly.

- Investigations continually show that illegal and dangerous pesticides are appearing in food. This appears to be from two sources: illegal use of pesticides in a country, and also the use of pesticides that are legal (or unpoliced) in the country where the food is grown.

### 1.3 Other Health Benefits of Organic Food

- Other health benefits of eating organic foods is that they seem to reduce the risk of heart attacks, strokes and cancer for individuals who abstain from consuming products produced by conventional farming methods.
- Biochemists are continually researching the inherent benefits of organically grown foods and discovering the consequences of consuming products loaded with toxins and chemicals. The fact is that we are ultimately what we eat.

### 1.4 Organic Food Tastes Better

- Animals and people have the sense of taste to allow them to discern the quality of the food they ingest. It comes as no surprise, therefore, that organically grown food tastes better than that conventionally grown. The tastiness of fruit and vegetables is directly related to its sugar content, which in turn is a function of the quality of nutrition that the plant itself has enjoyed.
- This quality of fruit and vegetable can be empirically measured by subjecting its juice to Brix analysis, which is a measure of its specific gravity (density). The Brix score is widely used in testing fruit and vegetables for their quality prior to export.

### 1.5 Organic Food Keeps Longer

- Organically grown plants are nourished naturally, rendering the structural and metabolic integrity of their cellular structure superior to those conventionally grown. As a result, organically grown foods can be stored longer and do not show rapid mould and rotting.
- Crops grown with Bio-Plant and Pro-Plant keep noticeably longer and stay fresher after harvest. This enables exporters to export the produce with less worry.

## 2. Grower Benefits

### 2.1 Disease and Pest Resistance

- A healthy plant grown organically in properly balanced soil resists most diseases and insect pests. This was proven by US doctor and soil nutrition pioneer, Dr. Northern, who conducted many experiments to test the hypothesis during the 1930's. For instance, in an orange grove infested with scale, he restored the mineral balance to part of the soil and the trees growing in that part became clean while the rest remained diseased.
- By the same means he grew healthy rosebushes between rows that were riddled by insects, and tomato and cucumber plants, both healthy and diseased, where the vines intertwined. Northern observed that the bugs ate up the diseased and refused to touch the healthy plants! The same phenomenon is observable with crops grown with Bio-Plant and Pro-Plant.



Diseased rice field in Isabela, Philippines. Many rice fields there have disease because of heavy use of chemical fertilizers and chemical sprays over many years.

### 2.2 Weed Competitiveness

- Weeds are nature's Band-Aids, placed by the wisdom of creation to heal and restore damaged soils. When farmers husband the life of the soil, as they do in organic agriculture, the improved conditions dissuade many weeds from growing and favour their crops. The crops, being healthier, are also better able to compete with those weeds that are present.



### **2.3 Lower Input Costs**

- By definition, organic farming does not involve the use of expensive agrichemicals. The greater resistance of their crops to pests and the diseases saves farmers significantly in expensive insecticides, fungicides and other pesticides.
- Fertilizers are either created in situ by green manuring and leguminous crop rotation or on-farm via composting and worm farming. Biodynamic farmers use a low cost microbial solution sprayed onto their crops. The result is living, fertile soil conditions for a low cost. Farmers can use Bio-Plant as an organic herbicide or fungicide in certain situations.

### **2.4 Drought Resistance**

- Organically grown plants are more drought-tolerant.
- Because chemical fertilizer is soluble, plants are forced to imbibe it every time they are thirsty for water. They can and do enjoy good growth as long as water is readily available. As soon as water becomes limited, however, the soluble nutrient salts in the cells of chemically fed plants are unable to osmotically draw sufficient water to maintain safe dilution. They soon reach toxic concentrations, and the plant stops growing, hays off and dies earlier than it otherwise would have.

### **2.5 Added Value**

- There is a discerning market of consumers who recognize the greater food value of organic produce and are willing to pay premium prices for it. After farming with Bio-Plant and Pro-Plant for 1 year, farmers can sell their produce as “Chemical Free”. After 3 years, they can sell it as “100% Organic” and get higher prices.

## **3. Environmental Effects of Organic Farming**

### **3.1 Climate Friendly**

- The synthetic inputs upon which conventional agriculture is so dependent are energy expensive to mine and manufacture. Today the embodied energy of industrial agriculture uses up 9 calories for every 1 calorie of food that it produces!
- In addition, organic agriculture with its low input needs of naturally derived substances, produces less greenhouse gas emissions and is considerably more climate friendly.

### **3.2 Ecologically Friendly**

- Organic fertilizer does not use soluble chemical fertilizers.
- The chief source of large algae blooms that plague many rivers, lakes, and ponds is conventional agriculture. Farmers pour tons of phosphate and Nitrogenous fertilizer on their cropping lands every year. Because it is soluble, much of this fertilizer is either washed off the soil surface and into waterways (especially phosphates) or leaches through the soil profile beyond the reach of plants and finds its way less directly into waterways (especially nitrates). Nitrate contamination of groundwater is widespread throughout the world. In many places, the concentration is greater than what is a safe level of nitrate in drinking water, resulting in groundwater that is unfit for drinking.
- With fresh water reserves under increasing pressure from climate change this is a grave situation for humanity.
- The soluble nutrient pollutants that contaminate surface waters fuel the overgrowth of algae. What is not used up by algae in fresh waterways, spews out into the ocean where it supports the growth of algae on sea plants and coral reef systems. This blocks access to sunlight, causing whatever it smothers to die.

### **3.3 No Chemical Pesticides or Herbicides Are Used**

- Another pollution disaster caused by agrichemical use is the contamination of groundwater reserves with poisons, such as Atrazine and Simazine, but also Dieldrin, Chlorpyrifos, Amitrole, Metolachlor, Trifluralin and Diuron Dieldrin, Lindane, and Alachlor.

- Groundwater studies in Australia have detected pesticides in at least 20% of samples, indicating significant contamination. Tests in the US have found similarly significant contamination. In Carolina, for example, over 27% of wells sampled in 1997 were found to be contaminated with pesticides predominantly from routine agricultural usage.
- There is no economically viable method to clean up widespread contamination. Pesticide contamination poses a serious, unreasonable public health threat to current and future ground water users.
- Synthetic agrichemicals (and most plastics widely used in our society) are derived from oil, and thus a source of endocrine-disrupting chemicals (especially xenoestrogens) in the environment. Distorted sex organ development and function in alligators has been related to a major pesticide spill into a lake in Florida, U.S.A. advantages and disadvantages organic farming.
- There is also evidence to link xenoestrogens to a range of human medical concerns, particularly reproductive problems such as reduced sperm count in men and breast cancer in women.
- Even the “safest” herbicides, such as Roundup (glycophosphate) - the second most widely used in the USA - are now known to pose a danger to wetland ecologies, and can totally decimate frog populations at routine contamination levels.

### **3.4 Supports Wildlife and Ecosystems**

- Organic farms can support substantially higher levels of wildlife especially in lowlands and where animals can roam pastures or graze on grassland. Not only does wildlife benefit, but entire ecosystems and ground water are improved by simply following organic farming methods.

### **3.5 Benefits of Cow-Grazing Land**

- Organic farming practices not only benefit farmers and consumers; but the dairies can also benefit. When dairies feed their cows organic feed and graze them on organic fields, the cows experience better health, less sickness, diseases and ultimately produce better tasting milk for consumers.

## **Part 4**

### **What is a Bio-fertilizer?**

#### **1. Introduction to the Benefits and Activities of Bio-fertilizers**

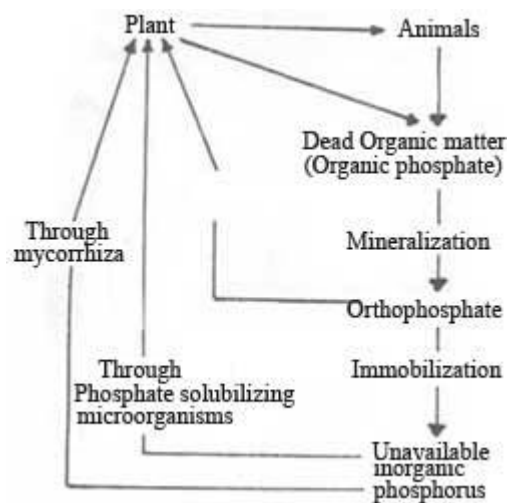
- Bio-fertilizer is a 100% natural and organic fertilizer that helps to provide all the nutrients and micro-organisms required for the benefits of the plants. It contains a large population of beneficial micro-organisms that enhance the productivity of the soil and increase plant growth either by fixing atmospheric Nitrogen or by solubilising minerals in the soil, including those unabsorbable by roots, and by stimulating plant growth through the synthesis of growth promoting substances.
- The term “bio” means living; so bio-fertilizers refer to living, microbial inoculants that are added to the soil.
- Micro-organisms create a micro environment around the roots of plants that makes nutrients easily available to the plants and helps to retain water. When you use chemical fertilizers and chemical sprays, however, most of these micro-organisms die forever, and as a result the soil loses its capacity to provide sustainable growth in the long term.
- Bio-fertilizers can be used on the soil as a high quality organic fertilizer and as a corrector of pH, bacterial life, and texture. They have a relatively high nutrient concentration, and can be used to prepare the soil before planting. Bio-Plant, for example, is especially effective in soil preparation when mixed with organic matter. The micro-organisms feed rapidly on the organic matter and multiply rapidly. The organic matter becomes like a factory mass-producing micro-organisms, which spread out and fertilize the soil.



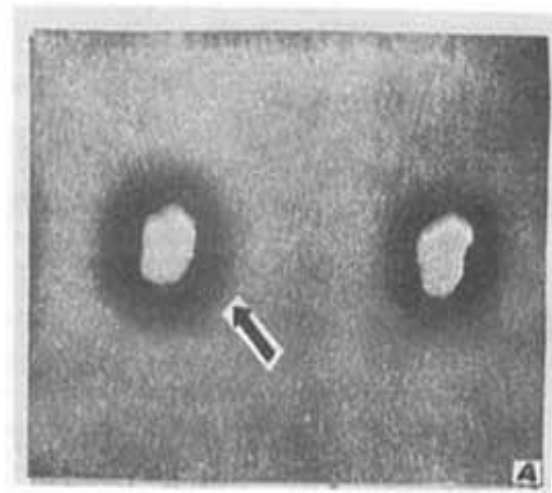
- The advantages of using bio-fertilizers are enormous. Not only are they very economical, but they produce high agricultural yields.
- Bio-fertilizers include phosphate-solubilizing microbes. Phosphorus is an important nutrient for plants. There are several micro-organisms which can solubilize the common sources of phosphorus, such as rock phosphate. They solubilise the bound phosphorus and make it available to the plant, resulting in improved growth and yield of crops. Soil phosphates are rendered available to plants by soil micro-organisms through the secretion of organic acids.
- In this way, phosphate-dissolving soil micro-organisms play an important part in correcting phosphorus deficiency in the soil. They may also release soluble inorganic phosphate into the soil through the decomposition of phosphate-rich organic compounds. Bio-fertilizers can substitute almost 20% to 25% of the phosphorus requirement of plants.
- Bio-fertilizers improve soil fertility and enhance nutrient uptake and water uptake in deficient soils, thereby improving the establishment of plants. Bio-fertilizers also secrete

growth substances and antifungal chemicals, as well as improve seed germination and root growth.

- The combined effects of phosphorus- and potassium-mobilizing micro-organisms and specific Nitrogen-fixing bacteria enrich the soil and cost less than chemical fertilizers, which harm the environment and deplete non-renewable energy sources.



**The Phosphorus Cycle**



**Microbial Solubilization of Phosphate Taking Place**

- Bio-fertilizers decompose organic material and help to build up the micro-flora, which in turn improves the health of the soil, enhances the growth of plants and increases the yield of crops.



**Comparison of Poor Soil With Soil Rich In Microbial Life**

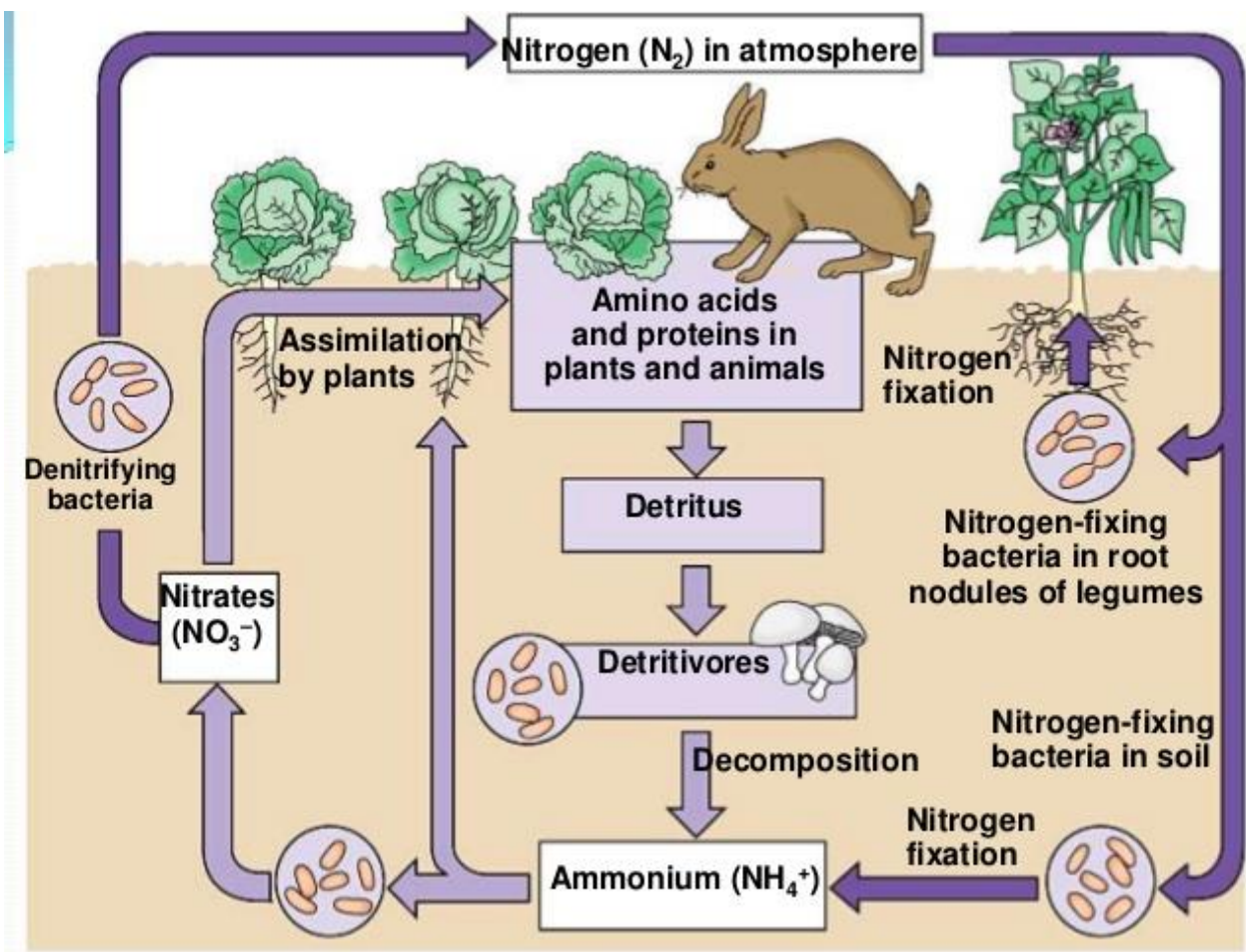
## 2. Some General Benefits of Bio-fertilizers Compared to Chemical Fertilizers

- Bio-fertilizers, such as Bio-Plant and Pro-Plant, have strong advantages over chemical fertilizers. For example:
  - a. Chemical fertilizers supply an abundance of Nitrogen and depending on the kind, also Phosphorus and Potassium, whereas bio-fertilizers provide in addition to these major minerals, minor minerals, certain growth-promoting substances, such as hormones, vitamins, amino acids, etc.
  - b. Chemical crops have to be provided with chemical fertilizers repeatedly to replenish the loss of Nitrogen utilised for crop growth. One reason for this is that chemical agriculture



kills off the microbial life that provides the plants with the Nitrogen they need, thereby making them dependent on chemical “fixes” of Nitrogen. Bio-fertilizers, however, supply the Nitrogen continuously through natural processes throughout the entire period of crop growth in the field under favourable conditions.

- c. Continuous use of chemical fertilisers adversely affects the soil structure by killing off soil micro-organisms and thereby disrupting essential processes (*see diagram below*) that create fertile soil. Bio-fertilizers provide chemical soil the micro-organisms that restore these processes and thereby improve the soil structure.



- d. Chemical fertilizers are toxic at high doses. Bio-fertilizers, however, have no toxic effects. With the introduction of green revolution technologies modern agriculture is getting more and more dependent upon the steady supply of chemical fertilizers, which are products of fossil fuel (coal + petroleum). The excessive dependence of modern agriculture on chemicals and the adverse effects being noticed due to their excessive and imbalanced use has compelled the scientific fraternity to look for alternatives. Bio-fertilizers provide a natural and effective alternative, and produce higher yields for a lower cost.
- e. Bio-fertilizers are ready-to-use live formulates of beneficial micro-organisms, which on application to the seeds, roots, or the soil mobilize the availability of nutrients by their biological activity in particular, and help to build up the micro flora, which in turn improves the soil's health in general.
- f. Certain micro-organisms harvest (fix) atmosphere Nitrogen and convert it into ammoniac form, which in due course is made available to the plants or is released in the soil. Phosphate-dissolving micro-organisms solubilize fixed forms of phosphorus already present in the soil and make it available for use by the plants. Bio-fertilizers are also used for hastening the process of composting and for enriching its nutrient value.
- g. Bio-fertilizers differ from chemical fertilizers in that they feed your plants while adding organic material, microbial life, and major and minor nutrients to the soil. Soils with lots of organic matter and microbial life remain loose and airy, hold more moisture and nutrients,



foster growth of soil organisms, and promote healthier plant root development. If only chemicals are added, the soil gradually loses its organic matter and micro-biotic activity. As the organic matter is used up, the soil structure deteriorates, becoming compact, lifeless and less able to hold water and nutrients. This results in increased amounts of chemical fertilizers needed to feed plants.

### **3. General Benefits About Bio-Plant and Pro-Plant**

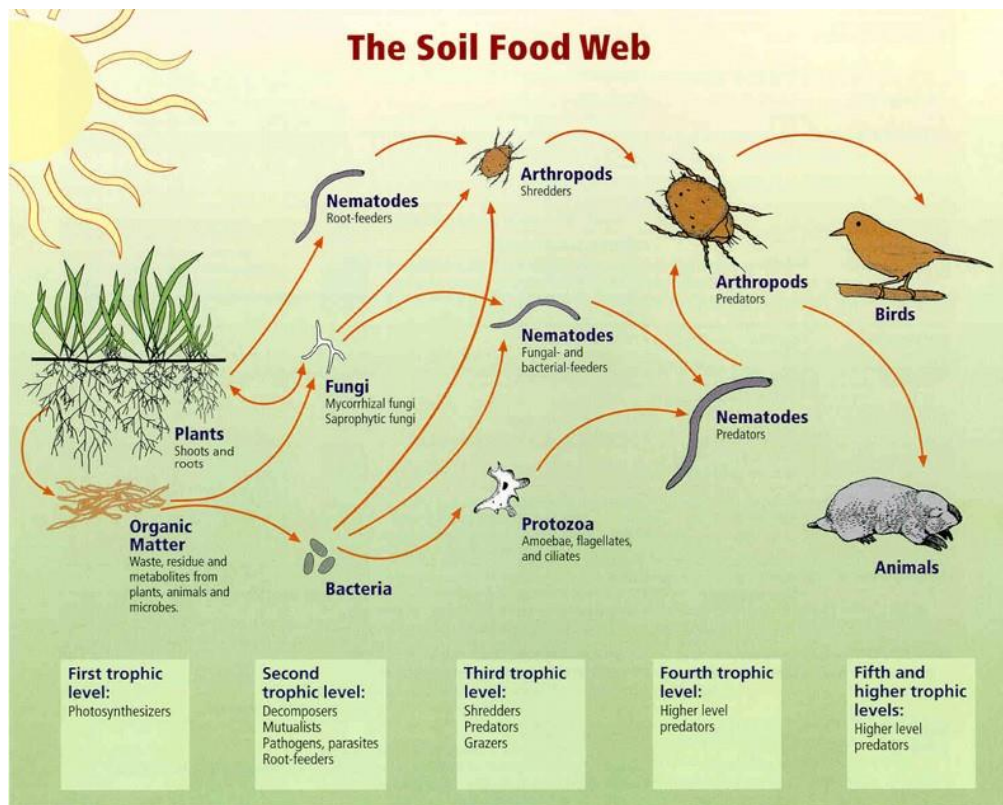
- Bio-Plant acts as a soil conditioner by stimulating microbial activity in the soil, which results in improved water-holding in the soil, the absorption of Nitrogen from the air, improved fertility, and soil that is less prone to compaction and erosion. Farmers who use it in their regular fertility program report increases in yield, quality, shelf-life, and resistance of crops to environmental stresses such as drought, extreme heat, and pests and disease problems, compared to chemical fertilizers.
- Pro-Plant contains a wide range of plant nutrients and trace elements, carbohydrates, amino acids and other growth-promoting substances. This blend makes it an excellent foliar fertilizer. It is a nutritionally complete fertilizer, which contains all the main major and minor minerals that plants need, and when sprayed properly onto the leaves the nutrients can be absorbed through the leaves and used at once by the plant.
- The Nitrogen in Pro-Plant is absorbed immediately because it is made from fish. The Nitrogen in fish is in the form of amino acids which plants take in and use directly, unlike in the case of inorganic fertilizers in which the Nitrogen needs to be converted into a usable form first.
- Additionally, because the micro-nutrients in fish are in a naturally chelated form, they are quickly and readily absorbed into the leaf surface. Foliar applications on a regular basis increase the health, vigour and yield of plants due to this easily absorbed additional nutrition.

## Part 5

### The Effect on the Soil Biology When Using Bio-Plant and Pro-Plant

#### 1. The Soil Food Web

- To eradicate plant disease you have to restore the soil biology. When the Soil Food Web has been damaged, which happens in chemical agriculture, the beneficial soil organisms die, the Nutrient Cycle does not work properly, plants get sick, the soil becomes compacted and anaerobic, disease-causing fungi take over, and pests, disease, and weeds are the result. Farmers then apply pesticides and herbicides, which make things worse.



#### 2. The Nutrient Cycle

- Photosynthesis:** Plants use sunlight and Carbon Dioxide to make sugars. They send most of these sugars down to their roots and then send them out from the roots as *exudates*. These are exuded from the roots to the soil for aerobic bacteria and fungi to feed on. The purpose is to encourage them to amass around the roots and prosper to protect the plant, and to provide the plant the nutrients it needs.
- These 'good guys' have three important functions: a) they form a protective army to fight off the 'bad guys' (anaerobic micro-organisms responsible for disease); b) they contain the necessary enzymes and acids to break down and transform inorganic nutrients in soil particles and stones into organic nutrients suitable for plants; and c) they play a critical role in the formation of an aerated soil structure with passageways for Oxygen to pass through, which is necessary for water retention and for preventing the leaching of nutrients.
- The exudates feed the bacteria and fungi. They bacteria and fungi grow and produce enzymes to pull in nutrients. The fungi create networks of hyphae to obtain nutrients for the plant. The fungi produce organic acids to obtain nutrients from stones and pebbles. But at this stage, the nutrients that plants need are still locked up in the bacteria and fungi, and are only released when the latter die. To enable this to happen, there are predators in the soil to ensure constant nutrient recycling.
- In this case, the predators are protozoa, which eat bacteria; and nematodes and micro-arthropods, which eat fungi. These predators then excrete the excess nutrients (now bio-

available) into the surrounding soil right by the roots where the bacteria and fungi are, thereby creating a constantly replenishing supply of food around the roots, where they are needed.

- When you cut a plant it sends out a huge amount of exudates through the root system. It sends out a massive amount of sugars, protein, and carbohydrates by means of these exudates. The bacteria and fungi respond by growing very rapidly. You then have more enzymes being produced to pull nutrients to the roots where they are stored in the bacterial and fungal biomass. However, they are not yet available to the plant until the protozoa, nematodes, and arthropods do their jobs. The bacterial-feeding protozoa and bacterial nematodes eat the bacteria. The fungal-feeding nematodes and fungal-feeding arthropods eat the fungi. Earthworms eat both. The 42 nutrients are then released in a high concentration right on the surface of the roots.

### **3. What Causes the Bacteria and Fungi to Grow in the Soil?**

- You have to have organic matter. The plant produces and sends out exudates (the sugars produced by photosynthesis and which are pumped down to the roots and into the soil), which grow the bacteria and fungi. Plants will send an exudate to produce a bacteria or fungi to solubilize a nutrient it needs. The bacteria or fungi will then get the nutrient very quickly. Some exudates grow the fungi, which will produce the enzymes needed to obtain certain nutrients from the soil. A protozoa or nematode will then eat the bacteria or fungi so that the plant can get the nutrient it needs.
- As a result of sending out exudates all the time, the plant increases the biomass of fungi and bacteria on the roots, and thereby gets its nutrients so that it can grow more and more. The bacteria and fungi eat the exudates and grow, and create the soil structure, which enables the roots to penetrate deeper and obtain more nutrients, etc.

### **4. Where Does This Take Place in the Soil?**

- Right by the roots where the bacteria and fungi are. They eat the bacteria and fungi and release nutrients in a plant-available, *chelated* form. They release all 42 essential nutrients required by plants to be healthy in a plant-available form.
- *Chelated* means “stuck to a protein or an amino acid”. Those proteins and amino acids are released when the bacteria and fungi are eaten. In a chelated form those nutrients can be easily taken into the roots.

### **5. What is the Effect of Chemical Agriculture on the Soil’s Biology?**

- The biology in our soil is destroyed by tilling, by compacting the soil, and by the use of chemicals. As a result, the protozoa, nematodes, and arthropods are killed off, and when that happens, the Nutrient Cycle breaks down. Pests, disease, and weeds result.
- If the soil does not have enough of the 2<sup>nd</sup> Level protozoa, nematodes, and arthropods to obtain the nutrients (*see diagram in part 1. above*), then the plant will die.
- If the soil does not have enough of the 3<sup>rd</sup> Level protozoa, nematodes, and arthropods to eat the 2<sup>nd</sup> Level protozoa, nematodes, and arthropods in order to release the nutrients, which will diffuse into the roots and feed the plant, then the plant will die.
- If you have too many of the 3<sup>rd</sup> Level protozoa, nematodes, and arthropods eating the bacteria and fungi, then the plant will not get the nutrients it needs because either they will be stuck in the bacteria and fungi or there will be no bacteria and fungi around the roots, and the plant will die. So, you need the 4<sup>th</sup> Level nematodes and arthropods to eat the 3<sup>rd</sup> Level protozoa, nematodes, and arthropods to prevent the 3<sup>rd</sup> Level becoming scarce. Balance is essential.
- Humans are at the top of the 5<sup>th</sup> Level, but we are creating an imbalance in the soil through our ways of farming. Our job is to make sure that all those protozoa, nematodes, and arthropods are present. Then the soil biology will create fertile soil, and the plants will be healthy and free of disease. Bio-Plant and Pro-Plant will enable farmers to restore the balance in the soil biology.
- We need 75,000 species of bacteria per teaspoon for this Nutrient Cycle to work. Per acre we need about 1 million species of bacteria and about 750,000 species of fungi. In addition, we

need several thousand species of protozoa, nematodes, and arthropods. However, we only know of about 5,000 different species of bacteria. So we cannot add all the species we need by ourselves. We do not even know how to grow each one. But if we make compost, the compost will create an environment where the bacteria and fungi species needed can grow.

- Bio-Plant enhances the compost-making process by providing a wide range of essential bacteria and fungi in a very high concentration of one billion cells per 1 cc, with each cell multiplying at the rate of one cell becoming one million in a day. The compost also provides a very rich environment for the protozoa, nematodes, and arthropods to multiply in. In this way, compost made with Bio-Plant can create the soil biology, which the plants need.

## **6. Compost is the Key to Sustaining Life.**

- A farmer's success is intimately bound up with the soil biology prevalent in the soil. The types, amounts, and ratios of bacteria, fungi and other microorganisms determine what crops will flourish, and indeed, whether they will flourish or not.
- It follows that what is growing is a good indicator of the soil biology; and it provides clues to where the imbalances might be in the soil, of what is preventing the farmer from growing the best crops he can. Again, the simple, quick, and easy way to fix problems in the soil biology is to inoculate the soil with compost.
- Compost is the nearest farming gets to a cure-all because it holds the key to sustaining life. It is cheap and easy, and as the soil becomes self-sustaining, the pest, disease, and weed problems go away and the crops are more productive. The crops become stronger, healthier and more nutritionally dense.
- Chemical fertilisers do not provide the 42 essential nutrients. 80% of the very few nutrients they do provide are washed out of the soil because chemical soil does not have the right soil biology or the organic matter and soil structure needed to hold the nutrients. Without the bacteria and fungi to bind soil particles together, the soil will not hold the nutrients, and they will leach.
- Chemical agriculture has a decimating effect on soil organisms because conventional, chemical farming involves tilling the soil, and using chemical fertilisers and pesticides, which kill the soil organisms. Compaction and erosion, which are common effects of chemical farming, also ruin the soil biology.

## **7. Effect of Compost on the Soil Biology.**

- Firstly, compost makes the soil an aerobic environment for soil bacteria and fungi to multiply in. The bacteria in the soil provide the glues, which hold the soil particles together. The glues are like the cement between the bricks of a house. They create passageways for Oxygen to aerate the soil and to make it aerobic.
- The fungi also help to build the structure of the soil by pulling together the bricks (soil particles) and by creating the holes in the soil through which the roots, air, and water can penetrate. These holes enable Oxygen to get into the soil, thereby enabling beneficial soil organisms to grow, while at the same time killing the pathogens and pests, which require reduced Oxygen conditions to grow in. As a result, creating the passageways is essential for plants to be healthy.
- By building the soil structure the bacteria and fungi help to increase the soil's water-holding capacity. The organic matter holds 10x its weight in water, which means that the soil retains its moisture and has moisture in times of drought. Moreover, the nutrients are not lost through run-off or leaching, and they are available when the plants need them.
- To turn dirt, sand, or clay into soil you have to apply a lot of organic matter or compost so that the organisms can start to build soil structure, air passageways, etc. This will change the soil biology and create a healthy loam.
- The compost farmers make must be aerobic, so they must know how to make it and also cure it properly once it has been made. If it goes anaerobic (lacking Oxygen), then it will feed the disease-causing fungi, which we do not want to be dominant, and disease and pests will attack the plants. We will also lose the Nitrogen as ammonia, and the Phosphorus and Sulphur as gases. The pH may drop to as low as 2. Acidic soil makes the roots mushy, and the roots are



unable to function properly. Also, we will be making alcohol, and alcohol kills plants. When the Oxygen level becomes low, the soil becomes anaerobic, and disease-causing fungi, protozoa, and nematodes will attack the roots. But, if the soil biology is good, the plants will even grow in drought and very low rainfall conditions.

## 8. A Balance of Bacteria and Fungi is Needed.

- Farmers need to know the ratio of bacteria to fungi for their particular crops. To grow vegetable crops with a high yield they will need a ratio of 1:1. To grow trees, there should be more fungi.
- Both fungi and bacteria are responsible for the decomposition of plant residues and for the release of plant nutrients. However, they have different roles in the recycling of nutrients due to their different choice of habitats within the soil and the different types of organic matter they consume. Therefore, the balance of fungi and bacteria in the soil is important for optimal soil biology. The more bacteria and fungi there are in the soil, the healthier the soil will become, weeds will not be a problem anymore, and there will be no disease.

### Soil biological succession causes plant succession



Bacteria ...A few Fungi.....Balanced .....More Fungi..... Fungi

Bacteria:	10 µg	100 µg	500	600 µg	500 µg	700 µg
Fungi:	0 µg	10 µg	250	600 µg	800 µg	7000 µg

## 9. Why do We Want a Lot of Fungi?

- Beneficial fungi protect our plants from disease by:
  - Out-competing disease organisms.
  - Creating a healthy soil biology.
  - Offering direct protection to our plants by producing anti-pathogens.
  - Providing nutrients and water directly to the plants for better plant health.
- Mycorrhizal fungi help plant roots absorb nutrients and fight off harmful, soil-dwelling predators. They physically attach themselves to the roots of plants and extend the 'reach' of the plant's roots, mining for water and nutrients in the soil that plants have a hard time accessing with their own roots alone. String-like hyphae form interwoven string networks. These networks have a massive surface area and are very effective at extracting nutrients and water from the soil and mulch.
- Vegetable crops generally enjoy an evenly matched ratio of bacteria and fungi (though leaning a bit towards bacteria.) On the other hand, most perennials, shrubs, and trees like the soil to be full of fungi at ratios from 10:1 to 50:1. Fruit trees and cocoa trees need a lot of fungi. Mulch, cover crops, and compost increase the fungi in the soil.
- When making compost aim for a 30:1 Carbon to Nitrogen ratio because fungi like a lot of Carbon. Compost made with Bio-Plant will provide the fungi and the environment for them to grow in. Include in the compost plants with a good cellulose content, such as rice, maize, and wheat stalks; straw; pruned branches; cocoa pods; etc. Fungi are the predominant cellulose decomposers. Cellulose has a high carbon content and a corresponding high C:N ratio, making it the ideal food source for fungi.



- In contrast, bacteria, which have a smaller C:N ratio than fungi, need food rich in Nitrogen (e.g. green manure, legume residues). A fertiliser rich in Nitrogen favours the bacterial community in a soil whereas a substrate with a relatively wide C:N ratio enables growth of the fungal population.
- Farmers will increase their crop yield by increasing the fungi content of their soil; reduce their weed problem; and increase the disease protection. Why? Because the soil biology will be improved more and more by doing this. As this happens, the nutrient cycling is improved more and more. The plants will get fed faster, and they will grow faster and become healthier. Compost made with Bio-Plant will add a lot of fungi (and bacteria) to the soil.
- The key for farmers is to restore the soil biology and to maintain it. They have to keep increasing the bacteria, fungi, protozoa, nematodes, and arthropods. So, including mulch and cover crops in the farming system is needed too.
- A balance of bacteria and fungi is needed for another reason. The glue, which the bacteria make, is alkaline. The pH in a bacterial-dominated soil is alkaline. Fungi produce organic acids. These organic acids will keep the pH between 5.5 and 7. So you want to have a lot of fungi in the compost and the soil.
- Planting chamomile, horkellia parryi, oreganum, chrysanthemum, thyme, Penstemon heterodoxus, and perennial herbs as an understory cover crop is beneficial for farmers because they create a balance of bacteria and fungi. Chamomile will increase the fungal biomass.
- Perennial plants will increase the length of the roots. Healthy root systems, allowed to grow over multiple seasons, are essential for fostering plant-protecting organisms in the soil.
- When you germinate a seed and plant it, if the low cover crop is already growing, the mycorrhizal fungi will extend to its roots and start to provide nutrients. The seed will then grow much more quickly.

#### 10. Eradicating the Problem of Weeds.

- Weeds grow best in a soil, which lacks Oxygen; which has a poor structure; which is high in nitrates (caused by chemical fertilisers); which is compacted; or which is left bare.
- If the roots of plants cannot grow deep, the weeds will grow. However, when the soil is not compacted the roots can grow deep down into the soil, open the soil up and bring in Oxygen, which weeds do not like. Insects, such as earthworms, will go into those holes and build the soil structure further and increase the Oxygen supply in the soil.
- In addition, by growing cover crop plants with a large root system, such as ryegrass, the roots will build a large network of mycorrhizal fungi, which will suck nutrients from the weeds and make them suffer in the soil.

#### 11. Are the Roots of Vegetables Longer When There is Life in the Soil?

- Yes they are. In chemically maintained management systems, soil life is killed and then the soil compacts rapidly, as it rains or the soil is irrigated. Compaction forms at 2 to 4 to 6 inches typically, which encourages weeds to flourish. Tillage is then "required" to break up that compaction, except that tillage slices, dices, crushes, and destroys soil life, the very things that would build soil structure, if they were allowed to stay alive.
- The transition back to healthy soil requires time to return the beneficial organisms to the soil. Let them build micro-aggregates (bacteria using their glues), and macro-aggregates (fungi using the filaments they grow), to break up the compaction and thus allow roots to grow deeper into the soil.

**Without  
compaction roots  
can go deep**

Hendrikus Schraven holding  
ryegrass planted July 15, 2002

Harvested Nov 6, 2002  
Mowed through the summer

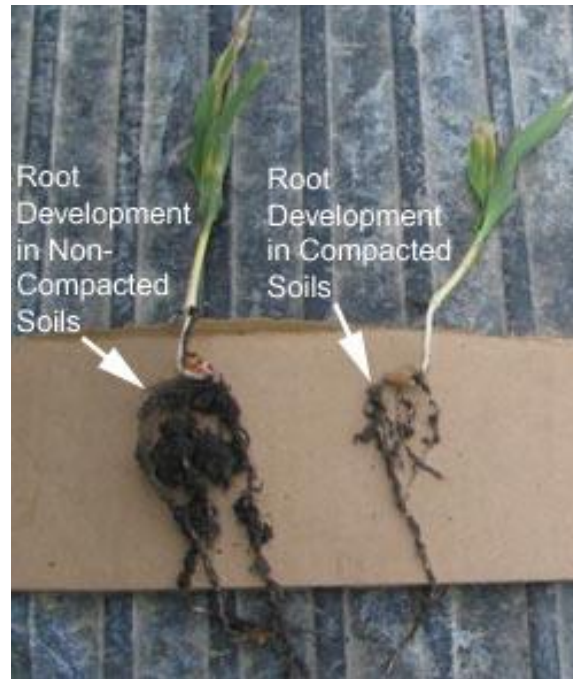
70% Essential Soil,  
30% Compost/organic  
fertilizer  
Compost tea once

No weeds, no disease

[www.soildynamics.com](http://www.soildynamics.com)



- At the end of the growing season, instead of leaving the soil bare, plant ryegrass because it will grow long roots, which will maintain the soil biology.
- As the compaction is broken up, the root system will increase, the soil will become aerobic, the bacteria and fungi will multiply, provide more nutrients and water to the roots, and in return the plant will provide more exudates through the roots for the bacteria and fungi to multiply more.



**Part 6**  
**Using Bio-Plant and Pro-Plant for Bio-chemical Farming**  
**The Path to Phasing out Chemical Agriculture**



**1. Introduction**

- Bio-Plant and Pro-Plant are 100% organic, liquid, microbial bio-fertilizers that enable a government to eradicate chemical fertilizers from the country, increase food production beyond what chemicals can achieve and for a lower cost, while restoring the soil's fertility.
- Because Bio-Plant and Pro-Plant are 100% organic, liquid, microbial bio-fertilizers they can be used far more effectively than chemical fertilizers to deal with the results of severe flooding of agricultural land where flood water has removed the top soil and severely damaged the soil's microbial life.
- In bio-chemical farming farmers can reduce by 50% immediately the amount of chemical fertilizer they use, lower their costs by about 34% on average, and still increase their yield by 30+%. In 100% organic farming the yield increases 25% (even up to 100%) for a much lower cost. The increase depends on different factors. 30% is most common in the first season.
- The increases can be 50%, and they can be up to 100%. For example, in 100% organic farming tests carried out by a provincial government in the Philippines with the bio-fertilizers the yield of rice increased to 8.3 MT per hectare. The norm was 4 MT – 4.5 MT.
- Bio-Plant contains the main micro-organisms and fungi of fertile soil, and enables plants to obtain abundant NPK, and also to absorb efficiently the large amounts of Nitrogen, Phosphorus, and Potassium that Urea, NPK, etc., leave unabsorbed in the soil.
- Pro-Plant contains a wide range of the major, minor, and trace minerals of fertile soil, and also provides essential micro-organisms that enrich the soil and also coat the surface of the leaves to act as a natural fungicide that protects the leaves from disease.

**1.1 Bio-chemical Farming**

- In bio-chemical farming the farmers can halve the amount of chemical fertilizer they use by mixing 330 cc of Bio-Plant with a 50 kgs bag of Urea / NPK / etc., and the yield will still increase. Bio-chemical farming with Bio-Plant alone replaces 100% chemical agriculture.
- The yield increases at least 30% if Pro-Plant is sprayed on the leaves and Bio-Plant is used in the seed and soil preparation. The amount of the increase depends on how the bio-fertilizers are used, and are often higher than this. The costs are reduced by 30%-34% on average.

**1.2 100% Organic Farming**

- When farmers prepare the soil with Bio-Plant and spray Pro-Plant (20 cc) mixed with water (20 litres) on the leaves, the yield usually increases 30+% above what chemicals achieve (often more, depending on how the bio-fertilizers are used). Costs are reduced significantly.

- The yield and savings increase each season as the soil becomes more fertile.
- Bio-Plant and Pro-Plant provide a very effective and proven solution to a country's fertilizer and crop productivity problems.
- They have been used successfully for about 10 years with no problems.
- There are no toxins and they are 100% organic.
- They show again and again that they can be used to eradicate chemical agriculture.
- In Vietnam, farmers using Bio-Plant and Pro-Plant to grow rubber and sugarcane have about 80% of the market share as factories and buyers prefer sugarcane and rubber grown with the bio-fertilizers.

## **2. The Composition and Its Benefits**

- Bio-Plant contains a wide range of beneficial, micro-organisms and fungi in a very concentrated form. No chemicals are used.

### **2.1 Bio-Plant: The Main Ingredients**

- The micro-organisms in Bio-Plant can withstand and function in very acidic soil (pH 4).
- The plate count is extremely high, and each cell multiplies at the rate of 1 cell into about 1,000,000 cells in a day in the soil.
- **Note:** The micro-organisms are asleep in endospore form. If the plate count is not conducted correctly, you will only find  $10^5$  or  $10^6$ .

### **2.2 Bio-Plant: General Benefits**

- The micro-organisms improve the physiology and biology of the soil by "flooding" it with micro-organisms.
- Certain micro-organisms fix extra Nitrogen from the air for the plants.
- They also decompose organic matter and extract nutrients for the plants, and which cannot be accessed.
- The microbial fertilizer bacteria colonize crop roots and start to multiply. The bacteria bind with the root hairs and cause root cells to swell, forming nodules.
- Within these nodules, the bacteria work as miniature "Nitrogen factories," pulling Nitrogen from the air and converting it into a form the plant can use.
- They dissolve the large amounts of N, P, and K left unusable in the soil by chemical fertilizers, and enable plants to absorb them, thereby cleaning the soil of chemicals.
- Weak and hard chemical soil can be restored in 3 years if a lot of organic matter mixed with Bio-Plant is used.
- Applying Bio-Plant to the soil increases the micro-organisms in the soil greatly. The soil becomes aerated, loose and fertilized, and the plants can absorb minerals consistently.
- Because chemical agriculture kills the micro-organisms in the soil, the soil becomes hard and weak, causing farmers to have to use more and more chemical fertilizers to get previous yields, and this increases their costs.
- Bio-Plant immunizes against pathogens so that the crops are much less prone to pests and disease.
- Bio-Plant's micro-organisms break the life cycle of soil-based pests.
- The stems of crops tend to be thicker, and harder for pests to eat.
- By mixing 100 cc of Bio-Plant with 1 kgs of large seeds, or by soaking small seeds in Bio-Plant, the crop yield can be increased by 5% - 10%.
- When you mix 100 cc of Bio-Plant in 20 litres of water and spray it on weeds, the concentration of micro-organisms can be used as an organic herbicide.

### **2.3 Bio-Plant: Benefits of the Micro-organisms**

- 1 cc of microbial liquid fertilizer is composed of  $10^9$  micro-organisms, which can be identified into 4 groups of micro-organisms:
  1. Micro-organisms which produce Nitrogen

2. Micro-organisms which produce Phosphorus
3. Micro-organisms which produce Potassium
4. Micro-organisms which turn minor elements into a useable and absorbable form.

#### **Group 1: Micro-organisms Which Produce Nitrogen**

- Micro-organisms break down the contents of chemical fertilizers into Nitrogen for the plants.
- Rhizopus fungi fix Nitrogen from the air.
- Certain micro-organisms in Bio-Plant have an enzyme which transforms Nitrogen gas into amino acid and other forms of Nitrogen that are useful for plants.

#### **Group 2: Micro-organisms Which Produce Phosphorus**

- There is, of course, Phosphorus within the soil, but it is not easily absorbed in soil with a pH that is too high or too low.
- The micro-organisms in Bio-Plant raise or lower the pH to a suitable, natural level so that it is more easily available.
- Bio-Plant consists of some micro-organisms that dissolve Phosphorus easily so that the roots can absorb it.

#### **Group 3: Micro-organisms Which Produce Potassium**

- Potassium plays a major role in protein, carbohydrate, and fat synthesis, so the quality and quantity of the crop yield depend on Potassium.
- The most rapid and appropriate way to obtain Potassium is through bio-weathering and organic weathering by micro-organisms, which tolerate the soil's pH.

#### **Group 4: Micro-organisms Which Make Available Other Minerals**

- Each kind of plant needs different minor elements. These elements exist naturally, but often in an unusable form.
- They need certain micro-organisms to transform them into a usable form.
- Bio-Plant has micro-organisms which transform them as required.

### **2.4 Pro-Plant: What It Is**

- It is produced from fish enzymes by a micro-biological complexation process that the company President has created.
- It provides through the leaves the proteins, and minerals that plants need to grow quickly, healthily, and abundantly.
- Coating the leaves with Pro-Plant also protects the plants from disease significantly.

### **2.5 Pro-Plant: Composition**

- This bio-liquid fertilizer is composed of major nutrients (Nitrogen, Phosphorus, and Potassium), and a wide range of essential minor nutrients that a plant needs for healthy and strong growth.

### **2.6 Pro-Plant: Main Benefits**

- It stimulates the respiratory and photosynthesis systems so that the plant can absorb more nutrients.
- It increases the quality and quantity of the crop yield, resulting in increased income for farmers.
- The plant is healthier, resulting in tolerance to pests.
- It is usable instantly by the leaves or roots.
- It accelerates plant growth, blooming, and fruit forming.
- It improves the soil structure.
- It increases the absorption rate of nutrients.
- It supplements the carbon dioxide-fixing process.



- Foliar feeding is spraying nutrients onto the plant leaves. Jointly, Michigan State University, and the Atomic Energy Commission determined that foliar feeding is 8 to 20 times more effective than putting the fertilizer on the soil.
- Foliar feeding seems to bypass some of the problems when feeding the soil, such as nutrient tie-ups, leaching, and soil interactions.
- All nutrients are absorbed readily. Some are more easily translocated when sprayed, like Nitrogen, phosphorus, potassium, copper, manganese and zinc, while others like calcium, boron, iron, magnesium and molybdenum, remain in the leaves.
- Foliar feeding is best when soil fertility is good and can otherwise have mixed results. It is used to move the plant from growth to fruiting, to counter leaching from steady rains, to give a bit of added push and to keep the plant's energy optimal.

### **3. Benefits for Bio-chemical Farming**

- In bio-chemical farming farmers can halve the amount of chemical fertilizer they use, and their yield still increases - 30% upwards if they spray Pro-Plant and prepare the seeds and soil with Bio-Plant.
- Farmers hardly have to change their habits as they can continue to use granular fertilizer.
- The micro-organisms in the bio-fertilizers make chemical fertilizer work more efficiently, and enable the plants to absorb the large amount of N, P, and K that chemical fertilizers leave unabsorbed in the soil.

#### **3.1 Cost of Bio-Chemical Farming: @ US\$45 per 50 kgs of Urea/NPK**

- Spray 1 litre of BP (US\$18) on 3 bags of Urea. These 3 bags replace the usual 6 bags of Urea / NPK that farmers use per hectare.
- Cost = US\$45 x 3 bags @ 50 kgs = US\$135 + US\$18 = US\$153 per hectare.
- Savings: US\$45 x 6 bags = US\$270 per hectare. US\$270 – US\$153 = a saving of US\$117 per hectare (43% less).
- Yield: The yield increases at least 10%.
- *Note: US\$18 is a common selling price of Bio-Plant to farmers per litre. The sample price of a 50 kgs bag of Urea/NPK is US\$45.*

#### **3.2 Bio-Chemical Farming: How to Increase the Yield Roughly 30%**

- 10% More: Spray Pro-Plant (20 cc) mixed with water (20 litres) 5 times during the productivity stage. Cost = US\$45 @ US\$9 per hectare per application.
- 10% More: Soak the seeds in water with Bio-Plant and Pro-Plant (20 cc of each in 20 litres). Cost = about US\$4 per hectare.
- 10% More: Prepare the soil with organic matter mixed with Bio-Plant (1 litre per hectare). Cost = about US\$18 per hectare.

#### **3.3 Bio-Chemical Farming: Summary**

- Savings: At US\$45 per bag there is a saving of US\$117 per hectare:
  - Costs decline 43%.
  - Yield increases about 10%.
  - Spend another roughly US\$67 per hectare to increase the yield an extra 30% upwards.
  - Overall yield increases about 25%. 30% is most common.

### **4. Benefits for 100% Organic Farming**

#### **4.1 Overall Financial Benefits**

- When farmers prepare the seeds and soil with Bio-Plant and spray Pro-Plant mixed with water on leaves, the crop yield increases by anything from 15%-100% (but 30% is most common in the first season) above what chemicals achieve, and reduce costs significantly while producing healthy, chemical-free food.
- The yield and savings increase in each season as the soil becomes more fertile.

#### **4.2 100% Organic Farming: Normal Application**

- Mix Pro-Plant (20 cc) with 20 litres of water and spray the crop every 2 weeks on average (every week with small vegetables). 500 cc per hectare.
- The farmers should prepare the soil with bio-compost (5 MT per hectare, using 1 litre of Bio-Plant); *or* spray the soil with Bio-Plant (500 cc) mixed with water (500 litres), and Pro-Plant (500 cc) if the soil is poor, and leave the soil for 14 days before planting the crop.

#### **4.3 100% Organic Farming**

- 1 litre = US\$18 (*common price to farmers*).
- 2.5-3 litres of Pro-Plant and 1-1.5 litres of Bio-Plant per hectare is the normal amount for a 3-month crop.
- Cost: US\$18 x 4 litres = US\$72 per hectare
- There is no need to use toxic insecticides, herbicides, and fungicides.

#### **4.4 Comparison With the Cost of Chemical Fertilizer (Urea)**

- 50 kgs. = US\$45+ per bag (*farmer's price*).
- 6 bags of chemical fertilizer (50 kgs) per hectare is common.
- Cost: US\$45 x 6 bags = US\$270 per hectare.
- There are additional costs for insecticides, herbicides and pesticides.
- **Saving:** US\$270 – US\$72 = US\$198 per hectare. (The farmers can afford to use more Bio-Plant to restore the soil.)

#### **4.5 100% Organic Farming: Summary @ US\$45 per Bag**

- Cost of Urea per hectare: US\$270 (6 bags).
- Cost of the Bio-fertilizers: US\$72.
- **Saving:** US\$198 per hectare. (Costs = 73% less)
- Yield increases by a minimum of 15%, but 30% is common in the first season. Indeed, much higher increases are also very common.
- With savings this high we encourage farmers to use more Bio-Plant in order to restore their soil faster and increase their yield more.

### **5. Benefits for the Crops**

- Bio-Plant and Pro-Plant immunize crops against pathogens and make the crops pest-resistant.
- After one harvest farmers can halve the amount of pesticides they use.
- Not only do the micro-organisms improve the health and immune system of the plants, but certain ones have a specific function of stopping diseases affecting the plants.
- During the first season the bio-fertilizers remove about 20% of harmful insects in the ground because they break their life-cycle. After a few harvests those insects have gone.
- They improve and regenerate the soil, even sandy soil, and enable plants to absorb the chemicals left by chemical fertilizers.
- They activate and accelerate plant growth, blooming, and fruiting.
- They increase the absorption rate of nutrients.
- Crops are healthier, weightier and fuller. Even after one season the seeds are fuller and are used and sold as mother seeds.
- Rice crops grown with chemical fertilizer do not compare with rice grown with Bio-Plant and Pro-Plant. The stems are stronger (so the rice plants do not lean over unlike rice grown with chemical fertilizer); there are more roots; the roots are stronger and longer; the rice heads contain much more grain; the rice seeds tend not fall off during harvesting; the soil is softer and has a lot of worms and insect life; there is no problem with the usual rice diseases (white spot, rust, etc.) because the rice plants develop immunity; and the quality of the rice is such that the seed becomes in demand as mother seeds.
- Fruit trees produce more, the fruit is larger, crispier, tastier, sweeter, and the Vitamin C level is higher by about 20%.

- Plants grown with the bio-fertilizers usually have about 20% more roots than plants grown with chemical fertilizers.
- Vegetables grow larger and are crispier and sweeter. Fruit and vegetables are free of chemicals at a lower price.
- Tea contains less tannin; the tea plants produce more leaves and branches; and the quality of the tea increases.
- The produce keeps longer after harvesting than the produce of chemical fertilizers.
- Flowers keep longer, have more scent, and look fresher.
- After one harvest the farmers can label the produce "Chemical-Free". After 3 years they can sell it as "100% Organic" and export the produce for higher prices.
- Organic fertilizers usually take 3 years to make a crop produce the same amount as chemical fertilizers.
- Bio-Plant and Pro-Plant surpass the yield of chemical fertilizers in one season.
- They alleviate rural poverty by making agriculture more profitable and successful, and by increasing income. They prevent the drift into urban areas by rehabilitating the soil and reviving agriculture where it has failed due to over-use of chemical fertilizer and pesticides.

## **6. Benefits & Costs of Making Bio-Compost**

### **6.1 Benefits of Bio-Compost**

- It kick-starts the soil and starts a major process of refertilizing the soil. The farmers should make 5 MT of bio-compost per hectare by spraying the compost waste matter with 1 litre of Bio-Plant (and ideally also 1 litre of Pro-Plant) and leaving it for 6-7 weeks.
- Chemical fertilizers cannot prepare the soil in such an effective way for just US\$18 (or US\$36) per hectare.
- The farmers can expect to be able to lower the amount of bio-fertilizer they use in the 2<sup>nd</sup> year, and to increase their yield.

### **6.2 The Bio-Compost Boxes**

- Build one box (10 metres x 1 metre x 1 metre) per hectare to produce organic matter for that hectare of land. Build one box per hectare of land.
- This box can be made with cheap wood or mud blocks. There should be a lid to cover the box and which keeps the heat inside. If boxes cannot be made, a hole could be dug, or the bio-compost could be made in piles one metre high, one metre wide, and 10 metres long and covered with plastic to keep in the heat.
- Place the dried grass and cow dung in 4 layers (2 layers each). Spray 250 litres of water mixed with 250 cc of Bio-Plant on each layer before putting the next layer on top. When the box is full, put the lid on tight. Open it once every 7 days and poke a stick in the bio-compost to release some of the heat. Then close the box again.
- Make 10 MT of organic matter per time. It takes about 7 weeks to make the bio-compost.
- If you are growing trees, apply 5 MT around the trees per hectare per time. Each month add another 5 MT to the soil around the trees as necessary. Before the box is empty, start to make another 5 MT or more of bio-compost.

## **7. Using Bio-Plant and Pro-Plant in Dry Areas**

- If there is no water supply or irrigation water, you will need to give extra special focus to preparing the seeds and soil with Bio-Plant and Pro-Plant.
- If there is no water for diluting or spraying Bio-Plant, mix 1 litre of Bio-Plant with 1 MT of organic matter. Dig the organic matter into the soil and leave it for 14 days before planting.
- If there is no water for spraying Pro-Plant, mix a litre of Pro-Plant with the 1 MT of organic matter at the same time that you mix in the Bio-Plant.
- If the farmers use chemical fertilizer, mix 330 cc with each 50 kgs bag of chemical fertilizer. This is very effective when there is little or no water for spraying. Combine this with the seeds and soil preparation above for maximum effect.

## 8. The Benefits for Bio-Chemical Farming

### 8.1 Overcoming Chemical Farmers' Fear of Change to Organic Farming

- Chemical farmers do not usually like to change their farming habits, especially if they have been farming with granular chemical fertilizer for a generation. Few want to change directly to 100% organic farming, even though they know that chemical agriculture is ruining them, partly because it involves a lot of change and uncertainty, and partly because they are afraid that their yield will be lower, which is often the case with 100% organic farming in the beginning. Even though using Bio-Plant and Pro-Plant in 100% organic farming will still result in a higher yield than chemical fertilizer, the farmers are usually still afraid to change. So, we solve the problem by having the farmers use the two bio-fertilizers for bio-chemical farming instead.
- In bio-chemical farming the farmers can halve the amount of chemical fertilizer they use by mixing 330 cc of Bio-Plant with every 50 kgs bag of chemical fertilizer. They will still get at least the same yield, and usually the increase in yield is by 5%-10%, especially if they also soak their seeds in Bio-Plant and Pro-Plant before sowing or planting.

### 8.2 Bio-Chemical Farming 1



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5%-10% increase in yield to begin with, rising each season. 34%-45% lower costs. Mix 330 cc Bio-Plant with each 50 kgs of Urea/NPK and use the bag over twice the normal area in a bio-chemical form.

- By spraying the leaves with Pro-Plant the yield can be increased by another 15%-20%. By preparing the soil using Bio-Plant another 10% can be added. The costs will also drop by about 35% compared to chemical fertilizer.
- In Year 2 the farmers can reduce the amount of chemical fertilizer by a further 25%, and by the final 25% in Year 3, so that by the end of Year 3 they are farming 100% organically willingly and by their own choice. Bio-Plant and Pro-Plant are very effective when farmers use them for bio-chemical farming because of the nature and concentration of the microbial life in them. Farmers see the benefits very quickly.

### 8.3 Bio-Chemical Farming 2



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25%-30% increase in yield. 30%-35% lower costs. The bag can be used over twice the normal area.

330 cc Bio-Plant

50 kgs Urea/NPK

Spraying Pro-Plant  
(500 cc per hectare)



## **Part 8**

### **How to Replace Chemical Sprays**

#### **Section 1: Prevention**

##### **1. General Advice**

- The easiest way to prevent insect damage in your garden is to discourage them from coming in the first place. A healthy garden is the best defense.
- Pull out any weak plants. They may already be infected. If not, they will attract insect predators. Pull the plant and dispose of it away from the garden area.
- Build healthy, organic soil. Natural composting methods, mulching and top-dressing your soil with compost or natural fertilizer is the best way to develop strong, vigorous plants.
- Spray the plants with Pro-Plant. It contains over 50 nutrients, including trace elements such as iron, zinc, barium, calcium, sulfur and magnesium, which promote healthy development in plants. Pro-Plant sprayed in mulch or spray form will enhance growth and give plants the strength to withstand disease. Pro-Plant and Bio-Plant sprayed mulch also repels slugs.
- Minimize the insect habitat. Clear the area of debris and weeds which are breeding places for insects. Use clean mulch.
- Interplant and rotate crops. Insect pests are often plant-specific. When plantings are mixed, pests are less likely to spread throughout a crop. Rotating crops each year is a common method to avoid re-infestation of pests.
- Keep foliage dry. Water foliage early in the day so that it will be dry for most of the day. Wet foliage encourages insect and fungal damage to your plants. Drip-irrigation delivers water to the root systems without wetting the foliage.
- Disinfect. If you have been working with infested plants, clean your tools before moving on to other garden areas. This will reduce the speed of invading insects.

##### **2. Pest Prevention Concentrate**

- You can use this as a preventative spray as well as a bug and pest killer. 1 cup of liquid dish soap (250 cc) and 1 tablespoon of vegetable oil. Mix the ingredients together then store in a plastic, airtight container. When you are ready to use, take 1 to 2 teaspoons of the concentrate and mix it with a litre of water. Pour into a spray bottle. When applying it make sure to get underneath the leaves as well as the flower buds and new suckers. In hot weather, repeat every third day (3 applications over 7 days). Warm to cool weather, use once a week for 3 weeks.
- **Tips:**
  - Apply the treatment on top of the leaves as well as underneath. Do not overdo it as excess can cause damage.
  - Most recipes can be used effectively with just a weekly treatment. Excessive use may affect the plant as well as kill the good insects you want to encourage in your garden (earthworms, bees, ladybugs, etc.). If you aren't seeing results with a 7-day treatment, you can bump it up to 5 days but watch carefully to make sure plants can handle it without being damaged.
  - Avoid treating during hot sunny weather. Do so later in the day to reduce the risk of burning.
  - If it looks like rain, delay until the weather is clear since any rain will wash away the new application. If it has recently rained, wait till the greenery is dry before applying to prevent the mix being diluted with water.
  - When trying a new recipe, test on just a couple leaves first. Apply then watch how the test leaves react after 2 or 3 days. If no signs of damage proceed with spraying the whole plant.



## **Section 2: Insecticides and Pesticides (Mostly Organic)**

### **1. Neem**

- Ancient Indians highly revered neem oil as a powerful, all-natural plant for warding off pests. In fact, neem juice is the most powerful natural pesticide on the planet, holding over 50 natural insecticides. This extremely bitter tree leaf can be made in a spray form.
- Pests controlled: aphids, Colorado potato beetles, grasshoppers, grubs, Japanese beetles, leafhoppers, locusts, plant hoppers, scales snails, thrips, weevils, and whiteflies.

#### **a. 3 Methods For Preparing Neem Insect Spray**

##### **Method 1:**

- To make your own neem oil spray, simply add 15 cc of high quality organic neem oil and ½ teaspoon of a mild organic liquid soap to two litres of warm water. Stir slowly. Add to a spray bottle and use immediately.

##### **Method 2:**

- For 20 litres of a stronger 1% solution of neem insect spray you need:
  - 200 cc neem oil
  - 20 cc mild liquid or insecticidal soap
  - 20 litres of water
- Use warm water if possible. If making a large batch, make a premix in a small amount of warm water, then add that into the big container.
- Mix the warm water with the soap first!
- Then slowly add the oil while stirring vigorously.
- Fill the mix into your sprayer.
- Keep shaking or otherwise agitating the mix while spraying.
- Use the mixture within eight hours.

##### **Method 3:**

- Pound gently 1-2 kgs of neem leaves. Place in a pot. Add 2-4 litres of water. Cover the mouth of the pot securely with the cloth and leave it as such for 3 days. Strain to get clear extract. Dilute 1 litre of neem leaf extract with 9 litres of water. Add 100 cc of liquid soap. Stir well.

#### **b. Guidance**

- **Spray thoroughly:** Spray the neem insecticide solution on all the leaves, especially the undersides where insects like to hide. If you have plenty, drench the soil around the roots as well. Neem oil is actually good for your soil.
- **Use the neem quickly:** Use your neem insect spray as quickly as possible, definitely within 8 hours. Once your batch of neem garden spray is mixed the neem oil starts breaking down. Always make a fresh neem batch for spraying, and only prepare the amount you need.
- **How often should you use neem garden spray?** The suggestions below are general guidelines. Keep a close eye on things and fine tune as needed. If you are worried about sensitive plants, spray just a little bit in a small area, wait for a day or two, and see what happens. If you use insecticidal soap you should not have any problems.
- **Use neem plant spray as a preventative measure:** Spray once a fortnight using a 0.5% solution. This should prevent any insect problems in the first place.
- **Use neem insect spray to fight an infestation:** When spraying the first time thoroughly drench all leaves and the soil around the plant. Then spray once a week until the problem disappears. If it rains you may need to respray sooner. If you are dealing with a less sensitive insect species you may need to increase the concentration of the neem spray. See how you go.
- **Does neem work?** Some farmers question neem's usefulness. They sprayed neem oil, and did not see an immediate effect. They probably did not understand how neem oil affects insects.

- Neem oil does work, but the way it works is different from other insecticides. Neem is not an instant, knock down, kill everything pesticide. Neem oil affects insects in many different, ingenious and subtle ways.
- **How neem oil messes with the insects' brains and bodies:**
  - Neem oil has many complex active ingredients. Rather than being simple poisons, those ingredients are similar to the hormones that insects produce. Insects take up the neem oil ingredients just like natural hormones.
  - Neem enters the system and blocks the real hormones from working properly. Insects "forget" to eat, to mate, or they stop laying eggs. Some forget that they can fly. If eggs are produced they do not hatch, or the larvae do not moult.
  - Obviously, insects that are too confused to eat or breed will not survive. The population eventually plummets, and they disappear. The cycle is broken.
  - How precisely it works is difficult for scientists to find out. There are too many different active substances in neem oil, and every insect species reacts differently to neem insecticide.
  - Neem oil does not hurt beneficial insects. Only chewing and sucking insects are affected.
  - Like real hormones, neem oil insecticide works at very low concentrations, in the parts per million range. A little neem oil goes a long way.
  - But this is not something that happens overnight. People spray neem oil as insecticide, and expect everything to die instantly, because that's what they are used to from chemical poisons. When that does not happen, they conclude neem insecticide does not work. It does work! Give it time to work. It is a much smarter way to deal with insect pests.
- **How neem oil deters chewing and sucking insects:**
  - There is a nice story that demonstrates how grasshoppers react to neem oil insecticide. Someone did an experiment. It involved two jars, two leaves, and two grasshoppers. One leaf was sprayed with a chemical insecticide, and one with neem oil.
  - The two grasshoppers were put in the two jars, with one leaf each. The first grasshopper ate the leaf and died almost instantly. The grasshopper with the neem oil covered leaf did not touch the leaf and lived. At least for a few days.
  - Eventually it starved to death. What would you prefer? A poisonous half-eaten lettuce, or an organic, untouched lettuce? It is a no brainer, isn't it?
- **Neem stops insects from eating the plants:**
  - Part of this action is due to the hormone-like action of neem oil explained above. Insects "forget" to eat after they have been in contact with even traces of neem oil.
  - But it is also the presence, the mere hint of a smell of neem oil, which seems to be enough to keep leaf eating insects away. Neem oil can be very powerful as an anti-feeding and insect repellent. This anti-feeding property is one of the most often advertised and lauded properties of neem oil insecticide. However, the hormonal effects described above are even stronger.
  - Neem oil as an insect deterrent works well against grasshoppers and leafhoppers, but all other insect pests are controlled mostly through the hormone action.
  - The subtlety of the hormonal effects, and the fact that they may take days or weeks to manifest, makes people overlook them. Ill-informed farmers seek instant gratification, i.e. lots of dead insects immediately, rather than a balanced environment in the long run.
  - It is a shame, because the hormonal effect is where the real power of neem oil lies. It is the key to neem oil being an effective insecticide and good for the environment at the same time. It is also important to understand this effect to use neem oil insecticide correctly.
- **Neem oil works from inside the plant:**
  - Many insecticides break down quickly. They wash away with rain, or when irrigating, or the sunlight destroys them. You either have to spray all the time or you have to spray something that is so stable that it stays around forever. That means the chemical builds up everywhere and eventually poisons everything, including you.

- Neem oil breaks down very quickly, too. It is especially susceptible to UV light. But neem oil is also a systemic insecticide. That means you can pour it on the soil (not pure neem oil of course, you use a dilution or extract) and the plants absorb it. They take it up into their tissue, and it works from the inside. A leaf hopper may take a couple of bites, but that's it.
  - This does not work for all insect species. The neem ingredients accumulate in the tissues deeper inside the plant. The phloem, the outermost layer, contains hardly any. A tiny aphid feeds from the phloem, it cannot penetrate deep enough to get a dose of neem. But any leaf hoppers, grass hoppers or similar chomping insects will be incapacitated quickly.
  - **Neem oil and beneficial insects:**
    - Neem is non-toxic for beneficial insects. The main reason is that insects need to ingest the neem oil to be affected, and beneficial insects do not eat your plants. But you can still kill beneficial insects, if you smother them with neem oil, so please be careful.
    - Beneficial insects are most active during the day. The best time to spray neem insecticide is very early in the morning, so the spray can dry before the good insects become active. Also a good time is the late afternoon or evening. Once the spray has dried it does not harm your bees, ladybugs, lacewings, predatory mites and wasps etc.
- 2. Salt Spray**
- For treating plants infested with spider mites, caterpillars, cabbage worms, and chewing insects. Mix 2 tablespoons of salt and 4 litres of warm water. Allow to cool to room temperature and spray on the infected areas.
- 3. Mineral Oil**
- Mix 10 cc – 30 cc of high-grade mineral oil with one litre of water. Stir and add to a spray bottle. This organic pesticide works well for dehydrating insects and their eggs. Helps with aphids, codling moth, leaf roller, mealybugs, scaled insects, and white flies.
- 4. Citrus Oil and/or Cayenne Pepper Mix**
- This is another great organic pesticide, which works well on ants. Simply mix 10 drops of citrus essential oil and/or cayenne pepper with one teaspoon of cayenne pepper and 1 cup of warm water (235 cc). Shake well and spray in the affected areas.
- 5. Soap, Orange Citrus Oil, and Water**
- To make this natural pesticide, simply mix 3 tablespoons of liquid soap with 30 cc of Orange Citrus Oil and 4 litres of water. Shake well. This is an especially effective treatment against slugs and can be sprayed directly on ants and roaches as well.
  - **Note About Liquid Soaps in Natural and Organic Sprays:**
    - Do not use a liquid soap that contains bleach or detergent since they can be harmful to plants; and ideally, no perfume or dyes as well. You can use a dishwashing liquid or “pure” soap, but be sure to avoid any dish washing liquids, which contain a degreaser, bleach, or those that are for an automatic dishwasher.
    - In addition, it is important that a home mixture never be applied to any plant on a hot or brightly sunny day, as this will quickly lead to burning of the plant and its ultimate demise.
- 6. Eucalyptus Oil**
- A great natural pesticide for flies, bees, and wasps. Simply sprinkle a few drops of eucalyptus oil where the insects are found. They will all be gone before you know it.
- 7. Onion and Garlic Spray**
- Mince one organic clove of garlic and one medium -sized organic onion. Add to a litre 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.

## 8. Chrysanthemum Flower Tea

- These flowers hold a powerful plant chemical component called pyrethrum. This substance invades the nervous system of insects rendering them immobile. You can make your own spray by boiling 100 grams of dried flowers into 1 litre of water. Boil dried flowers in water for twenty minutes. Strain, cool and place in a spray bottle. Can be stored for up to two months. You can also add some organic neem oil to enhance the effectiveness.

## 9. Tobacco Spray

- **Method 1:** Just as tobacco is not good for humans, tobacco spray was once a commonly used pesticide for killing pests, caterpillars and aphids. To make it, simply take one cup of organic tobacco (preferably a brand that is organic and all-natural) and mix it in 4 litres 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, with the exception of those in the solanaceous family (tomatoes, peppers, eggplants, etc.).
- **Method 2:** Soak about 1 kgs of dry tobacco and 5 litres of a local alcohol (such as a local whisky) in water for about 24 hours. In Moslem countries replace the alcohol with water.
- Take a herbal poison, such as lemongrass and/or herbal basil (seeds or leaves or both), make sure it is dry with no more than 15% moisture, and cut it up into very small pieces. Soak about half a kilogram of this in the alcohol and tobacco. The weight of the tobacco and herb can be up to 2 kgs. Use the mixture the next day. It will keep up to a week.
- Take 200 cc – 300 cc of the solution and add it to 20 litres of water. Spray this over the crop. It will not kill insects and pests, but it will keep them away.
- 20 litres of water is suitable for about 500 square meters. If there are still some pests flying over the crop, increase the amount you add to 20 litres of water to up to 600 cc.
- Spray once every 2-3 days, or more often if you need to.

### Notes

- When using water instead of alcohol, if the mixture with the lemongrass and/or basil does not dissolve, add 50 cc of Bio-Plant and leave it for 3-4 days longer.
- Then take 100 cc - 200 cc of the solution and mix it with 20 litres of water, and spray it.
- If it is not concentrated enough, add more than 200 cc to the 20 litres, such as up to 600 cc.
- Alternatively use 1 kgs of lemongrass instead of 0.5 kgs in the preparation. If you are adding basil seeds or leaves as well, then use 0.5 kgs or 1 kgs in order to make the solution more concentrated.

## 10. Garlic Spray

- The strong scent of garlic keeps certain pests from feeding on your vegetables. For this organic pesticide, combine 10 to 12 garlic cloves with 1 litre of water in a blender. After blending, allow the mixture to set for 24 hours. Then strain it (perhaps through cheesecloth, which is covering the opening of a glass jar) and add 1 cup of cooking oil (235 cc). This concentrated mixture can be stored for several weeks until ready to use.
- For an even more powerful homemade pesticide, add 1 tablespoon of cayenne pepper to the concentrated mixture and let it soak for another 24 hours before straining the liquid once again. When ready to use, dilute 1/2 cup of the liquid (70 cc) with 4 litres of water.

## 11. Garlic Tea

- Make your own garlic spray by boiling a pint of water, throw in roughly chopped garlic cloves and steep until the water cools. Remove the garlic bits and then apply the garlic tea.

## 12. Garlic Sprays

- **Note:** Do not use metallic containers with garlic sprays as they may react with the mixture. This is good for insects generally.



**a) Non-Oily version**

- Ingredients: 1-2 garlic bulbs, boiling water, and 1 litre of soap spray.
- Chop the garlic bulbs and cover with boiling water in a lidded jar. Leave to soak overnight. Strain and add to the soap spray. Unused spray will decay but it can be frozen to preserve it.

**b) Oily Version**

- **Ingredients:** 100 grams chopped garlic, 30 cc liquid paraffin or baby oil, 500 cc of water, 5 cc of liquid soap (phosphate free).
- Soak the garlic for at least 24 hours in paraffin or baby oil in a sealed jar. Add water and liquid soap and stir well to emulsify the oil. This should keep well. Use 30 cc of preparation in 500 cc to spray plants.

**c) Powdered dry garlic bulbs**

- Sprinkle the powder over affected plants or mix with water to make a spray.

**13. Garlic, Peppers & Onion Insecticide**

- Mix 2 hot peppers, 1 large onion, 1 whole bulb of garlic, and 1/4 cup water (60 cc) in a food blender. Add water, if necessary, and blend until a mash is made. Cover the mash with 4 litres of hot (not boiling) water and let it stand for 24 hours. Strain. Spray on roses, azaleas, and vegetables to kill bug infestations. Bury the mash in the ground where bugs are heaviest. Good for thrips, aphids, grasshoppers, chewing and sucking insects.

**14. Ginger, Garlic, and Chilli Extract**

- Soak 50 g of peeled garlic overnight in 10 cc mineral oil. Combine garlic, 25 g of green chilies, and 25 g of ginger. Add 50 cc of water to the mixture. Grind them. Add 3 litres of water. Pests controlled: aphids, armyworm, cotton bollworm, caterpillars, corn earworm, fruit borers, leaf miners, sucker borers, thrips, tomato fruit worm, whiteflies.

**15. Chili Spray**

- In a pot, boil 4 cups of ripe pods or 5 cups of chili seeds in water for 15-20 minutes. Take the pot from the fire and add 3 litres of water. Cool and strain. Add 30 grams of soap. Stir well. Strain. This spray material also controls fruit flies.

**16. Red Pepper Spray**

- Red pepper powder can be used to create a homemade pesticide that is safe to use with vegetables. Combine 1 tablespoon of red pepper powder, 6 drops of liquid soap, and 4 litres of water and mix the ingredients thoroughly. Pour the red pepper mixture in a garden sprayer and thoroughly cover the vegetables with the spray. If needed, reapply the spray once a week to keep garden pests such as leafhoppers, spittlebugs, beetles, and loopers off the plants.

**17. Tomato Leaves Mix**

- Crush leaves from a tomato plant and soak them in water for a couple days. Strain then spray. Good for grasshopper and white fly control. Tomato leaves are poisonous, take care when preparing and handling. Do not use on food-bearing plants.

**18. Basil Tea**

- 4 cups water (1 litre), 1 cup fresh basil (or 2 tablespoons of dried basil), and 1 teaspoon of liquid soap. Bring the water to a boil then add basil. Remove from heat, cover and steep until cool. Strain. Mix in the liquid detergent then apply. Good for aphids.

**19. Onion Insect Repellent**

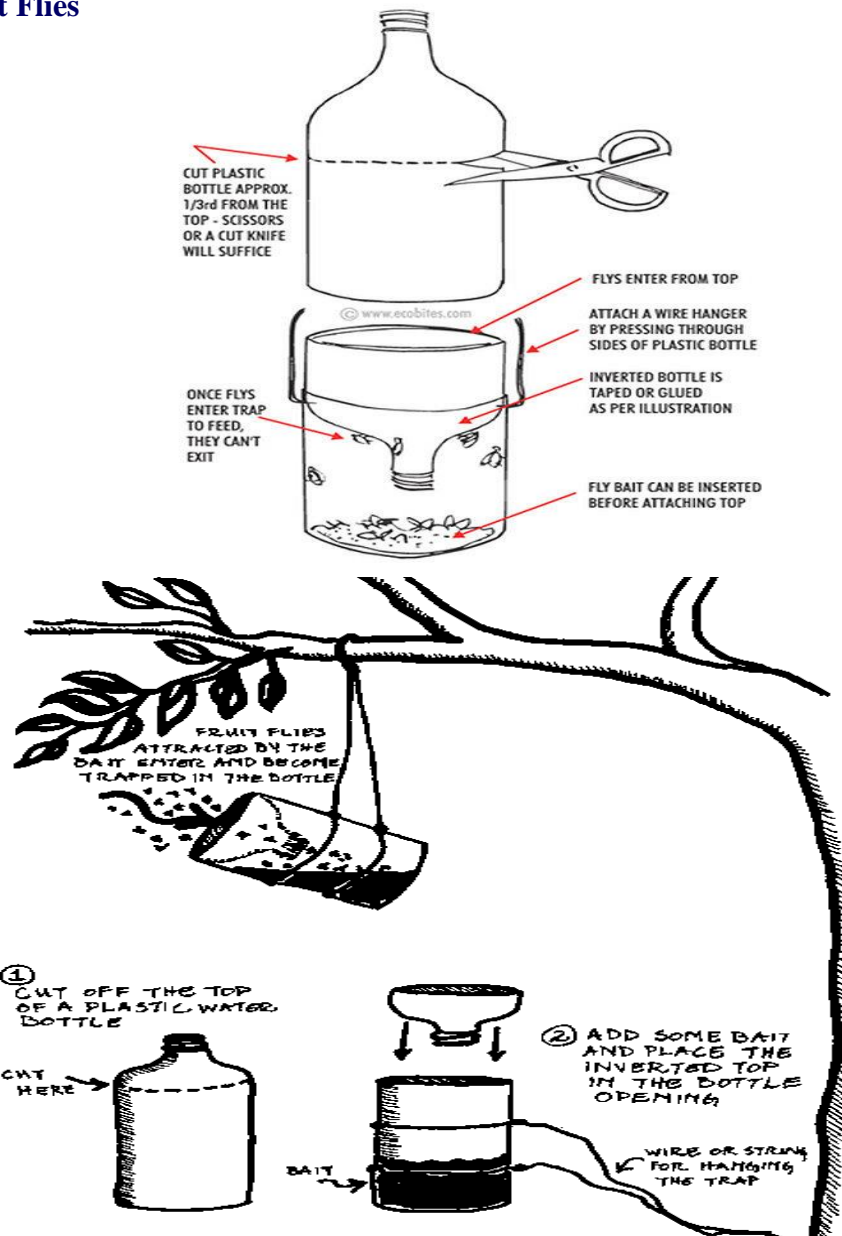
- Save onion skins, peels and ends then refrigerate in an empty margarine-sized tub or ziploc bag until the container is full. Once you have enough, place the onion pieces in a bucket and fill with warm water. Soak for a few days, up to a week. After one week, strain the onion bits

out and store the onion water in spray bottles. Bury the onion bits around plants that are prone to aphids, spiders and other pests. Spray both house and garden plants with the water to fight aphids and pests. You could also mix your garlic trimmings in with the onion pieces as bugs hate garlic too.

## 20. Epsom Salt Spray

- 12 teaspoons of Epsom salt mixed with 8 litres of water. Helps with black spot, mildew, wilt and rust.

## 21. Mango Fruit Flies



## 22. Horticultural Oil Mix

- 1 tablespoon of vegetable oil, 1 teaspoon of liquid dish detergent, and 2 cups water. Fill a spray bottle with the ingredients then shake it to mix the ingredients.

## 23. Citrus Spray

- 2 cups orange peels (or lemons/limes) and 4 cups water (1 litre). Bring water to a boil, remove from heat and add peels. Cover and steep until cool. Strain and use. Use the lemon (or lime) mixture to repel the white flies.

## 24. Slug Bait Trap

- Set out beer in shallow containers to attract slugs. They will drown in the beer.

## **25. Hot Pepper Recipe**

- 1/2 cup hot peppers (or 2 teaspoons cayenne pepper), 1 litre water, and 1 teaspoon liquid soap. Bring the water to a boil, remove it from the heat and add the peppers. Cover and steep until cool. Strain then mix in the soap. If using cayenne pepper, no need to bring water to a boil first. Apply.

## **26. Liquid Soap & Baking Soda**

- 2 tablespoons of liquid soap, 2 tablespoons baking soda, and 4 litres of water. Mix all the ingredients together then use.

## **27. Peppermint Tea**

- 1 tablespoon of peppermint essential oil and 1 litre water. You can also use an infusion made with mint leaves in which case increase the amount to 1 cup of infusion. Mix them together and use as an insect spray. This is effective with ants.

## **28. Japanese Beetle Bait Trap**

- 2 cups water, 1 mashed banana, 1/2 cup sugar, 1/2 cup wine (120 cc), and 1/2 teaspoon yeast. Mix the ingredients together, put it in an old margarine container, cover with the lid, and set the container out in the hot sun for a day. The next day, remove the lid and set the container in the area where the beetles have been spotted. Use a shallow container.

## **29. Potato Leaves Tea**

- 1 cup potato plant leaves and 2 cups water (470 cc). Chop the leaves then cover with hot water. Seal the container and leave 24 hours in a sunny window. Strain then use. Potato leaves are poisonous. Take care when preparing and handling the tea. Do not use on food-bearing plants.

## **30. Insect Repellant**

- 1 kgs of red chilli powder, 1 small bottle of vinegar, and 1 small bottle of 35% white alcohol. Also a small individual serving bottle of a probiotic drink as sold in supermarkets.
- Mix the ingredients together (leave out the probiotic drink) and leave for 24 hours in a cool place with the lid on. Then when you are ready to spray the plants add the probiotic drink.
- Mix 10 cc of the mixture with 20 litres of water and apply it every 3 days.

## **31. Armyworm Repellant (Maize Crops)**

- Buy ripe chilli powder (pepper) or prepare your own using ripe pepper. Dry the pepper and make powder by either grinding or pounding, remove the big particles and leave the fine powder. Sieve cold wood ash from the fireplace. Fill a 2 kgs. container of ash and mix it with 5 teaspoonfuls of chilli powder. Mix the chilli and ash properly by shaking them in a container. Put the mixture in a used pesticide container that has small holes. Apply the mixture from the container by shaking it once into each maize plant funnel. For good results, apply the mixture immediately you see the worms in the maize and repeat the same if you notice any pests in the maize or pest damage to your crop.

## **Section 3: Organic Fungicides**

### **1. Organic Baking Soda Fungicide**

- You can dip cut pieces of potato in this fungicide before planting them.
- **Version 1:** Mix 2 tablespoons of baking soda and 1/2 teaspoon of vegetable oil or bleach-free liquid soap in 4 litres of water. Mix all of the ingredients thoroughly. You can also spray the whole seed potatoes with the mixture or dip potatoes in it, if you wish.
- **Version 2:** Mix 1 tablespoon of baking soda, 2.5 tablespoons of vegetable oil with 4 litres of water. Shake this up very thoroughly. To this mix add 1/2 teaspoon of liquid soap and spray. Be sure to agitate your sprayer while you work to keep the ingredients from separating. Cover

the upper and lower leaf surfaces and spray some on the soil. Repeat every 5-7 days as needed.

## **2. Organic Garlic Fungicide**

- This acts as a fungicide and as an insect repellent.
- **Version 1:** Put in a blender: 1 whole head of garlic, 3 cups water (700 cc), 2 tablespoons of canola oil, 4 hot peppers and a whole lemon / lime. Blend until finely chopped. Soak the mixture overnight. Strain through a fine cheesecloth. Use at a rate of 4 tablespoons per 4 litres of water. Store the unused portion in the refrigerator.

## **3. Applying Bio-Plant as a Fungicide**

- Replace the chemical fungicide you may be using with Bio-Plant mixed with water.
- a. For Prevention:**
- Dosage: 5 cc - 10 cc / 20 litres of water. Spray on the tree. Avoid the leaves as much as possible. This is to prevent fungus.
- b. A Little Fungus:**
- 10 cc - 20 cc per 20 litres of water. Spray on the tree, if there is some fungus already. Avoid the leaves as much as possible.
- c. The Whole Tree Has Fungus:**
1. Spray 50 cc/20 litres of water only on the branches. Or:
  2. The farmer can scrub or brush on the branches 50 cc/20 litres of water. Avoid the leaves. Spray every 7-10 days for a better effect, if the trees have fungus already. When you spray Pro-Plant the leaves get coated with micro-organisms that protect the trees from disease. The Bio-Plant strengthens the immune system so that the trees are less susceptible to disease.
- If there is a need to spray pesticides, please spray them at least 3 days apart from when you apply the bio-fertilizers as the chemicals kill the micro-organisms that will now be multiplying in the soil and being sprayed onto the leaves.

## **Section 4: Organic Herbicide (To Kill Weeds)**

- Cut into small pieces 5 kgs of waste fruit with their skins – bananas, guavas, pineapple, banana tree trunk, papaya, etc. Put this into a container and mix in 1 kgs of molasses and 10 litres of water. Leave this for a month. Then crush the undissolved fruit, strain, and leave for another month. Then spray the mixture onto weeds and they will die.

## **Section 5: Organic Way to Remove Animal Smells**

- Mix 30 kgs of fruit - bananas, pumpkin, pineapple, and papaya - with 10 kgs of molasses, and 30 litres of water. Leave this for 22 days.
- Then mix a bottle of the mixture with a drum of the pigs' water and give it to the pigs to drink. Their shit will not smell. You can also spray this over the floor of the pig sty to kill any smell.
- The pig shit will make very good (non-smelling) fertilizer. You can dry it and then place it around trees.



## **Section 3**

### **How to Use the Bio-fertilizers to Grow Crops**



## Part 8

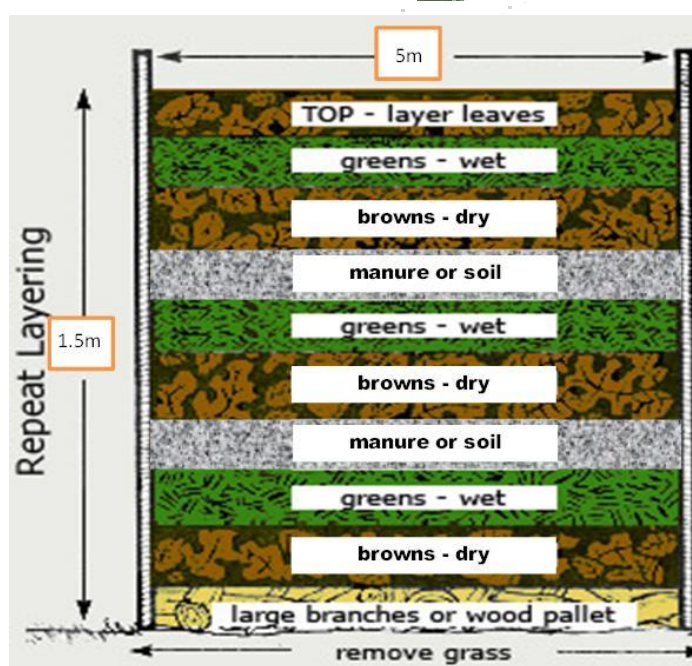
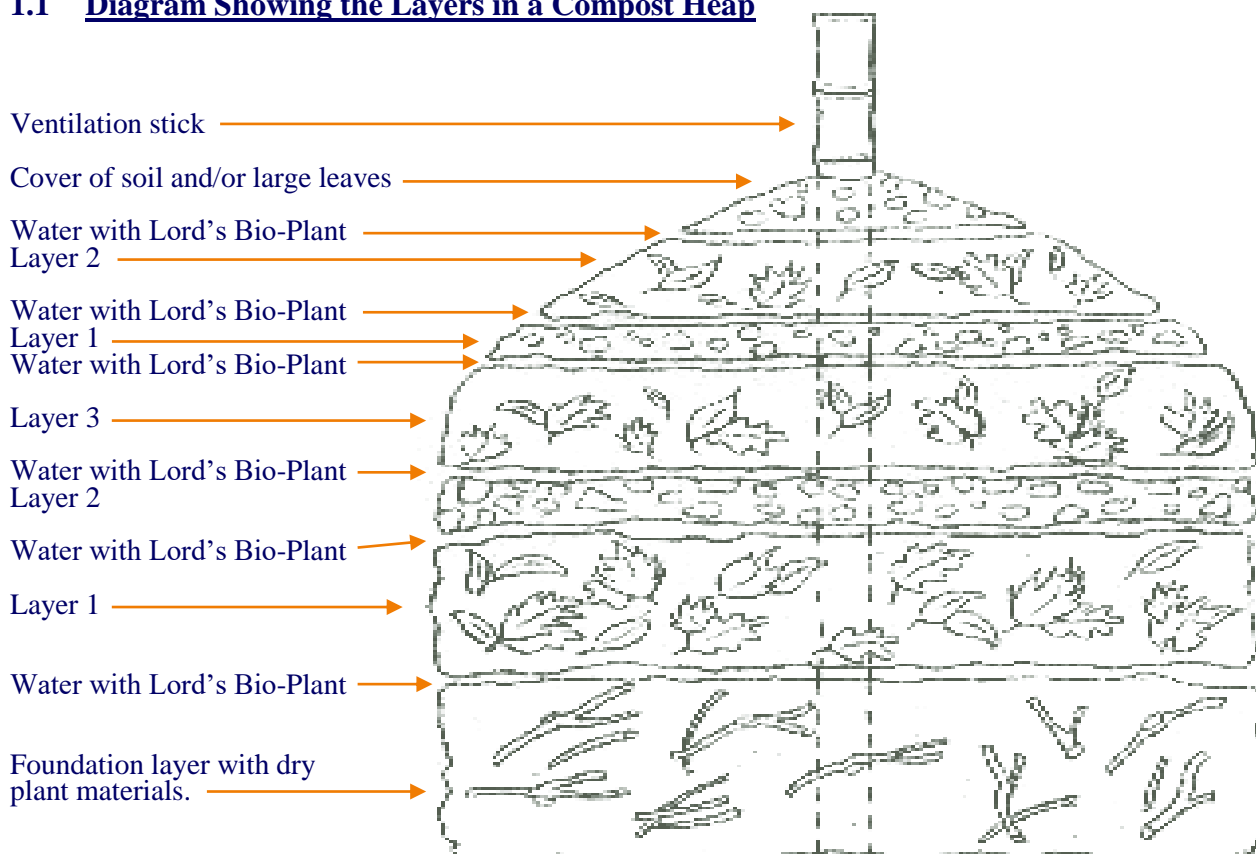
### Compost and Soil Preparation Methods, Cover Crops, and Mulching

#### Section 1: Compost Preparation and Soil Preparation Methods

##### 1. How to Make a Layered Compost Pile

- This method is most suitable for vegetable growers when they clean their fields before the next crop is planted. The residues left after the crop has been harvested, such as stems and leaves from rice, maize, pumpkins, potatoes, tomatoes, chili peppers, zucchini, cabbage, banana trees, etc., and any damaged crops that cannot be sold or eaten, can be collected together and used to make compost.

##### 1.1 Diagram Showing the Layers in a Compost Heap





## 1.2 Selecting the Site

- The following factors need to be considered:
1. The site should be accessible for receiving the materials, including water and/or urine, and for frequent watching/monitoring and follow-up.
  2. The site should be protected from strong sunlight and wind, e.g. it should be in the shade of a tree, or on the west or north side of a building or wall.
  3. The site should be protected from high rainfall and flooding.
  4. You will never have too much compost. Make sure there is plenty of compost-making space. Make several heaps of compost at the same time.



## 1.3 Preparing the Site

- Clear the site of stones, weeds and grass. Set up the site in the shade of trees. The trees will grow, provide shade and protect the compost heaps.

## 1.4 How to Start to Make the Compost Heap

1. Mark out the area for the compost heap. An area to make a minimum amount of compost for a hectare (5 MT) is 1 m x 5 m x 1 m. Including the covering layer, the height will probably be nearly 1.5 m. If you want to make more than 5 MT, make separate compost heaps, or make the length longer than 5 metres as opposed to making the heap taller.
2. Dig a shallow trench in the ground the same dimensions as the compost heap. Make the trench about 25 cms. deep. The bottom and sides of the trench should be smeared with water (which will combine with the earth to create mud) or a mixture of cow dung and water. This seals the heap so that moisture with nutrients do not leak out of the base of the compost heap.
3. The foundation layer of compost-making materials is placed in the trench. (*See below.*)
4. The trench holds moisture during the dry season.
5. Materials are added in layers to make the heap, as shown in the diagram on page 3, and described in more detail below.

## 1.5 The Layers in Making the Compost Heap

### 1.5.1 The Foundation Layer



Dig a trench for the foundation layer.

Add twigs, straw, or crop stalks to make the foundation layer.

Sprinkle water + Lord's Bio-Plant over each layer in the compost heap.

The finished compost heap.

1. Dry plant materials, e.g. twigs, thick straw, and stalks of maize and/or sorghum are used for the foundation. *These need to be broken into short lengths (about 10–15 cms. long)*. The stalks can be crushed, and then chopped. If possible let cattle lie down or sleep on them for one night, or walk on them.
2. Spread the dry materials evenly over the bottom of the trench to make a layer about 25 cms. thick, which is as deep as a hand. Then sprinkle water mixed with Lord's Bio-Plant at the ratio of 20 cc in 20 litres of water with a watering can, or scatter water evenly by hand over the dry plant materials so they are moist, but not soaking wet.
3. The foundation layer provides ventilation for air to circulate, and for excess water to drain out of the upper layers.

### 1.5.2 The Three Basic Layers

#### **Layer 1 (Carbon - Brown Material) – Fungal Food**

- Place a layer of brown, dry plant materials, such as dry leaves, crushed sugarcane waste, cocoa pods, straw, dried grass, dried weeds, stalky crop residues such as rice and maize stems, bran and rice husks, pruned material, and dry hay. It is important to make compost which is rich in fungi because then the weeds will grow less and less. Fungal foods for the compost pile have a high C:N ratio, such as 60:1. The fungal component will shift the nitrate side of the soil to ammonium (NH<sub>4</sub>), which weeds cannot use. Weeds love the nitrates of chemical fertilisers. The layer should be 25 cms. thick, i.e. as deep as a hand. Cut up the material into small pieces or grind it up.

#### **Layer 2 (Nitrogen - Green Material) – Bacteria Food**

- Add a layer of moist (but not wet), green, plant materials, either fresh or wilted, e.g. weeds or grass, plants from clearing a pathway, green stems and leaves left over from harvesting vegetables, damaged fruits and vegetables, waste fruit from a fruit processing factory; leafy branches from woody plants as long as the materials are chopped up, and cut up green banana tree leaves and pseudo-stems. The Greens are food for bacteria at around 30:1. The layer should be 25 cms. thick. Cut up the material into small pieces or grind it up.

#### **Layer 3 (Manure) – High Nitrogen**

- Add a layer of animal manure collected from *dried and crushed* cow dung, horse, mule or donkey manure, sheep, goat or chicken droppings. Sprinkle water or urine mixed with Bio-Plant at the ratio of 20 cc in 20 litres of water with a watering can or scatter water evenly by hand over the manure so that it is wet. The animal manure can be mixed with soil, clay, old compost, some wood fire ash, and/or some rock phosphate to make a layer 5–10 cms. thick. If there is only a small quantity of animal manure available, it is best to mix it with water to make slurry, and then spread it over as a thin layer 1–2 cms. thick. This serves to make the bacteria and fungi grow rapidly so as to get the heat up and thereby kill the pathogens.

#### **Notes:**

- Add layers to the heap in the sequence Layer 1, Layer 2, and Layer 3 until the heap is about 1–1.5 metres tall. The layers should be thicker in the middle than at the sides so the heap becomes dome-shaped. If the heap is taller than 1.5 metres, the microbes at the bottom of the heap will not be able to work well.
- Water or slurry (animal manure mixed with urine) mixed with Bio-Plant at the ratio of 20 cc of Bio-Plant in 20 litres of water should be sprayed or sprinkled with a watering can evenly over each layer making it moist but not soaking wet.
- Layers 1 and 2 are essential to make good compost. Make sure that the pieces are small or ground up. In Layer 3, if there is a shortage or absence of animal manure, use good soil instead.
- Place one or more ventilation and/or testing sticks vertically and every 1 metre in the compost heap, remembering to have the stick long enough to stick out of the top of the heap. Ventilation and testing sticks are used to check if the decomposition process is going well, or



not. A hollow stick of bamboo makes a good ventilation stick as it allows Carbon Dioxide to diffuse out of the heap and Oxygen to diffuse into the heap. A testing stick is needed as it can be taken out at regular intervals to check to see the progress of decomposition in the heap. If the stick is hot, then the process is going well.

### **1.5.3 Suggestions**

1. Moisten straw before using it.
2. Use no more than 30% of any one individual material. The best composts are made with the greatest diversity of materials.
3. Add a few shovels of good compost, or add a variety of other composts. This adds micro-organisms to the pile.
4. Add clay or a clay soil to the pile when constructing it. Clay will assist with moisture control during composting; greatly extend the life of your compost; and most importantly, promote the growth of mycorrhizal fungi when the mature compost is added to soil. Up to 10% of the pile can be clay. Add it on top of any layer.
5. Add up to 10% crushed basalt dust in the compost because it has a high paramagnetic property which means the Earth's magnetic field is enhanced in the soil. This is said to be beneficial to soil life. The paramagnetic effect can have a massive impact upon compost quality and has been shown to increase microbial subdivision by up to 400%. The compost will be more bioactive as a result and the paramagnetic effect of the rock dust will be transferred to your soil. Trace minerals in the rock dust are released more rapidly as a result of the enhanced bioactivity.
6. When building the pile, add humic acid to the compost when you turn it. Spray it over a few layers. It will supply around 70 trace minerals and ensure the growth of beneficial microorganisms. To make humic acid take 2 or 3 handfuls of already made compost, put it in a thin cloth, and run a litre of water through it slowly. The fungi in the compost will grow crazily.

### **1.5.4 Things Not to Compost**

- Bread products: This includes cakes, pasta and most baked goods.
- Cooking oil: Smells like food to animal and insect visitors. It can also upset the compost's moisture balance.
- Diseased plants: Trash them, instead. You don't want to transfer fungal or bacterial problems to whatever ends up growing in your finished compost.
- Heavily coated or printed paper: This is a long list, including magazines, catalogs, printed cards and most printed or metallic wrapping paper. Foils don't break down, and you do not need a bunch of exotic printing chemicals in your compost.
- Human or animal feces: Too much of a health risk.
- Meat products: This includes bones, blood, fish and animal fats. Another pest magnet.
- Milk products: Refrain from composting milk, cheese, yogurt and cream. While they will certainly degrade, they are attractive to pests.
- Rice: Cooked rice is unusually fertile breeding ground for the kinds of bacteria that you don't want in your pile. Raw rice attracts varmints.
- Sawdust: Unless you know the wood it came from was untreated, stay away from it.
- Stubborn garden plants: Dandelions, ivy, and kudzu are examples of plants or weeds which will probably regard your compost heap as a great place to grow, rather than decompose.
- Used personal products: Tampons, diapers, and items soiled in human blood or fluids are a health risk.
- Walnuts: These contain juglone, a natural aromatic compound toxic to some plants.

### **1.5.5 The Carbon to Nitrogen Ratio**

- To keep it simple, aim for a ratio of 2 to 2.5 parts of Browns to 1 part of Greens. 2 shovels of Brown, 1 shovel of Green and ½ shovel of High Nitrogen.

- This is important because the right amount of Carbon and Nitrogen makes the microbes grow fast. Having fast-growing microbes means that the composting process happens quickly and the pile heats up to desirable temperatures. So, for fast compost it is important to feed the microbes the right ratio of Carbon to Nitrogen.
- If you use too much Browns, the pile will decompose slowly and the pile will not heat up enough. If you use too much Greens, the pile will smell unpleasant. You need Greens to make the pile hot. But not too much. If you do not have much Greens, add more chicken or cow manure or urine.

### 1.5.6 Making the Covering Layer

1. The finished heap needs to be protected from drying out, and also from animals pushing into it and disturbing it. The covering layer can be made of thick straw or wet mud mixed with grass or straw, with or without cow dung; or wide leaves of pumpkin, banana trees, fig trees, etc.; or plastic; or any combination of these materials, i.e. mud plaster covered with leaves or plastic, or leaves covered with plastic.
2. The cover should be put on both the sides and the top of the heap with only the ventilation stick coming out of the top.
3. The Covering Layer:
  - a) Prevents rain water from getting into the heap and damaging the compost making process;
  - b) Helps keep heat inside the compost making heap. (*See 2.2 below for how to check on the heat and moisture in the compost.*)
4. The compost heap is best left untouched until it is time to turn it over. (*See 3. below on how to turn the compost pile.*) When the compost is turned over, water should be sprinkled over each layer to keep all the materials moist. It is not necessary to try and keep the original, different layers when turning over the compost. It is best, if all the materials can be mixed well together, then added in layers about 25 cms. in height, and then water is sprinkled or splashed over each layer.
5. A mature compost heap is about half the height of the original heap, and the inside is full of a dark brown or black earthy substance, namely humus, which smells good. When the compost is mature, it should be very difficult to see the original materials. This will take about 7 weeks.
6. This mature compost can be used immediately in the field or plantation after it has cooled down, or it can be covered and stored until the growing season. *When it is put in the field, it should be covered quickly by soil or mulched with leaves so that the sun and wind do not damage it, and the Nitrogen does not escape into the atmosphere.* Therefore, it is best to put compost on a field just before ploughing, or at the same time as sowing the crop. In the case of row-planted crops, it can be put in the furrows with the seeds. In the case of transplanted crops, it can be put in the holes with the seedlings.

### 1.5.7 Making Compost with Cocoa Pod Husks

- A layer could be created using cocoa pods. The pods should be crushed, ground up, sliced, or cut up into small pieces so that they break down and compost easily.
- Treat this layer in the same way as Layer 1 in the Heap Method. The layer should be about 25 cms. thick, i.e. as deep as a hand. Water or slurry mixed with the Lord's Bio-Plant at the ratio of 20 cc in 20 litres of water should be scattered by hand or sprinkled with a watering can evenly over this layer making it moist but not soaking wet.
- A benefit of this approach is that the temperature during the composting will kill any pathogens in the cocoa pods.



*Rorak ditches between cocoa tree rows.*

- If the farmer does not wish to make compost with the cocoa pods using layers, then he could create a long layer of ground-up cocoa pods about 25-50 cms high; cover it with water mixed with Lord's Bio-Plant at the ratio of 20 cc in 20 litres of water by hand or sprinkled with a watering can evenly, making it moist but not soaking wet; mix in a lot of chicken manure and burned rice husks; and then cover the layer with plastic so as to keep in the heat. Ideally, follow the ratio of crushed cocoa pods (20 parts), chicken manure (20 parts), and burned rice husks (1 part). Basically, the composting method would be the same, but with just one layer.
- Crushed cocoa pods can also be placed in **rorak ditches** and mixed with leaves and other organic waste between the rows of cocoa trees where the roots extend out to.
- The rorak ditches should be covered in leaves to keep in the moisture.
- The soil will then be full of minerals and micro-organisms, which will increase the fertility of the soil rapidly.

## **2. What to Do During the Compost-Making Process**

### **2.1 Using a Temperature Stick or Rod**

- A long stick, length of bamboo, or a metal rod can be inserted vertically in the centre of the heap so it goes through all the layers, and left there for the whole composting period. The stick must be longer than the height of the heap so that it can be pulled out and examined. Alternatively, put a metal rod or stick in the compost pile for 10-15 minutes to test the temperature. Place it on the back of your hand. If you are not using a thermometer, you will have to feel the different temperatures so that you know when the temperature is too high.
1. If the stick feels hot and the smell is good, the temperature is normal for the compost and good decomposition has started. Turn the pile when the temperature starts to feel too hot.
  2. If the stick feels cool or cold, the temperature is too low for good composition. This usually means that the materials are too dry, and some water and/or urine should be added. (*See 2.3 on how to correct this.*)
  3. If the stick is warm and wet, and there is a bad smell like ammonia, this indicates that there is too little air and too much water in the compost. The materials will be rotting and not making good compost. (*See 2.3 on how to correct this.*)

### **2.2 Checking the Temperature**

- The first 15 days are important. You have to reach the correct temperature of about 55 Celcius in order to kill all pathogens. Within 72 hours the compost pile should be hot at this temperature. If it is not, you have to add more High Nitrogen material inside.
- If the temperature continues to rise above this temperature and the pile is becoming very hot (65-70 degrees Celcius), then it is time to turn the pile as the organisms are growing so fast that they are using up all the oxygen in the pile.
- When it becomes too hot again, turn it. 2-3 days later it will be too hot again so you will have to turn it again. Do this every 2-3 days in the first days.
- A pile should be aerated by turning it at least 5 times during the 15 days. After that you can probably turn it every 5-7 days.
- After 15 days the pile will heat up to close to the 55 Celcius level before cooling again. When you notice it is cooling, turn the pile again. Keep doing this until the temperature no longer increases and the compost has a beautiful earthy smell and a fine texture with little or no evidence of the original ingredients.
- If you start to smell bad smells, you should already have turned it. Every day smell the wooden stick you put into the centre of the pile.
- After one month, you should have turned the pile about 7 times, probably every 5-7 days after the first 15 days. By then you will not be able to tell the Greens from the Browns as the organic matter will have broken down. The stick or rod will gradually feel warm rather than hot, and as the heap cools it will sink more and more.

## 2.3 Correcting the Problems

- **If the materials are cool and dry:**

1. Lift up the top layers and put them to the side of the pit or heap.
2. Sprinkle water or cattle urine diluted with water on the material at the bottom.
3. Then put back the material in layers of about 25 cms. each sprinkling water or a mixture of water and urine over each.  
Replace the testing stick and cover the heap or top of the pit with soil, leaves, plastic, etc., as described earlier.

- **If the materials are too wet:**

1. Try to remove the wet material. Leave it to dry and then use it as Carbon in the next compost pile.
2. Or, collect some more dry plant materials and/or some old dry compost. Break up and mix the new and wet materials. If old, dry compost is not available, use only dry plant materials.
3. Lift off the top of the heap or take out the wet material and put it to one side. Mix the new dry materials with the wet compost materials. Then rebuild the compost pile.
4. Make a new test of the moisture after another few days.

Troubleshooting the Composting Process		
SYMPTOM	PROBLEM	SOLUTION
The compost has a bad odor.	Not enough air	Turn the pile, add more PVC pipes.
The compost has a bad odor and is soggy.	Not enough air and too wet	Mix in dry ingredients like straw or shavings, add PVC pipes and cover with a tarp.
The inside of the pile is dry.	Not enough water	Add water when turning the pile. Should be as damp as a wrung-out sponge.
The compost is damp & warm in the middle, but nowhere else.	Pile is too small	Collect more raw material and mix it into the old ingredients. Piles smaller than 3-foot-square have trouble holding heat.
The pile is damp and smells fine, but is not heating up.	Too many shavings, wood chips or bedding (carbon source) and not enough manure (nitrogen source)	Mix in a nitrogen source—straight manure, fresh grass clippings, blood meal, or ammonium sulfate.

- **If the compost heap smells:**

- Decomposition of organic materials must take place aerobically, i.e. with sufficient oxygen present. If the compost becomes smelly it is a sure sign that anaerobic decomposition has taken place (insufficient oxygen available). "Smelly" probably means lost nutrients and the production of some nasty organic acids by anaerobic microbes. In severe anaerobic cases, the compost may become phytotoxic (kills plants). It is probably best to park this pile for at least a year or use the failed compost in a later compost pile. (Use it as the "Brown" component in the next pile).

## 2.4 Checking the Moisture Level

- Moisture level is critical and should remain between 45-55% during the heat cycle. This is measured by taking a handful of compost from near the centre of the pile and squeezing it hard:



- If water runs out – compost is too wet and well in excess of 55% moisture.
- If one drop comes out – compost moisture is excellent at around 50-55%.
- If no drop comes out but the compost stays in a tight lump, the moisture is between 45-50%. Adding water when turning the pile is not essential, but monitor the moisture level.
- If no water comes out and the squeezed compost breaks apart - moisture is less than 40% - add moisture when you turn it. (Note: Mature compost will have a moisture content of around 40%).

### **3. Turning the Compost Pile**

#### **3.1 How to Turn the Pile**

- Use a fork to build a fresh heap next to the original pile. Take the top off and put it on one side. Take the hot centre and place it on the ground around the edges of the new compost pile. Place the outside of the old pile and put it in the new centre. Place the old top of the pile in the new centre as well.
- Every time you turn the compost, make sure you bring the pile's exterior material into the interior. This enables all material to be evenly broken down. Water can be added to maintain the correct moisture levels, but be careful as the pile will cool if it is too moist.

#### **3.2 Why You Should Turn the Pile**

- Turning allows you to re-introduce oxygen that is rapidly being used by the aerobic microbes. It is also likely that additional moisture will be required at each turn of the pile. This is because air is travelling into and out of the pile and taking moisture out. This sometimes looks like steam coming from the pile.
- Air is important to the decomposition process. The mix of Carbon (BROWN) and Nitrogen (GREEN) organic material in your pile is like a fire; air is necessary to keep it going. Aerating your compost pile gets the bacteria all fired-up again.
- Aerating remixes ingredients, exposing new surfaces for bacteria to munch on. This aerobic form of composting heats up the pile once again.
- Turning creates new passageways for air and moisture before the pile compresses. As material decomposes your pile will compress and shrink in size. This will naturally cool down the pile sooner than the material is fully decomposed. Turning exposes more material to heat. It fluffs it all up, thereby allowing the mix of air, moisture and heat to continue the decomposition process.

#### **3.3 Turning Speeds up the Composting Process**

- A cold pile breaks down very slowly, like a fire going out or extinguished. Each time you turn your pile you create more surface area for the vegetal material, enough so that the pile will reheat itself repeatedly after each turning.

#### **3.4 Turning Eliminates Odours and Matting of Material**

- A pile that stinks probably has too much Nitrogen (GREEN) materials and/or is too moist. It is also probably compressed under the weight of so much moisture in the green materials. Adding more Carbon (BROWN) materials to balance out the greens is important. Turning the pile is critical to fluff up the organic material. Also, turning odourous or matted compost heaps exposes more surface area so that air and heat can move again through the pile.

### **4. When is the Compost Finished?**

- Compost is ready when it looks, feels, and smells like rich, dark earth rather than rotting vegetables. In other words, it should be dark brown, crumbly and smell like earth. The compost might not lower heat up when it is turned, but this does not mean that it is ready to be used. Compost is not finished until it has been cured. Curing takes 1-2 months once the pile is cool.



#### **4.1 The Importance of Curing Compost**

- When the pile no longer heats up, mesophyllic micro-organisms move in to finish the compost. The extra time for curing allows the microbes that operate at lower-temperature to put their finishing touches on the pile. It also allows earthworms and other larger organisms which do not tolerate high heat to move back into the compost. they improve the compost itself and then they improve the soil where the compost is added.
- Keep the pile damp by spraying water on it. These micro-organisms need moisture.
- Curing assures that the compost will be of a much higher quality. For example:
  - The pH will become neutral.
  - Uncured compost may contain substances damaging to plants, including acids and pathogens. Soil micro-organisms will colonise the compost and impart disease-suppressing qualities to it.
  - If there is too much Carbon in the compost because you got the ratio of carbon to Nitrogen wrong, this will cause a temporary Nitrogen deficiency in the soil. Why? Because the micro-organisms will take Nitrogen from the soil to break down the rest of the Carbon. But the micro-organisms will restore the balance of Carbon and Nitrogen to the compost during the curing process. Having said this, if there was too much Carbon, the pile you would know because it would not become very hot and it would take a long time for the compost to develop. So you would have added green material.
  - Curing makes the compost optimum for plant growth.
- For all of these reasons, it is important that compost is thoroughly mature before it is used.

#### **4.2 How to Know When the Compost is Ready**

- If you have a hot pile that has been turned regularly, knowing when it is done is easy: it will not heat up any more, even after being turned.
- After curing for 1-2 months.
- Check for fine particle, dark-coloured humus-like appearance and an earthy smell.
- In completely finished compost made from shredded materials, none of the original ingredients will be recognizable. If you do not shred ingredients, however, the decomposition will take a long time.
- The important test for whether cool compost is done is the look, feel, and smell of it. Mature compost does not contain slimy things, for instance. The ingredients should be unrecognizable, save for the occasional woody stem or autumn leaf. If many ingredients can still be picked out and named, the compost needs more time.

#### **4.3. Screen the Compost Before Using or Bagging**

- There are several ways to deal with *over-size* woody pieces in the compost that will not fit through about a half-inch wire mesh.
- You can use the compost as is with the over-sized pieces in it, pick the biggest pieces out by hand, or screen the entire batch, returning the bigger bits to the active compost pile for another round. If you do remove the overs and return them to the pile, they take with them the composting micro-organisms that adhere to them which give a boost to the fresh compost.
- The first option is to ignore them. Just use the compost as is, even with the occasional recognizable peanut or egg shell. These things will decay in your soil, though it is true that the process requires a certain amount of Nitrogen. It is therefore not recommended to add compost with a high proportion of uncomposted refuse to Nitrogen-poor soil.
- Alternatively, you can pick the biggest offenders — the corn cobs and avocado pits — out of the finished compost and toss them back into the active pile for another go-round. This can be done easily with things as large as corn cobs, but if you find yourself picking through the compost to find individual peanut shells, it is time to set up a screen.
- Screening compost takes time and a certain amount of energy but it results in a gorgeous, light and uniform soil.

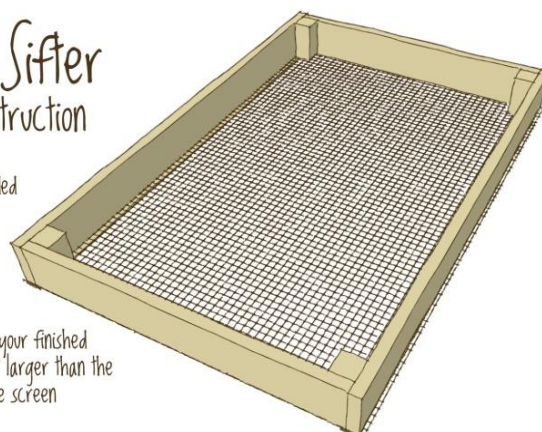
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Compost Sifter  
finished construction

2x12s provide added  
frame support

make sure your finished  
width is not larger than the  
width of the screen



## 5. Making Potting Soil and Organic Fertilizer to Place Around Vegetables and Trees

### Method 1 - To Improve the Soil

Mix rice husks with chicken dung (dry or wet dung) and spray it with Bio-Plant (20 cc in 20 litres of water). You could mix this with bamboo leaves and roots. You could add bio-compost made with Bio-Plant. Leave it for up to 45 days. Then place it around trees – 10 kgs per tree over 1 metre in height.



*The Final Product - Compost Humus*

### Method 2 – Small Bags for Planting Small Plants (Seedlings)

1. Rice husks (1 part).
2. Coconut coir (1 part). Soak the coconut coir in warm water.
3. Soil (2 parts).
4. Bio-Plant mixed with water (20 cc in 20 litres).

**Note:** You could add 1 part of bio-compost made with Bio-Plant.

### Method 3 – For a Vegetable Patch

1. Soil (2 parts).
2. Cow dung (1 part).
3. Chicken dung mixed with rice husks (1 part) or separate.
4. Sugarcane bagasse or molasses-soaked earth (1 part)

5. Coconut coir (1 part). Soak the coconut coir in warm water.
  6. Bio-Plant mixed with water (20 cc in 20 litres)
- Note:** You could add 1 part of bio-compost made with Bio-Plant.

#### **Method 4 – Concrete Circles for Planting Trees**

1. Rice husks (1 part).
  2. Cow dung (1 part).
  3. Coconut coir (1 part). Soak the coconut coir in warm water.
  4. Soil (3 parts).
  5. Bio-Plant mixed with water (20 cc in 20 litres).
- Note:** You could add 1 part of bio-compost made with Bio-Plant.

#### **Method 5 – Concrete Circles for Planting Trees**

1. Soil (3 parts).
  2. Rice husks (1 part).
  3. Cow dung (1 part).
  4. Coconut coir (1 part). Soak the coconut coir in warm water.
  5. Bio-Plant mixed with water (20 cc in 20 litres).
- Note:** You could add 1 part of bio-compost made with Bio-Plant.

#### **Method 6 – Concrete Circles for Planting Trees**

1. Coconut coir (3 parts). Soak the coconut coir in warm water.
  2. Soil (2 parts).
  3. Cow dung (1 part).
  4. Bio-Plant mixed with water (20 cc in 20 litres). Use 10 litres of water.
- Note:** You could add 1 part of bio-compost made with Bio-Plant.

#### **Method 7 – Concrete Circles for Planting Trees**

1. Soil (3 parts).
  2. Cow dung (2 parts).
  3. Rice husks (1 part) or coconut coir (1 part).
  4. Bio-Plant mixed with water (20 cc in 20 litres).
- Remember to crush and sieve the soil.
  - Allow the micro-organisms to expand for 10-14 days before use.
  - **Note:** You could add 1 part of bio-compost made with Bio-Plant.

#### **Method 8 – Fertilizer for Placing Around Trees**

1. Leaves (3 parts).
  2. Cow dung (1 part).
  3. Bio-Plant mixed with water (20 cc in 20 litres).
- The farmer who makes this fertilizer leaves the piles for 2 months, and turns over and waters the piles using the style of making compost.
  - **Note:** You could add 1 part of bio-compost made with Bio-Plant.

#### **Method 9 – Fertilizer for Potting Soil and for Placing Around Plants and Trees**

1. Sugarcane bagasse waste (2 parts).
  2. Rice husks (2 parts).
  3. Cassava peel (2 parts).
  4. Cow dung or chicken dung (1 part).
  5. Sawdust (no chemicals in it) (2 parts).
  6. Leaves (2 parts).
  7. Bio-Plant mixed with water (20 cc in 20 litres).
- Layer the ingredients and make the compost in the same manner as for making compost.
  - These are the ingredients of a company, which produces potting soil and fertilizer in bags.
  - **Note:** You could add 1 part of bio-compost made with Bio-Plant.

### **Method 10 - To Improve the Soil**

- Cut 2 kgs each of pumpkin, bananas, and papaya. Mix in 2 kgs of brown sugar. (Alternatively, 3 kgs of each, 4 kgs, etc.) Mix them and leave for 15 days. Make a hole so as to let the gas to escape. Then mix 100 cc of the mixture with 20 litres of water. Spray the soil while the vegetables are growing.

### **Method 11 – Fertilizer for Potting Soil for Seed Flats**

1. Burned rice husks (3 parts).
  2. Coconut coir (1 part).
  3. Bio-Plant mixed with water (20 cc in 20 litres).
- Soak the coconut coir in warm water. Mix the ingredients well and then place them in the seed flats. Water the potting soil well. Cover the seeds over with more potting soil. Plant 1 or 2 seeds in each section.
  - Water with a fine spray because this will ensure that more seeds germinate. Put the seeds in the shade until they grow about 0.5 cm. Then put them out in the sun. Spray them each time with the fine spray.
  - **Note:** You could add 1 part of bio-compost made with Bio-Plant.

### **Method 12 – Fertilizer for Potting Soil for Seed Flats**

1. Compost made with Bio-Plant (1 part).
  2. Coconut coir (1 parts).
  3. Bio-Plant mixed with water (20 cc in 20 litres).
- Soak the coconut coir in warm water. Mix the ingredients well and then place them in the seed flats. You could add soil (1 part). Water the potting soil well.

### **Method 13 – Fertilizer for Potting Soil for Seed Flats**

1. Burned rice husks (1 part).
  2. Coconut coir (3 parts).
  3. Bio-Plant mixed with water (20 cc in 20 litres).
- Mix the ingredients well and then place them in the seed flats. Water the potting soil well. Cover the seeds over with more potting soil. Plant 2 seeds in each section. Water with a fine spray because this will ensure that more seeds germinate. Put the seeds in the shade until they grow about 0.5 cm. Then put them out in the sun. Spray them each time with the fine spray.
  - **Note:** You could add 1 part of bio-compost made with Bio-Plant.

## **6. Soil Preparation With Organic Matter and Bio-Compost**

### **6.1 Important Notes**

- These guidelines should be applied to 100% organic farming **and** bio-chemical farming.
- Ideally, farmers should make a continuous supply of compost, which they can apply to their crops. But if the farmer has not made any compost before planting his crop, then he should obtain organic matter and use it as in **Method 1** instead.
- **Very Acidic Soil:** Even though the use of Bio-Plant in **Method 1** and **Method 2** will raise the pH of the acidic soil and restore the soil's fertility, adding lime to the soil as well will make it easier for the micro-organisms to multiply, to carry out their functions, and to restore the soil's microbial life. As a result, also using lime in very acidic soil is highly recommended.
- **Per Tonne:** Chicken dung or cow dung - 300 kgs.; Dried grass, rice stems, leaves, sugarcane bagasse, cassava peels, etc., ground up or cut into 1-2 inch lengths - 600 kgs.; Earth -100 kgs. Black soil is the best.

### **6.2 Method 1 – Preparing the Soil with Uncomposted Organic Matter**

- You could collect organic matter; then spread it over the field, and then plough it into the soil. However, to avoid damaging the soil structure, Conservation Agriculture techniques encourage farmers not to plough the soil but rather to leave the crop stubble in the ground; to



cover the soil completely with crop remains; to create planting trenches or holes between the rows of crop stubble; to place organic matter in the planting trenches or holes; and then to plant into the organic matter. Spraying Bio-Plant mixed with water will make the organic matter decompose faster. Alternatively, spray Bio-Plant onto the organic matter before placing it in the planting trenches or holes. Prepare the soil in this way at least 2 weeks before planting the crop so that the micro-organisms can do their work.

- **For a hectare:** 1 litre of Bio-Plant mixed with 1,000 litres of water and 5 MT of uncomposted organic matter is normal for 1 hectare. Adding 10 MT or more of organic matter would be wonderful, if a lot of organic matter is available. 5 MT is just the minimum. If there is a shortage of water, then 500 litres will do, but up to 1,000 litres is better as this will make the micro-organisms multiply better. If chemical fertilizer has been used on the soil for a long time, or no fertilizer at all, a better way to prepare the soil is to mix 2 litres of Bio-Plant with 1,000 litres of water and 10 MT of uncomposted organic matter (ideally which has a lot of chicken dung - 30% of the volume). If the farmer wishes to reduce costs, then he could mix 1 litre of Bio-Plant with 1,000 litres of water and 10 MT of uncomposted organic matter.
- **For an acre,** 4 MT will be best amount, especially in the first year, but 2 MT is the normal amount. The usual amount of Bio-Plant for an acre is 250 cc mixed with 250 litres of water. Spray this over the uncomposted organic matter once it has been laid over the ground, and plough it into the soil. If the soil is very weak in micro-organisms and nutrients, spray 500 cc of Bio-Plant mixed with 500 litres of water.
- **For half an acre,** 1-2 MT with 2 MT being the ideal amount in the first year. The usual amount of Bio-Plant for half an acre is 125 cc mixed with 125 litres of water. If the soil is weak in micro-organisms and nutrients, spray 250 cc of Bio-Plant mixed with about 250 litres of water (or even 500 cc of Bio-Plant mixed with 500 litres of water) over the uncomposted organic matter once it has been laid over the ground, and plough this into the soil.

### **Guidelines**

- Preparing the soil in this way will supply the roots with a lot of macro- and micro-nutrients; as well as enable the plants to obtain extra Nitrogen from the air.
- Prepare the soil in the same way both for 100% organic farming and bio-chemical farming.
- Leave the organic matter mixed with the Bio-Plant for 2 weeks before planting. Leaving the soil for about 14 days allows the micro-organisms to multiply before planting. The water is needed to “awaken” the micro-organisms. It takes about a week to awaken them, and the rest of the time is for them to multiply in the organic matter.
- We recommend this because often chemical fertilizers have been used for so long that the micro-organisms in the soil have mostly been killed off.

### **Method 2: Preparing the Soil with Bio-Compost**

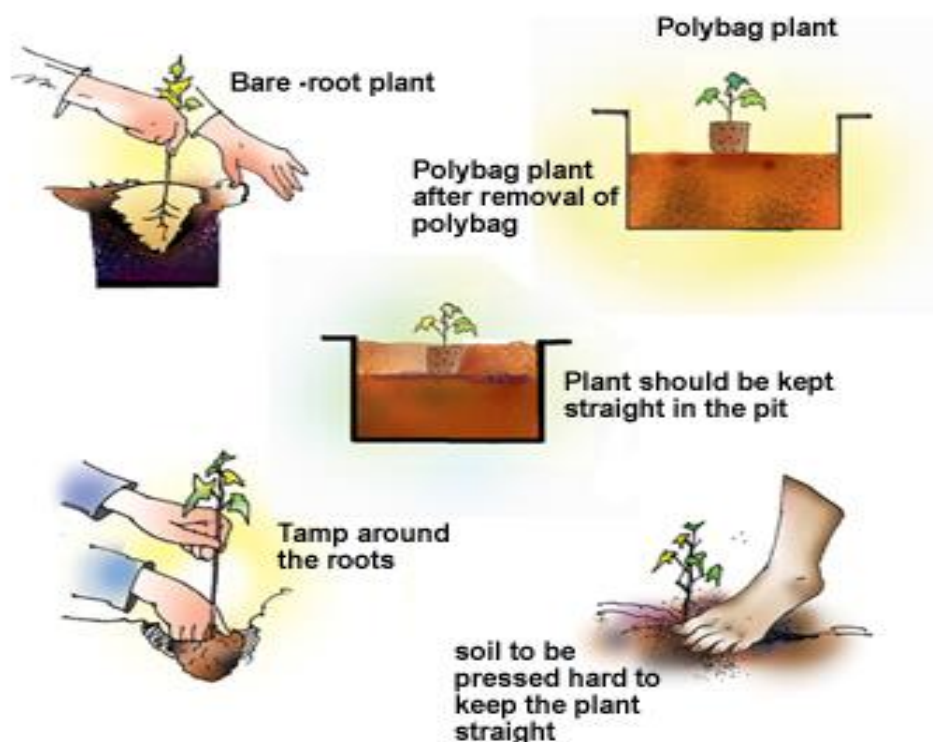
- This would be better than Method 1 above because the organic matter has been broken down and turned into rich compost already.
- In the first year we recommend that the farmers use a minimum of 5 MT per hectare and ideally 10 MT per hectare. The reason for this amount of compost is that the soil has probably been weakened severely for many years by chemicals. If the farmers do this in the first year, the soil will recover very quickly with the bio-fertilizers and in the second year the farmers can reduce the amount of compost by half.
- If the seeds/seedlings will be planted on ridges, then you could place the compost on the ridges only, and then you could plant the seeds/seedlings into the compost,
- If the seeds/seedlings will be planted in trenches or holes, then you could place the compost in the trenches or holes, and plant the seeds/seedlings into the compost,

### **Planting Saplings**

- When planting saplings in holes, use a 1:1 mixture of bio-compost and soil in the holes where the tree seedlings are to be planted. Make the hole about 60 cms. x 60 cms, and fill the hole halfway up with the mixture.



- Place the sapling with its soil around the roots on top of the compost with the top of the roots being at the level of the top of the hole; and then fill in the hole with the soil from the hole.
- Put the topsoil at the bottom of the hole with the compost and the soil from the bottom of the hole on top of the sapling.
- Finally, spread 5-10 kgs of bio-compost around the sapling while avoiding placing the bio-compost against the stem of the sapling.



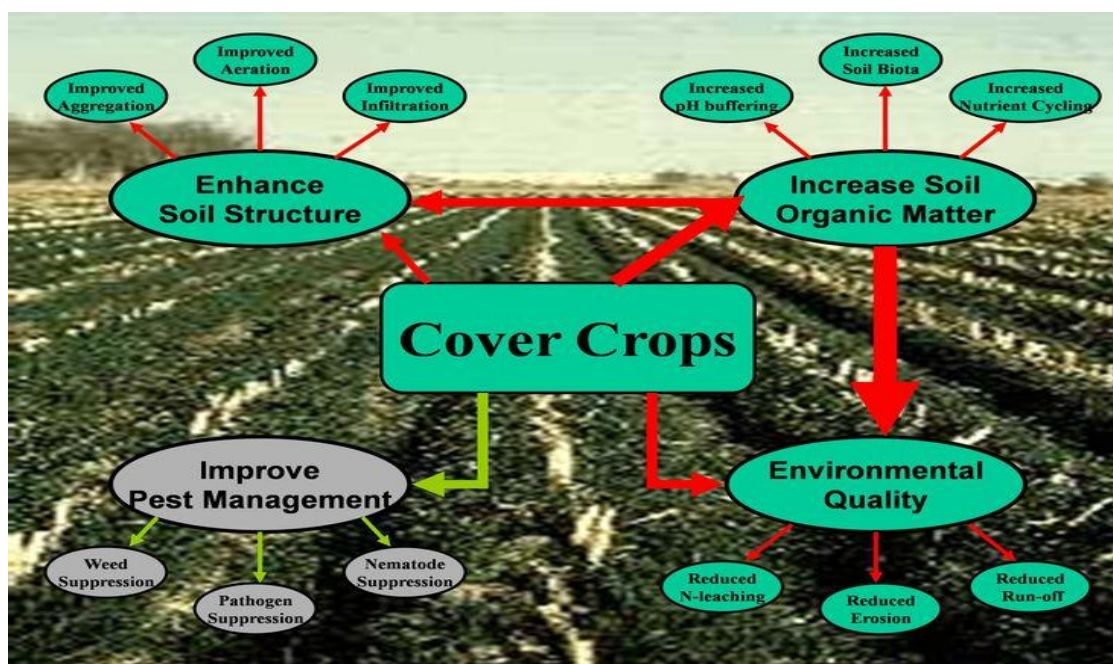
### **Trees Already Growing**

- Once a month place 5-10 kgs around trees which are already growing - a minimum of 5 kgs per tree, if the trees are under 1 metre high, and about 10 kgs around trees over 1 metre in height. But 10 kgs can be applied to trees under 1 meter in height as well. Place 15 kgs, if the soil is very poor or there is a problem with disease.
- Ideally, apply 5 MT – 10 MT per hectare around the plants on Day 30 and Day 60 of a 90-day crop. Do the same once a month or every 2 months in the case of crops growing for 6 months upwards.
- For rice, when water is let into the field every 2 weeks, let 500 cc of Bio-Plant also flow in per hectare.

### **6.3 Urine**

- There are no doubts about the effectiveness of this near perfect, soluble fertilizer on your garden. Urine is sterile. Neat or diluted, it is a popular compost activator. Pour it on because it is loaded with Nitrogen as well as potassium and phosphorous. The Nitrogen is in the form of urea, which is the ideal form for soil uptake and fertilizing plants.
- Urine should be used as fresh as possible to fertilize your plants, but if that's not always possible, put a lid on the jar or container immediately. Urine that has been left in the air for a while will be busy converting urea into ammonia - your compost pile will still love it though.
- For pouring around the roots of your vegetables and other plants, dilute 1 to 10 with water (keep a handy watering can near the back door). For younger plants and seedlings, dilute 1 to 20 with water, and for plants in containers dilute 1 to 30 with water.
- Urine is high in Nitrogen and has a lot of mineral salts in it, so it can burn plants. These salts are a good reason to try to avoid applying urine to plant leaves. It is best to pour in the soil around plants. Apply weekly to fast growing and large plants, less often to very young and slower growing plants.

## 7. 10 Benefits of Planting a Cover Crop



### 7.1 What Are They?

- Cover Crops – sometimes called green manures – are plants that are used primarily to help improve the soil because of the advantages they bring to the soil. Cover crops are often used to help ‘repair’ soil that has been depleted or eroded. There are many benefits a farmer or gardener can get from cover crop planting.
- Plant short (in height) perennial cover crops, such as alfalfa, clovers, chamomile, horkellia parryi, oreganum, chrysanthemum, thyme, penstemon heterodoxus, and perennial herbs as an understory crop. Then you do not have to buy more seeds each year. Also, the roots will get longer. Healthy root systems, allowed to grow over multiple seasons, are essential for fostering plant-protecting organisms in the soil.
- In addition, cover crops create a balance of bacteria and fungi. Some have a larger fungal effect, such as chamomile, which increases the soil’s fungal biomass.

### 7.2 Prevent Erosion

- Bare earth is something to be avoided. Soil that is exposed to the elements is at a greater risk of erosion by wind and water runoff. This can mean the removal of the rich topsoil and the compaction of the soil underneath, making planting much harder. Cover crops help to stabilize the soil, prevent runoff, and both bind the soil together and improve its structure.

### 7.3 Improve Soil Structure

- The roots of the cover crop will also help to improve the structure of the soil. The foliage of the plants helps to prevent compaction of the soil by protecting it from rain and erosion. They increase the fungal networks in the soil, which tie soil particles together and create passageways. The passages and pore spaces that they and the roots create, allow for moisture percolation and storage, and soil aeration; as well as the means by which insects and other microorganisms, which are themselves essential to the health of the soil, can move through it.
- The holes enable Oxygen to get into the soil and beneficial organisms to grow. The Oxygen kills pathogens and pests because they usually require reduced Oxygen conditions to grow.

### 7.4 Organic Matter

- Soil is improved by the addition of organic matter. Organic matter helps stimulate microorganism activity, gives nutrients to the soil, improves the structure and helps with moisture retention. Cover crops add to the organic matter of the soil, both when living as leaves drop to the floor, and when slashed or allowed to die back, when they form a natural

mulch or compost. Combining cover crops and compost is one of the most efficient ways to maintain soil quality throughout the year.

### **7.5 Suppress Weeds**

- Cover crops are also called ‘living mulches’ because of their ability to suppress weeds. The roots of the cover crops compete vigorously with weeds for available nutrients, depriving the weeds of the elements they need to thrive. The leaves of the cover crops also compete for light and space above ground, typically shading out the weeds so that they cannot photosynthesize effectively. Furthermore, when crops die back or are slashed back, they perform a more conventional mulching function of smothering the weeds and their incipient seeds.

### **7.6 Moisture**

- Planting a cover crop is an effective way to conserve and even increase the moisture content of the soil. Besides preventing runoff by limiting the erosion of the topsoil, the crops do this in two ways. Firstly, simply by providing a cover for the soil, they protect it from evaporation by the sun and the wind. Secondly, many cover crops send down deep roots, which can bring up moisture from lower down in the soil profile.

### **7.7 Nutrients**

- Another benefit, which cover crops bring to the soil, is to add valuable nutrients, such as Nitrogen. Legumes have a special ability to ‘fix’ Nitrogen in the soil. Examples of leguminous cover crops include vetch, field peas, and clover. They have nodules on their roots that provide a habitat for certain Nitrogen-fixing bacteria. Not only does this increase levels of Nitrogen in the soil while the plant is growing, when the plant dies back, the Nitrogen is released into the soil and becomes available for other plants to use. In traditional agricultural methods, the cover crop would be cut down then ploughed into the soil. To avoid this destructive technique, the cut plants can be mulched to quicken breakdown.
- So, if you are planting a food crop in succession after the cover crop, it will have a good nutrient load with which to get started.
- Also, when you germinate a seed and plant it, if the cover crop is already growing, the mycorrhizal fungi will extend to its roots and start to provide nutrients to the main crop. The seed will then grow much more quickly.

### **7.8 Less Work**

- Cover crops also save time and energy. Given all the nutrients that they provide to the soil, there is no need for composting or mulching. This makes cover crops a good option when looking to improve the soil quality of a large area.

### **7.9 Biodiversity**

- Instituting cover crops adds to the biodiversity of your permaculture plot. All species of plants have their own unique characteristics, including how they interact with other plants (such as providing shade or fixing Nitrogen) and organisms (such as attracting beneficial insects, or repelling insects that could damage neighbouring specimens). The cover crops can also attract wildlife to your fields or garden, by providing habitat, feeding opportunities (on insects attracted by the plants, for instance), and protection from the elements and predators.

### **7.10 Insects**

- This biodiversity is a major part of attracting a wide variety of insects. By planting cover crops rather than leaving bare earth, you will attract more species of insect. Some insects will predate on others and so prevent populations booming which may impact upon your crop yield. Attracting insects also increases the number of pollinators, helping propagate your plants.
- The increased organic matter and nutrients in the soil also feed beneficial microbes that can keep fungal and bacterial infections in check, and limit the number of nematodes that feed on plant roots and stems, and which can carry viruses that they transmit to the plants.

## **8. Mulching - Benefits of Mulching the Soil**

### **8.1 What is Mulching?**

- Mulching is one of the most important ways to maintain healthy landscape plants. A mulch is any material applied to the soil surface for protection or improvement of the area covered.
- Mulching is really nature's idea. Nature produces large quantities of mulch all the time with fallen leaves, needles, twigs, pieces of bark, spent flower blossoms, fallen fruit and other organic material.

### **8.2 Benefits of Mulching**

- When applied correctly, mulching has the following beneficial effects on plants and soil:
  - Mulches prevent loss of water from the soil by evaporation.
  - Mulches reduce the growth of weeds, when the mulch material itself is weed-free and applied deeply enough to prevent weed germination or to smother existing weeds.
  - Mulches keep the soil cooler in the summer and warmer in the winter, thus maintaining a more even soil temperature.
  - Mulches prevent soil splashing, which not only stops erosion but keeps soil-borne diseases from splashing up onto the plants.
  - Organic mulches can improve the soil structure. As the mulch decays, the material becomes topsoil. Decaying mulch also adds nutrients to the soil.
  - Mulches prevent crusting of the soil surface, thus improving the absorption and movement of water into the soil.
  - Mulches prevent the trunks of trees and shrubs from damage by lawn equipment.
  - Mulches help prevent soil compaction.
  - Mulches can add to the beauty of the landscape by providing a cover of uniform colour and interesting texture to the surface.
  - Mulched plants have more roots than plants that are not mulched, because mulched plants will produce additional roots in the mulch that surrounds them.

### **8.3 How to Apply Mulch**

- Before applying any type of mulch to an area, it is best to weed the area. Spread a layer of mulching materials over the entire plant bed. Keep mulch 2 to 3 inches away from the stems of woody plants. This will prevent decay caused by wet mulch.
- Newly planted trees require a circle of mulch 3 to 4 feet in diameter. Maintain this for at least three years. Do not pile mulch against the trunk.
- For established trees in lawns create a circle of mulch about 2 feet in diameter for each inch of trunk diameter. Increase the size of the mulched area as the tree grows.
- Try to apply the mulch at least 6 to 12 inches beyond the drip-line of the tree. Because the root system can extend 2-3 times the crown spread of the tree, mulch as large an area as possible.

### **8.4 How Deep to Mulch**

- The amount of mulch to apply depends on the texture and density of the mulch material. Many wood and bark mulches are composed of fine particles and should not be more than 2 to 3 inches deep. Excessive amounts of these fine-textured mulches can suffocate plant roots, resulting in yellowing of the leaves and poor growth.
- Coarse-textured mulches such as pine bark nuggets and straw allow good air movement through them and can be as deep as 4 inches. 4 inches will stop weeds growing.
- Mulches composed of grass clippings or shredded leaves should never be deeper than 2 inches, because these materials tend to mat together, restricting the water and air supply to plant roots.



## **Part 9**

### **Seed Preparation**

#### **1. How to Germinate Vegetable Seeds**

##### **1.1 Method 1 – The Common Approach**

- Put the seeds in a plastic bag or a container. Soak them for 24 hours in warm water. For small seeds, such as flower seeds, 12 hours is usually enough. The container of water only needs to cover the seeds 3 inches. Place a cloth over the top to increase the warmth during the soaking. Keep the seeds in a warm place out of direct sunlight. Soaking them will speed up germination in the soil.
- If you are soaking a lot of seeds, soak the seeds in water that contains 20 cc of Bio-Plant per 20 litres. (The ratio is 10 cc per 10 litres of water.) If the amount of seeds is small, reduce the water to just a few litres. It does not have to be exactly 20 cc, so do not worry.
- After soaking, plant the seeds as soon as possible in a seed potting soil tray where there is potting soil in each small section of the tray. Usually you would place one seed per small hole or two seeds, if the hole is large, but you can space 20 or more seeds in the same 1.5 – 2-inch hole. Then cover them over with more soil and water them.



Seed Planting Tray  
with Sections.

- If you do not have a tray with holes for the individual seeds, place them in a flat tray. Put some newspaper on the bottom and cover the newspaper with potting soil. Use a stick and create a small ditch about 0.5 cms. deep from one side of the tray to the other. Place the seeds in the ditch and then cover them over with a little soil.



Flat Tray with Ditches

- It is beneficial to spray the potting soil before use with water mixed with Bio-Plant (at a ratio of 20 cc of Bio-Plant in 20 litres of water).
- Cover the soil with wet paper or a wet cloth. Leave them for about 5 days until the seedling has penetrated the surface, grown 2-3 inches, and formed some good roots, and will soon be

too large for its growing space. Then plant each sprouted seedling in an individual pot or black plastic planting bag.

- Once your seedlings have several leaves you will need to move them to a larger pot to give them more room to grow. Let the plant grow for about 22-25 days and become sturdy and leafy before transplanting it into composted furrows in a field.

## 1.2 The Baggy Method

- Another effective way to germinate seeds is to use the “Baggy Method”.
  - a) Wet a paper towel so it is just damp, not wet.
  - b) Place your seeds on 1/4 of the paper towel, then fold the paper in half, then in half again. Your seeds should have one layer of filter on one side, three layers on the other.
  - c) Place the folded paper into the zip lock plastic bag, then seal it, leaving it just slightly puffed, not completely flat.
  - d) Place it in warm place to germinate and wait.
  - e) Check the bag every few days, and remoisten as needed. Do not leave the bag for over a week without opening it for some fresh air.



## 1.3 How to Prepare Rice Seeds

- **Sort the Seeds:** Separate good and bad seeds using the egg floatation technique, as follows:
  - **Step 1:** Fill a container with water, large enough for all your rice seeds.
  - **Step 2:** Place a fresh egg in the water. It will sink to the bottom.
  - **Step 3:** Mix salt with the water until the egg floats.



- **Step 4:** Take out the egg and put in the rice seeds. Swirl the seeds around in the water for a few minutes. The good seeds will sink to the bottom and stay there. The poor seeds will rise to the surface. Scoop them out. Feed them to the chickens.



- **Step 5:** Wash the salt off the good seeds by rinsing them in water 3 times, and then soak these seeds in another container of water for 24 hours.

- **Soak the Seeds for 24 Hours:** Put the seeds in a plastic bag (with small holes punctured in it), or in a sock, a cloth, or sack and tie up the ends so that the seeds cannot escape. Water should be able to enter through holes. Soak them for 24 hours in water that contains 20 cc of Bio-Plant per 20 litres. (The ratio is 10 cc per 10 litres of water.) If the amount of seeds is small, reduce the water to just a few litres. *The amount of Bio-Plant can be increased to between 20 cc and 100 cc for a better effect.* Do not soak them for longer than 24 hours or they might rot. The container of water only needs to cover the seeds 3 inches. Place a cloth over the top to increase the warmth during the soaking.
- Put the sack (or whatever you soaked the seeds in) on the ground for 1-2 days. Keep it out of the sun and in a warm shaded place. Keep the seeds warm. They will germinate. When they have germinated, plant them either in a nursery for about 3 weeks before planting them in a field, or if you prefer, plant the germinated seeds directly in a field.

#### 1.4 How to Prepare Maize Seeds

- Soak the maize seeds in water that contains 20 cc of Bio-Plant per 20 litres for 12 hours before planting. The ratio is 10 cc of each bio-fertilizer per 10 litres of water. If the amount of seeds is small, then reduce the water to just a few litres.
- As you plant the seeds, dip them in Bio-Plant (100 cc of Bio-Plant per 1 kgs of the seeds), and then plant them. You should certainly do this, if you do not soak the seeds.
- Plant the seeds very soon after soaking them as they will start to germinate.

#### 1.5 How to Prepare Orange Seeds

- Soak the orange seeds in water that contains 20 cc of Bio-Plant per 20 litres for 24 hours. The ratio is 10 cc of each bio-fertilizer per 10 litres of water. If the amount of seeds is small, then reduce the water to just a few litres.
- Place them on a very damp paper towel (or cloth) and cover them with a second damp piece of paper. Keep them in a warm area. Keep the paper (or cloth) very moist and they will germinate within 2 weeks.

#### 1.6 How to Prepare Small Seeds

##### Step 1

- Sprinkle small seeds across a paper towel (or cloth) and thoroughly soak the seeds and surrounding material with water mixed with Bio-Plant (at the ratio of 20 cc in 20 litres of water).

##### Step 2

- Wet a second piece of paper and place it over the first, covering the seeds.

##### Step 3

- Leave the seeds soaking for up to 24 hours, checking regularly to see when they begin to swell. Add more water mixed with Bio-Plant (and Pro-Plant, if you wish) to the seeds, if the towel or cloth dries out.
- Once the seeds appear to be approximately double in size and germinating, remove them from the towels or cloth and plant them in potting soil.

#### 1.7 How to Prepare Hard-Shelled Seeds

##### Step 1

- Large seeds or seeds with particularly hard coats can benefit from scarification before soaking. Scarification means to damage the seed coat in some way so that the water is better able to penetrate the seed. Scarification can be done through several methods. These include rubbing



the seed on fine grain sand paper; shaking them in a tin lined with sandpaper; using a nail file; nicking the seed coat with a knife or nail clippers; or gently tapping the seed with a hammer to help crack the seed coat.

- If a seed is big and you cannot dent it with a fingernail, use a knife. A small, sharp, pocketknife blade or a rat-tail file is ideal. Do not go at it too zealously. You need to remove only a very small slice or section of the seed coat. You can also line a jar with a sheet of sandpaper cut to fit, screw on the lid, and shake the jar like a maraca until the seed coats are abraded. Scarify seeds just before planting. Seeds nicked too long before planting may dry out and be worthless when they finally reach the soil.
- Scratching the surface of seeds that have hard casings cuts through the layers of the tough outer coating and allows water to penetrate the seed and end the seeds' dormant phase. This only needs to be done at one location on the seed.
- **Mango Seeds:** In the case of a mango seed, dry the seed for 2 days or more in a cool location away from direct sunlight. Cut the husk at the stalk end of the mango to create a small slit. Open the seed with a sharp knife, as you would shuck an oyster, being careful not to cut too deeply and damage the enclosed seed. Pry the shell of the seed open and remove the seed, which resembles a large lima bean.



## Step 2

- Place the seeds into a bowl of water mixed with Bio-Plant (and Pro-Plant, if you wish) for about 24 hours prior to planting in potting soil.
- If you are planting several mango seeds, plant them next to each other, about a centimetre apart. The seeds are kidney-shaped. Plant the seed on its edge with the concave edge facing downwards.



- Leave part of the top of the seed uncovered. If in a few days the seed is green, it means it is healthy and should grow well. If the seed is brown or black, it is probably rotting and can be removed and replaced with another seed. Once the seed has germinated and the growth is good, it is ready to be transplanted into a pot.



## **Part 10**

### **How to Apply Pro-Plant**

#### **1. Guidelines for How to Spray Pro-Plant**

**1.1 In the Case of Plants in a Field:** Spray the leaves with water that contains a ratio of 20 cc of Pro-Plant per 20 litres of water. For grapes, increase this to 30 cc in 20 litres of water.

- For a hectare, mix 500 cc of Pro-Plant with 500 litres of water. For an acre, mix 250 cc of Pro-Plant with 250 litres of water. For half an acre, mix 125 cc of Pro-Plant with 125 litres of water. For 200 sq.m. mix 35 cc with 35 litres of water. For an area of 10 metres x 10 metres (100 sq.m.) mix 20 cc in 20 litres of water.
- Spray the leaves before 9 a.m. when the stomata pores are open most. Direct the spray onto the leaves as well as diagonally upwards so that the spray hits the underside of the leaves because this is where the pores (stomata) are. Make sure that the spray is a very fine, misty, foggy kind of spray. Be thorough and generous when you spray.
- Spray on top of the leaves as well because the micro-organisms in Pro-Plant will coat the leaves and protect the plant from fungal diseases.
- By spraying Pro-Plant the nutrients will be available immediately and much more quickly by means of solid fertilizer through the roots, which takes at least a week.
- Spray the leaves, buds, flowers, fruit, and the vegetables – not only the leaves. Continue spraying until a week before the vegetables (or fruit) are harvested.

**1.2 In the Case of Seedlings in Black Polybags:** After the seeds have germinated, they will be transplanted on about Day 3 to black bags with soil where they will usually grow for about 22-25 days before being transplanted to a field. Spray them every 7 days once they are in the plastic bags. The ratio is 20 cc of Pro-Plant per 20 litres of water, but you will not need to spray much of the mixture because of the size of the seedlings.

#### **1.3 How Much to Spray per Plant**

- When plants are very small you do not need to spray much of the Pro-Plant / water mixture. But as the plant grows spray a bit more. In the case of a tree you will probably spray 1-2 litres of Pro-Plant mixed with water per tree, depending on its size. The key point is to cover as many of the leaves as possible with the spray.

#### **2. Examples of When to Spray Vegetables**

##### **a. Lettuce or Other Small Vegetables (*See page 64 for examples.*)**

- Lettuce takes 45-55 days from seed. Spray it every 7 days from Day 7 after germination and transplanting into the soil in black plastic bags.
- Continue spraying every 7 days when the lettuce (or any other 45-day to roughly 75-day small vegetables) has been transplanted into a field. Spray on Days 7, 14, 21, 28, 35, 42, etc.
- Continue spraying until a week before harvest. If you spray with a hazy spray, you can be more economical when spraying Pro-Plant.

##### **b. Maize**

- Spray Pro-Plant mixed with water onto the leaves on Day 21, 30, 40, 50, 60, and 70. This is for the 80-day variety of maize.
- If the crop is the 90-day kind, spray also on Day 80.
- If the crop is the 110-day or 120-day kind, spray also on Day 80 and Day 90. As a guideline, make the last spray 20 days before harvest in the case of varieties over 90 days.

**c. Beans**

- Spray the plants every 7-10 days from Day 7 after germination and transplanting into the soil in black plastic bags. Spray on Days 7, 14, 21, 28, 35, 42, etc. Continue when the plants are in a field, and continue spraying every 7-10 days until a week before harvest. Spraying every 7 days provides more nutrients to the plants than 10 days. If the crop duration is under 70 days, spraying every 7 days would be best.

<b>Vegetables</b>	<b>Days from Seed to Harvest (Depends on the Variety)</b>
Beans, broad	75 - 85 days
Beans, green, bush	48 - 60 days
Beans, green, runner	62 - 68 days
Beans, Lima, bush	65 - 78 days
Beans, Lima, pole	78 - 90 days
Beetroot	56 - 70 days
Broccoli	55 - 75 days
Brussels Sprouts	80 - 100 days
Cabbage	65 - 120 days
Carrot	80 - 120 days
Cassava	180 - 210 days
Cauliflower	75 - 85 days
Cucumber	60 - 70 days
Celery	90 - 125 days
Chilli	65 - 80 days
Chinese Cabbage	70 - 90 days
Eggplant	60 - 70 days
Kale	55 - 60 days
Kohlrabi	50 - 60 days
Leek	110 - 120 days
Lettuce, butter	45 - 70 days
Lettuce, head	50 - 80 days
Maize (Sweet)	85 - 90 days
Maize (Animals)	110 - 120 days
Marrow, baby	34 - 50 days
Marrow, large	70 - 80 days
Melon, musk/sweet	80 - 110 days
Okra	50 - 60 days
Onions	90 - 100 days
Parsley	70 - 80 days
Pea, green	60 - 80 days
Pechay	30 - 34 days
Pepper, sweet	65 - 80 days
Potato	90 - 120 days
Pumpkin	110 - 120 days
Radish	20 - 30 days
Soya Beans	45 - 65 days
Spinach	34 - 50 days
Squash	50 - 60 days
Sweet Potato	100 - 120 days
Tomatoes	75 - 90 days
Turnips	65 - 75 days
Watermelon	75 - 95 days
Zucchini	45 - 50 days

## Part 11

### Using the Bio-fertilizers for Growing Rice

#### **1. Soil Preparation**

##### **1.1 Make Compost**

- See the **Compost and Soil Preparation Methods** guidelines in Part 8 on page 43. Method 2 on page 55 is better than Method 1 because the soil preparation uses bio-compost made over about 7 weeks.
- Use compost or manure to add nutrients to the field. Soil that is enriched with compost or manure will usually have better structure so that plant roots can grow more easily in the soil. Compost releases its nutrients more slowly than does chemical fertilizer so plants get more benefit from this source of nutrients.
- Making compost and working it into the soil of the field is usually a lot of work. But experience shows that this is a good investment for the farmer because the better quality soil supports better root growth and performance. Adding chemical fertilizer is not as good as adding organic material to the soil.

##### **1.2 Plough the Rice Fields**

- Plough the fields roughly after the harvest. Plough in the rice stubble. Leave the fields dry for 15-30 days. This helps to kill weeds.
- Then, soak the soil with water for 7-10 days so that the weeds and the remaining rice seeds germinate. After that, roughly plough the fields for the second time.
- Leave the fields saturated with water for 10-15 days. It takes 5-7 days for weed seeds to germinate after being soaked in still water. This is intended to let any further remaining weed seeds germinate again.
- Then, repeat the ploughing and level the land. Drain the water out until the level of water is shallow enough to see whether the land is even or not. If there are any parts that are not level to others, then these sections should be adjusted. This will also help control the amount of water required with more efficiency and ease.

##### **1.3 Upland Rice**

- In general, compost is quite sufficient as a source of nutrients. Chicken manure, for example, is very rich in nutrients. Consequently, apply at least 5 MT of compost mixed with Bio-Plant to each hectare before planting upland rice.
- Farmers have found that they get best results by working compost made from diverse sorts of biomass into the soil during the preceding cultivation season, when they are growing a crop between their rice crops, such as potatoes or beans or onions. The compost applied to the second crop between the rows of rice helps that rice crop to grow better, and the further decomposition of the compost provides adequate nutrients for the rice crop that follows.
- **Method 1:** To prevent weeds growing by smothering them, and to provide the soil with Nitrogen and nutrients, a cover crop should be planted after the rice harvest. The rice should be planted when the cover crop has died down. The space between the rows of rice should be mulched with the remains of the cover crop.
- **Method 2:** Often upland rice farmers plant a cover crop, such as beans, 2 months after planting their rice or maize crop. The crop should be well-established before the cover crop is planted. When the farmers prepare the soil to plant rice again, the bean cover crop has died down already, and it is cut to provide mulch between the rows.
- **Method 3:** A living mulch, such as clover, is planted between the rows of rice or maize. Clover, beans, legumes, and peanuts can be planted with rice and maize because they do not compete for light. Beans have deep roots while upland rice has shallow roots, so there is little competition for nutrients.

- The main crop may have a lower yield than if it is grown on its own with mulching and no cover crop, but the yield of the two crops together, such as beans and maize, will be higher than just one crop, e.g. maize, on its own,
- Before the introduction of chemical agriculture and monocropping, planting 2 crops together was normal. A diversity of crops increases plant health.

## 2. Seed Preparation

- See the **Seed Preparation** guidelines on page 60.

## 3. Growing Seedlings With the Modified Mat Nursery Method

- To increase the yield, you could use the modified mat nursery, in order to produce seedlings, as follows.

### a. **What is a Modified Mat Nursery**

- A modified mat nursery establishes seedlings in a layer of soil mix on a firm surface. Seedlings are ready for planting within 15–20 days after seeding (DAS).

### b. **Why Use a Modified Mat Nursery?**

- The modified mat nursery uses less land; it can be installed closer to the house than traditional field nurseries; and it uses less labour for both transporting seedling mats and replanting. As a result, root damage is minimal while separating seedlings.
- **Limitation:** The system is best suited for irrigated areas. If transplanting is delayed, the seedlings can be damaged when separated for planting.

### c. **How to Establish a Modified Mat Nursery?**

**Note:** The numbers correspond to the photographs on the next page.

1. **Seed:** To plant 1 hectare (with 2 seedlings/hill at 25 x 25 cms. spacing), use 18–25 kgs good quality seeds. Well sorted seeds result in more uniform germination, vigorous seedlings, less replanting, fewer weeds, and 5%–20% increase in yields.
2. **Nursery Area:** Prepare 100 m<sup>2</sup> nursery for each 1 hectare to be planted. Select a level area near the house and/or a water source. If the area is not sufficiently compacted, then spread a plastic sheet or banana leaves on the marked area to prevent roots growing into soil.
3. **Soil Mixture:** Four (4) m<sup>3</sup> of soil mix is needed for each 100 m<sup>2</sup> of nursery. Mix 70–80% soil + 15–20% well-decomposed organic manure + 5–10% rice hull or rice hull ash.
4. **Pre-germinate the Seeds:** Soak the seeds for 24 hours (some varieties may need longer to bud). Drain and incubate (cover and keep moist) the soaked seeds for another 24 hours in a sack. In this time, the seeds will germinate and the first seed root grows to 2–3 mm long.
5. **Lay the Soil Mixture:** Place a wooden frame of 0.5 m long, 1 m wide and 4 cms. deep, divided into 4 equal segments on the plastic sheet or banana leaves. Fill the frame almost to the top with the soil mixture.
6. **Sow the Seeds:** Sow the pre-germinated seeds uniformly and cover them with a thin layer of dry soil. (Approximately 1 seed/cm<sup>2</sup> or about 200 grams for every 3 square meters.)
7. **Soak the Seedbed:** (a) Sprinkle water immediately to soak the bed. (b) Remove the wooden frame. Fill with the soil mix if the seeds become exposed.
8. **Water:** Water the nursery as needed to keep the soil moist. Protect the nursery from heavy rains for the first 5 days after seeding (DAS). If the nursery can be flooded then at 7 DAS, maintain a 1 cm water level around the mats. Drain the water two days before removing the seedling mats for transplanting.
9. **Fertilizer Application:** Spray Pro-Plant (20 cc in 20 litres of water) once or twice every 7-10 days while the seedlings are growing.
10. **Lift the Seedling Mats:** Transplanting should be done when the seedlings have just two leaves, and before they have more. This usually occurs between 8 and 15 days. Lift the seedling mats and transport them to the main field



## The Modified Mat Nursery



The frame is shown being placed on a mat made of banana leaves.



The rice seedlings in the mat nursery are ready for transplanting.

#### 4. Sowing the Seeds: Sowing by Throwing the Seeds

- We do not recommend this method of sowing seeds, especially as it makes weeding very difficult indeed. But if the farmers really want to sow the seeds by broadcasting the seeds, they should flood the field with water about 15 cms. deep first and then sow the seeds. Then they should let the water flow out once the seeds have settled into the mud. This stops the birds eating the seeds.

#### 5. How to Get Plants to Produce More Tillers?

- The key to success with SRI is the early transplanting of seedlings, as explained below. This usually means transplanting seedlings before they are 15 days old, and as early as 8 or 10 days - when only the first small root and tiller, with two tiny leaves, have emerged from the rice seed. When you plant older seedlings, i.e. 3, 4, 5 or 6 weeks old, they have already lost much of their potential to produce a large number of tillers.



- When seedlings are planted with much delay after being removed from the nursery, they suffer a lot. Once removed from their seedbed, seedlings should be replanted in the field within half an hour, and preferably within 15 minutes.
- When seedlings are pushed into the ground, rather than gently laid into the soil, they also must expend a lot of energy to resume root growth. This disturbs their development.
- Transplanting rice seedlings early and carefully helps plants resume their growth in the field without reducing their potential for high yields by harvest time.

#### 6. How Can We Get Rice Plants to Grow Stronger Roots?

- Plant single seedlings, one by one, rather than plant them together in bunches of 3 or 4 seedlings, or even more, as is usually done. When several seedlings are planted together, their roots must compete with each other. This is a similar problem for rice plants as when they grow close together with weeds and must compete with them for nutrients, water and sunlight.
- It is important, as discussed below, that the seedlings be spaced wide apart, usually at least 25 centimeters from each other, and preferably in a square pattern. This facilitates weeding at the same time it gives the rice more access to sunlight and air above ground.





- Spacing is a variable to be tested and evaluated. It is usually best to start with 25 x 25 cms. spacing, possibly increasing the distance between plants as farmers' gain skill and confidence, and as soil fertility is enhanced by compost.
- When the rice plants are set out far from each other, and if the soil conditions are good, their roots will have plenty of space to spread out into, especially when they are not competing with each other.
- With wider spacing and with single planting, there will be many fewer plants in a field. Indeed, there may be only 10 or 16 in a square meter instead of 50 or 100. The highest yield has been achieved with only 4 plants per square meter, spaced 50 cm by 50 cm so the plants grow like bushes. Wide spacing saves seed - as much as 100 kilograms per hectare - at the same time that it contributes much greater production at harvest time because the rice plants produce many more tillers and grains.
- Planting seedlings with precise spacing can be one of the more difficult aspects of SRI at the beginning, when farmers are not used to this.

#### • **Seedling Spacing Methods**

Two different methods have been developed:

1. Farmers can stretch strings across their field, tied to sticks stuck into the bund at the edge of the field, spaced at 25, 30 or more centimeters, with the strings marked (knotted or painted) at whatever interval has been chosen (25, 30, or more centimeters), and then these sticks and strings (parallel to each other) are moved across the field; or...
  2. A kind of "rake" that has teeth the desired distance apart (25, 30 or more centimeters) can be constructed simply from wood. It is pulled across the surface of the prepared muddy field, scratching lines onto the surface at desired intervals. Drawing the rake across the first set of lines perpendicularly (at a right-angle) to them creates the desired square pattern, on which seedlings are planted at the intersections of lines.
- The first method is more precise but the second is quicker and saves considerable labour time.

#### 7. **Mortality of Seedlings**

- Farmers are often worried, when planting, about some seedlings dying. In fact, with SRI methods there is very little mortality, maybe 2%, so that it is not worth the effort to replace them, as surrounding plants grow a little larger to take advantage of the open area. Farmers who are concerned should plant some seedlings along the edge of the field that they can transplant into any vacant spaces at the time of the first weeding.

#### 8. **Planting Seedlings**

- A very important influence on the size and health of the roots is how the tiny seedlings are placed into the soil when they are transplanted.
- When seedlings (or the clump of several seedlings) are thrust straight downward into the soil, the tips of their roots will be pointed up toward the surface. The shape of the transplanted seedling will be like a J, with its root bent upward.



- The rice plant root grows from its tip. If the tip is pointing upward, the root must change its position in the soil to get the tip pointed downward before it can resume growth. This requires a lot of energy and effort from the tiny root, at a time when it is still weak after transplanting, especially if it has been allowed to dry out by delay in getting it from the nursery and into the field.
- With SRI, one does not thrust seedlings downward into the soil. Rather, each seedling is slipped sideways into the soil, very gently and close to the surface, so that its root lies horizontally in the moist soil. This makes the shape of the transplanted seedling more like an L than like a J. With this shape, it is easier for the tip of the root to grow downward into the soil. When the plant is shaped more like an L than a J, less energy is necessary for the plant's root to start growing quickly downward and to begin putting out more roots at the same time that it is sending tillers upward.

## 9. Weeding

- A very simple mechanical weeder, called a rotating hoe, pushed by hand has been developed to enable farmers to eliminate weeds easily, quickly and early. It reduces the hard labour of pulling up individual weeds by hand once they emerge. The weeder, by churning up the soil, destroys weeds before they absorb many nutrients. By leaving them on the soil to decompose, it returns their nutrients to the soil.
- This weeder, which has rotating wheels mounted vertically in the metal plate that is pushed along the ground, is not expensive. It can cost as little as US\$5, if locally made.
- It may take as much as 25 days of labour to weed a hectare of rice. However, each weeding can add one ton or even two tons of production to the yield, so that the payoff to the farmer from each additional weeding can be very great.



- The first weeding should be within about 10 days after transplanting, and at least one more weeding should follow within two weeks. This will dig up weeds at the same time that it puts more air into the soil for the roots to utilize.
- Doing one or two additional weedings (3 or 4 weedings in all), before the plants have completed their growth and begin flowering, will provide still more oxygen to the soil. This is more important than removing any remaining weeds. Extra weedings can greatly increase yields.

## 10. Spraying Pro-Plant

- (See *Part 9. How to Apply Pro-Plant* on page 64.)



## 11. Guidelines for 100% Organic Farming

Crop Variety	Soil and Seed Preparation with Bio-Plant (1 Hectare)	Application of Pro-Plant During Crop Growth
Rice	<ol style="list-style-type: none"> <li>1. <b>See 1.1 Compost and Soil Preparation Methods (Land Area 1 Hectare)</b> in Part 8 on page 43, especially Method 2 on page 55. Prepare the soil with a lot of organic waste matter (at least 5 MT per hectare). Basically, use as much organic matter as you can. The more there is, the more the micro-organisms can turn it into a “factory” producing more and more micro-organisms.</li> <li>2. Add 500 cc of Pro-Plant per hectare, if the soil is short of minerals.</li> <li>3. Leave the soil for 14 days before planting the crop so that the micro-organisms have longer to multiply and fertilize the soil. Water the soil every 7 days while it is under preparation.</li> </ol> <p><b>Note:</b> In actual practice, rice farmers tend to prepare the soil by ploughing in the rice stems. Then they cover the soil with 3 MT of chicken dung and cow manure, the more the better. This should add up to 5 MT.</p> <ol style="list-style-type: none"> <li>4. <b>Seeds:</b> Put the seeds in a cloth or bucket and soak them for 24 hours. Soak the seeds in water that contains 20 cc. of Bio-Plant and 20 cc. of Pro-Plant per 20 litres. This is enough for each 20 kgs of seeds. <i>The amount can be increased to 100 cc of Bio-Plant for a better effect.</i> Then leave them for 2 days in a sack to germinate and then sow them the same day.</li> </ol> <ul style="list-style-type: none"> <li>• When the farmers sow the seeds, they flood the field with water and then sow the seeds. Then they let the water flow out at once. This stops the birds eating the seeds.</li> </ul> <p><b>Notes About Actual Practice in Vietnam</b></p> <ul style="list-style-type: none"> <li>• When the farmers release water into the fields every 2 weeks they mix 500 cc of Bio-Plant with each 500 litres of water, which is enough for 1 hectare. In other words, they add additional Bio-Plant during the crop, which is a good idea.</li> </ul>	<ol style="list-style-type: none"> <li>1. Day 1: No need to spray when the farmers plant the seeds as the seeds have been soaked in the bio-fertilizers. Apply the water mixture to the soil after soaking.</li> <li>2. Spray on Day 15 (Optional): Equals 500 cc in 500 litres of water per hectare.</li> <li>3. Spray on Day 30: Equals 500 cc in 500 litres of water per hectare.</li> <li>4. Spray on Day 34: Equals 500 cc in 500 litres of water per hectare.</li> <li>5. Spray on Day 50: Equals 500 cc in 500 litres of water per hectare.</li> <li>6. Spray on Day 60: Equals 500 cc in 500 litres of water per hectare.</li> <li>7. Spray on Day 70: Equals 500 cc in 500 litres of water per hectare.</li> </ol> <p><b>Note:</b> If the rice is the 110-day kind, then also spray on Days 80 and 90.</p> <p><b>Very Important Note:</b> Please spray Pro-Plant using spraying equipment that gives a fine, misty spray, and that the spray is directed diagonally upwards so that it hits the pores of the leaves underneath as well as lands on the leaves. Spray the leaves well and ideally before 9 a.m. when the leaf pores are open most.</p>

Crop Variety	Soil and Seed Preparation with Bio-Plant (1 Acre)	Application of Pro-Plant During Crop Growth
Rice	<ol style="list-style-type: none"> <li>1. <b>See 1.1 <u>Compost and Soil Preparation Methods</u> (Land Area 1 Acre)</b> in Part 8 on page 43, especially Method 2 on page 55. Prepare the soil with a lot of organic waste matter (at least 2.5 MT per acre). Basically, use as much organic matter as you can. The more there is, the more the micro-organisms can turn it into a “factory” producing more and more micro-organisms.</li> <li>2. If the soil is weak in micro-organisms and nutrients, spray 500 cc of Bio-Plant mixed with about 500 litres of water over the organic matter once it has been laid over the ground.</li> <li>3. Add 250 cc of Pro-Plant if the soil is short of minerals.</li> <li>4. Leave the soil for 14 days before planting the crop so that the micro-organisms have longer to multiply and fertilize the soil. Water the soil every 7 days while it is under preparation. <b>Note:</b> In actual practice, rice farmers tend to prepare the soil by ploughing in the rice stems. Then they cover the soil with 3 MT of chicken dung and cow manure, the more the better. This should add up to 5 MT.</li> <li>5. <b>Seeds:</b> Put the seeds in a cloth or bucket and soak them for 18-24 hours (no longer). Soak the seeds in water that contains 20 cc. of Bio-Plant and 20 cc. of Pro-Plant per 20 litres. This is enough for each 20 kgs of seeds. <i>The amount can be increased to 100 cc of Bio-Plant for a better effect.</i> Then leave them for 2 days in a sack to germinate and then sow them the same day. <ul style="list-style-type: none"> <li>• When the farmers sow the seeds, they flood the field with water and then sow the seeds. Then they let the water flow out at once. This stops the birds eating the seeds.</li> </ul> <p><b>Notes About Actual Practice in Vietnam</b></p> <ul style="list-style-type: none"> <li>• When the farmers release water into the fields every 2 weeks they mix 500 cc of Bio-Plant with each 500 litres of water, which is enough for 1 hectare. In other words, they add additional Bio-Plant during the crop, which is a good idea.</li> </ul> </li> </ol>	<p>Day 1: No need to spray when the farmers plant the seeds as the seeds have been soaked in the bio-fertilizers. Apply the water mixture to the soil after soaking.</p> <ol style="list-style-type: none"> <li>1. Spray on Day 15 (Optional): Equals 250 cc in 250 litres of water per acre.</li> <li>2. Spray on Day 30: Equals 250 cc in 250 litres of water per acre .</li> <li>3. Spray on Day 34: Equals 250 cc in 250 litres of water per acre.</li> <li>4. Spray on Day 50: Equals 250 cc in 250 litres of water per acre .</li> <li>5. Spray on Day 60: Equals 250 cc in 250 litres of water per acre .</li> <li>6. Spray on Day 70: Equals 250 cc in 250 litres of water per acre .</li> </ol> <p><b>Note:</b> For a lower yield, but a higher cost, you can spray every 15 days instead, namely on Day 30, 45, 60, and 75. If the rice is the 110-day kind, then also spray on Days 80, and 90.</p> <p><b>Very Important Note:</b> Please spray Pro-Plant using spraying equipment that gives a fine, misty spray, and that the spray is directed diagonally upwards so that it hits the pores of the leaves underneath as well as lands on the leaves. Spray the leaves well, and ideally before 9 a.m. when the leaf pores are open most.</p>

## 12. **Bio-chemical Farming**

### 12.1 **Soil Preparation**

- See the **Compost and Soil Preparation Methods** guidelines in Part 8 on page 43, especially Method 2 on page 55. Method 2 is better because the soil preparation uses bio-compost made over about 7 weeks.

### 12.2 **Preparing the Seeds (See also pp. 51-52.)**

- Put the seeds in a cloth or sack, tie up the ends. Water should be able to enter through holes. Soak the seeds for 18-24 hours (no longer) before planting in water that contains 20 cc of Bio-Plant and 20 cc of Pro-Plant per 20 litres. (The ratio is 10 cc per 10 litres of water.) If the amount of seeds is small, which will be the case here, reduce the water to just a few litres, but do not reduce the amount of the bio-fertilizers. *The amount of Bio-Plant can be increased to 100 cc for a better effect.*
- Put the sack on the ground for 1-2 days. Keep it out of the sun and in a warm shaded place. Cover the sack with a cloth to keep it and the seeds warm. They will germinate. When they have germinated, plant them either in a nursery for a month before planting in a field or before sowing the seeds in a field. It depends on the local preference.
- **Sowing Seeds:** When the farmers sow the seeds, they flood the field with water about 15 cms. deep and then sow the seeds. Then they let the water flow out once the seeds have settled into the mud. This stops the birds eating the seeds. Plant around 8-10 kgs per section.
- **Planting the Seeds or Seedlings:** Plant the seeds or seedlings in the field 25 cms. apart. The quality will be higher in this way.

### 12.3 **Spraying the Leaves With Pro-Plant**

- See the spraying guidelines on page 64. Be generous when you spray.

### 12.4 **Spraying Pesticides**

- When you spray Pro-Plant the leaves get coated with micro-organisms that protect the leaves from disease. The Bio-Plant strengthens the immune system so that the plants are less susceptible to disease. If there is a need to spray pesticides, please spray them at least 3 days apart from when you apply the bio-fertilizers as the chemicals kill the micro-organisms that are now multiplying in the soil and being sprayed onto the leaves.
- If disease is a problem in the area, add Bio-Plant (5 cc) to the Pro-Plant (20 cc) in 20 litres of water and spray this over the rice.

## Part 12

### Using the Bio-fertilizers for Growing Maize

#### 1. Soil Preparation

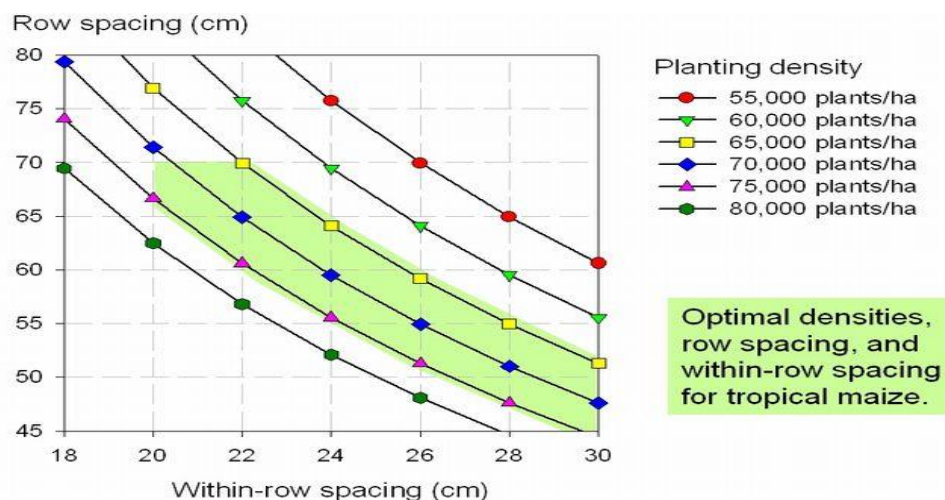
- See the **Compost and Soil Preparation Methods** guidelines in Part 8 on page 43. Method 2 on page 55 is better than Method 1 because the soil preparation uses bio-compost.
- Prepare the soil with at least 5 MT of compost. The healthier the soil, the less chance that you will have disease.
- Plant a cover crop. When it has died down, spray it with Bio-Plant mixed with water and either plough it into the soil or, better because there is less disturbance of the soil, cut it down and plant the maize seeds through the cover crop mulch. If you are going to add 5 MT of compost prepared with Bio-Plant to the soil preparation with the cover crop, there is no need to spray the cover crop with Bio-Plant.
- Add more compost mixed with Bio-Plant around the maize plants after 30 days and 60 days.



**A mulched maize field to suppress weeds and provide nutrients.**

#### 2. Spacing of the Rows and Seeds

- A row spacing of 75 cms. and a spacing between plants of 25 cms. is optimum.





3. **Preparing the Seeds**

- Soak the seeds overnight for about 12 hours, and then dip them in Bio-Plant before planting.

4. **Applying Pro-Plant** (*See Part 9. How to Apply Pro-Plant on page 64.*)

- Spray Pro-Plant generously every 10 days from Day 30 to Day 80. Spray 500 cc per 500 litres of water per hectare. Stop spraying 10 days before harvest. Spray on the leaves and the cobs.
- Alternatively, you could spray every 7 days from Day 7. But do not spray much in Month 1 because the maize plants are small and under 1 meter high. Increase the amount you spray in Month 2 on Days 35, 49, and 56. In Month 3 spray on Days 63, 70, and 77. Spray more than in Month 2. Keep the ratio of Pro-Plant to water the same.

5. **Crop Maintenance and Post-Harvest**

- Remove weeds after 20-30 days and then on Day 60. Ideally, mulch the soil to prevent weeds.



**An un-mulched maize field with a weed problem.**



**A weedy maize field.**

- After the harvest plough in the crop stubble and plant a cover crop for the next season.
- When you cut down (or plough in) the cover crop, spray it with Bio-Plant (500 cc per 500 litres of water per hectare.) to quicken the break-down of the cover crop into soil nutrients.

## Part 13

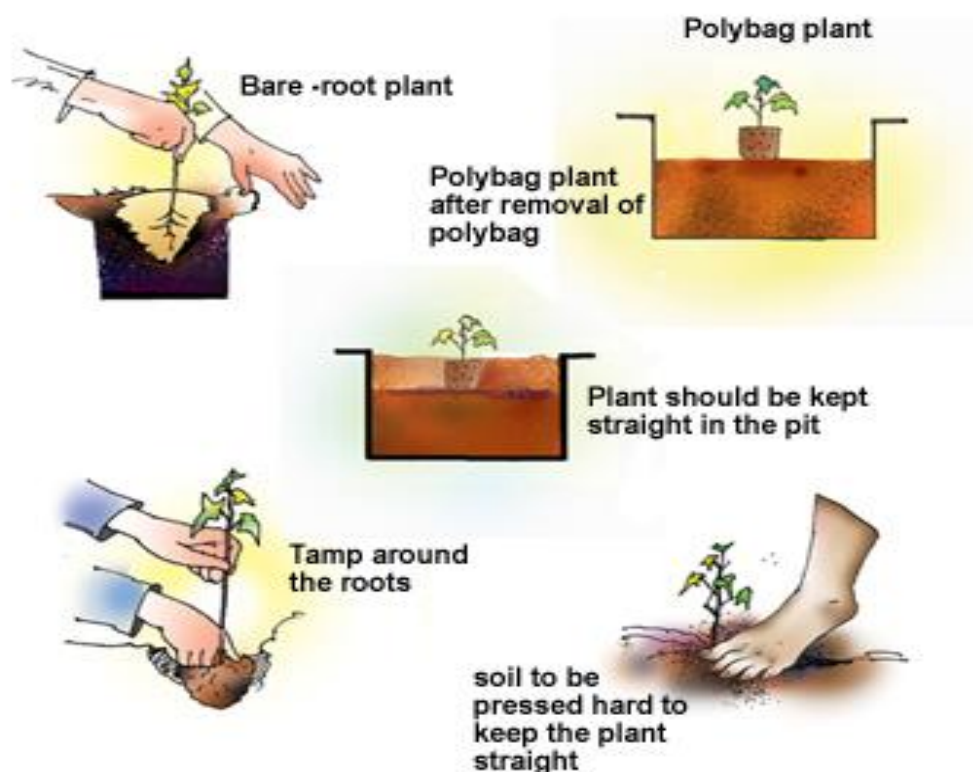
### Using the Bio-fertilizers for Growing Fruit Trees

#### 1. Compost and Soil Preparation Methods

- See the *Compost and Soil Preparation Methods* guidelines in Part 8 on page 43. For trees, you need to prepare bio-compost with Bio-Plant. The Heap Method explains how to do this.

#### 1.1 Planting Saplings

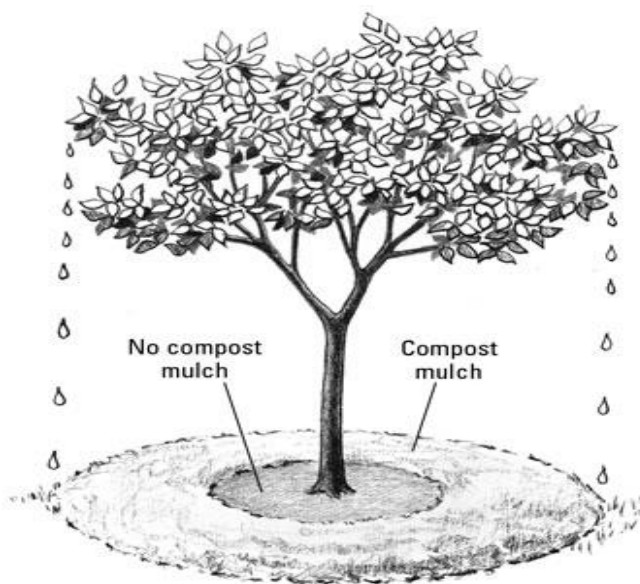
- When planting seedlings in holes, use a 1:1 mixture of bio-compost and soil in the holes. Make the hole about 60 cms. x 60 cms. x 60 cms., and fill the hole halfway up with the mixture. Then spread 5-10 kgs of bio-compost around the sapling while avoiding placing the bio-compost against the stem of the sapling.



#### 1.2 Applying Bio-Plant During the Growth of the Trees

- Once a month place 5-10 kgs around trees which are already growing - a minimum of 5 kgs per tree, if the trees are under 1 metre high, and about 10 kgs around trees over 1 metre in height. But 10 kgs can be applied to trees under 1 meter in height as well. Place 15 kgs, if the soil is very poor or there is a problem with disease.
- If you do not have any bio-compost, pile up leaves around the base of the tree and spray the soil once a month with a mixture of 100 cc of Bio-Plant in 100 litres of water. Pour about 2 litres of the water at the base of each tree where the roots are. (See the diagram on the next page.) Apply this mixture once a month. The Bio-Plant provides extra nutrients by dissolving the leaves. We recommend this because often chemical fertilizers have been used for so long that the micro-organisms in the soil have mostly been killed off, and there is a lack of minor minerals. The farmers need to try to restore the soil as quickly as possible.

- The fallen leaves could be raked into a circle around the tree up to the distance shown in the diagram, and the Bio-Plant could be sprayed on the leaves to help them break down. Bio-Plant's micro-organisms will then have organic matter to multiply in. The farmer should do this once a month, and it is a good idea to continue to do this even after flowering. (See 1.3 below.)



### 1.3 Applying Additional Bio-Plant During the Flowering Stage of the Trees

- When the flowers start to appear, spray the organic matter around the base of the tree (or soil if there is no organic matter around the tree) with 20 cc of Bio-Plant mixed with 20 litres of water. For a hectare, mix 500 cc of Bio-Plant with 500 litres of water. Ideally, spray all of the trees at their base once every 2 weeks once the flowers have appeared instead of once a month.

## 2. Applying Pro-Plant (See Part 9. How to Apply Pro-Plant on page 64.)

### 2.1 General Guidelines

- Spray 20 cc of Pro-Plant in 20 litres of water.
- For a hectare, mix 500 cc of Pro-Plant with 500 litres of water.
- Spray the leaves every 14 days once the leaves have appeared until the flowering stage. Ideally, 2-3 weeks before the flowers appear, spray the leaves and fruit every 7 days. Continue spraying until 7 days before the fruit are harvested.
- Spray the leaves of the trees before 9 a.m. when the pores are open most for better results. Use spraying equipment that gives a fine, misty spray, and that the spray is directed diagonally upwards so that it hits the pores of the leaves underneath as well as lands on the leaves.
- Be generous when you spray a tree. You do not have to spray every leaf.
- If the farmer wishes to spray pesticides, spray them at least 3 days before or after spraying either bio-fertilizer. We encourage farmers not to use chemical sprays, though, as they kill the micro-organisms.

- ### 2.2 If the trees are too tall for spraying the leaves with Pro-Plant, then mix 100 cc of Pro-Plant with 100 litres of water and pour about 2 litres of the mixture about a metre from the trunk of each tree every 2 weeks. If there are 450 trees per hectare, you will need to use a litre of Pro-Plant each time you spray.

## 2.4 For Immediate Use with Fruit Already Growing on the Trees

- If you are just beginning to use Pro-Plant, spray the leaves and fruit with water that contains 30 cc of Pro-Plant per 20 litres of water. When the flowers or fruit are on the trees, spray the whole tree with no less than 30 cc and no more than 35 cc per 20 litres of water. If the flowers have not yet appeared, then spray at the ratio of 20 cc of Pro-Plant per 20 litres of water every 2 weeks.
- For a hectare, mix 500 cc of Pro-Plant with 500 litres of water before the flowers and fruit appear, and 750 cc in 500 litres of water, if the flowers or fruit have appeared. For an acre, mix 250 cc of Pro-Plant with 250 litres of water before the fruit appear and 375 cc in 250 litres of water, if the flowers or fruit have appeared.
- Spray the trees every 7 days once the flowers or fruit have appeared. Spray the leaves and the buds, flowers, or fruit. Continue until a week before the fruit are picked.
- If the farmer wishes to spray pesticides, spray them at least 3 days after spraying either bio-fertilizer.
- **Very Important Note:** Spray Pro-Plant with a fine, misty spray. Spray on the leaves as well as diagonally upwards so that Pro-Plant enters the pores of the leaves underneath as well as on the leaves. Spray the leaves well, and ideally before 9 a.m. when the leaf pores are open most.

## 2.5 Applying Bio-Plant as a Fungicide

- Replace the chemical fungicide you may be using with Bio-Plant mixed with water.
- a. **For Prevention:** Dosage: 5-10 cc/20 litres of water. Spray on the tree. Avoid the leaves as much as possible. (This is to prevent fungus.)
- b. **A Little Fungus:** 10-20 cc/20 litres of water. Spray on the tree, if there is some fungus already. Avoid the leaves as much as possible.
- c. **The Whole Tree Has Fungus:**
  1. Spray 50 cc/20 litres of water only on the branches. Or:
  2. The farmer can scrub or brush on the branches 50 cc/20 litres of water. Avoid the leaves. Spray every 7-10 days for better effect, if the trees have fungus already. When you spray Pro-Plant the leaves get coated with micro-organisms that protect the trees from disease. The Bio-Plant strengthens the immune system so that the trees are less susceptible to disease.
- If there is a need to spray pesticides, please spray them at least 3 days apart from when you apply the bio-fertilizers as the chemicals kill the micro-organisms that will now be multiplying in the soil and being sprayed onto the leaves.

## 3. Preparing the Seeds (See Part 9, *Seed Preparation* on page 60.)

- Normally, when planting small seeds, you should put the seeds in a cloth or sock and soak them in water that contains 20 cc of Bio-Plant and 20 cc of Pro-Plant per 20 litres for 18-24 hours (no longer) before planting. If the amount of seeds is small, then reduce the water to just a few litres. Sow the seeds very soon after soaking as they will start to germinate.
- For large seeds and stones, such as date seeds, mango stones, mix 100 cc of Bio-Plant with 1 kgs of the seeds, then sow the seeds. In the case of small saplings being transplanted, dip the roots in Bio-Plant before planting.
- In the case of mango stones (seeds), they will only grow once water has soaked through their thick skins to the middle. If a seed has a thick coat, it takes longer for the water to get inside and for the seed to start growing. Mango stones are so hard that we must help the water get inside before they will grow. Using a very ripe fruit helps it get started.
- Rub the mango stone lightly with sandpaper. Fill a jar or bowl with water and drop the stone into it. Put the jar or bowl in a warm place and soak the stone for two weeks. Change the water every day so it does not go smelly. If you notice your stone sprouting, take it out of the water and plant it; otherwise plant it at the end of the two weeks.



## Part 14

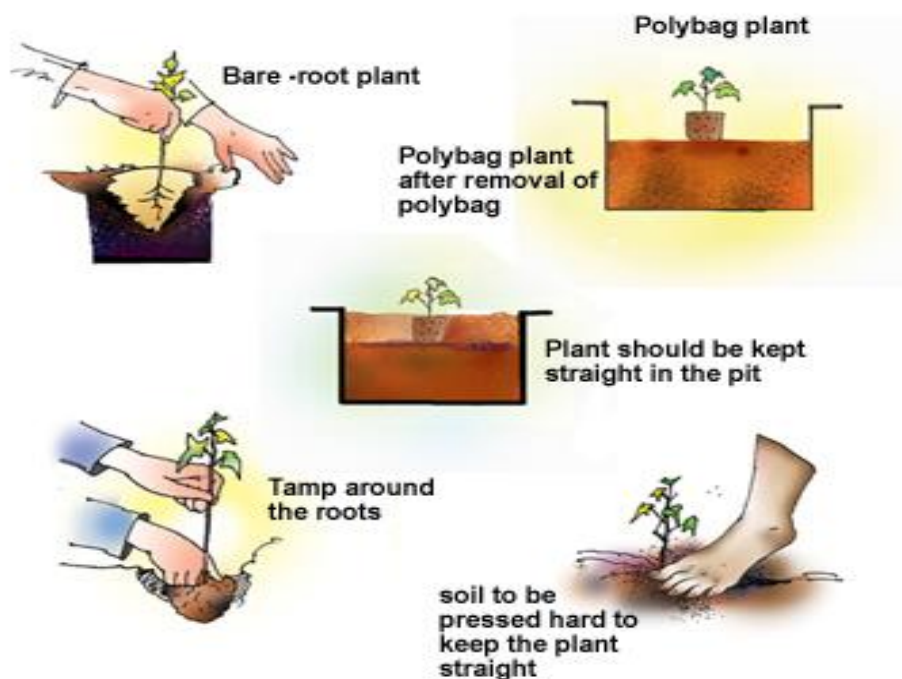
### Using the Bio-fertilizers for Growing Banana Trees

#### 1. Compost and Soil Preparation Methods

- See the *Compost and Soil Preparation Methods* guidelines in Part 8 on page 43. Method 2 on page 55 is better than Method 1 because the soil preparation uses bio-compost.
- Soil preparation with a lot of compost made with Bio-Plant will be invaluable in increasing growth. Prepare the soil with compost made with Bio-Plant. The soil must be soft so that the roots can spread out.
- Make sure that the compost is made with lots of green and dry banana leaves so that the banana trees receive a lot of Potassium as they grow. Also add wood ash for extra Nitrogen.

#### 2. Planting Banana Suckers

- Cut away a sucker from the base of a mother banana tree.
  - Soak the sucker overnight in water, which contains 20 cc of Bio-Plant and 20 cc of Pro-Plant in 20 litres of water. This can be scaled down to 10 cc in 10 litres.
  - Once a month place 5-10 kgs around trees which are already growing - a minimum of 5 kgs per tree, if the trees are under 1 metre high, and about 10 kgs around trees over 1 metre in height. But 10 kgs can be applied to trees under 1 meter in height as well. Place 15 kgs, if the soil is very poor or there is a problem with disease.
  - If you have not made any bio-compost, place organic matter around the base of the tree instead and spray the organic matter with water that contains 20 cc of Bio-Plant per 20 litres of water. Repeat this every month as desired to keep topping up the micro-organisms. If there is disease around, repeat this once a month. Spray about 2 litres on the organic matter and 1 metre around each tree in order to increase the amount of micro-organisms. You will need one litre per hectare.
- The Bio-Plant provides extra nutrients by dissolving the leaves.
- When planting banana suckers in holes, put bio-compost made with Bio-Plant into the holes where the young banana suckers are planted. When planting a tree, make the hole about 60 cms. x 60 cms. x 60 cms., and put into the hole about 10 kgs of compost.



### 3. Mulch the Trees

- Mulch the soil around and between the banana trees to control weeds. You can chop up banana tree trunks and leaves and use them as mulch. Dry coconut fronds, chopped up maize stalks or rice straw, leaves, and other similar materials may also be used as mulch.
- Mulch should be made thick (about 10 cms) so that it will not rot completely within four or five months. Further to protecting the soil from excessive loss of moisture, mulching tends to add some nutrients to the soil from the decaying materials used.



### 4. Applying Additional Bio-Plant During the Growth

- It is a good idea to add more organic matter mixed with Bio-Plant every month during the crop. Once a month place 5 - 10 kgs of bio-compost around the trees (a minimum of 5 kgs if the trees are under 1 metre and about 10 kgs around trees over 1 metre, but 10 kgs can be applied to trees under 1 meter as well).
- If you have not made any bio-compost, place organic matter around the base of the tree instead and spray the organic matter with water that contains 20 cc of Bio-Plant per 20 litres of water. Repeat this every month as desired to keep topping up the micro-organisms. If there is disease around, repeat this once a month. Spray about 2 litres on the organic matter around each tree in order to increase the amount of micro-organisms. You will need one litre per hectare.
- When the purple flower just starts to appear after about 6 months, add more bio-compost each month or spray the organic matter you are placing around the base of the tree (or soil if there is no organic matter around the tree) with 20 cc of Bio-Plant mixed with 20 litres of water. For a hectare, mix 500 cc of Bio-Plant with 500 litres of water and spray all of the trees at their base once every 2 weeks once the flowers have appeared.

### 5. Applying Pro-Plant (See *Part 9. How to Apply Pro-Plant* on page 64.)

- Spray the leaves of the trees. Spray before 9 a.m. when the pores are open most for better results. Please spray Pro-Plant using spraying equipment that gives a fine, misty spray, and that the spray is directed diagonally upwards as well as downwards so that it hits the pores of the leaves underneath as well as lands on the leaves. Be generous when you spray a tree. You do not have to spray every leaf. Spray 20 cc of Pro-Plant in 20 litres of water.
- For a hectare, mix 500 cc of Pro-Plant with 500 litres of water.
- Spray the leaves every 14 days until the flowering stage once the leaves have appeared. When the purple flower appears, spray the leaves and purple section every 7-10 days. When the bananas appear, spray them every 7-10 days. Continue spraying until 7 days before the fruit are harvested.
- If the farmer wishes to spray pesticides, spray them at least 3 days before or after spraying either bio-fertilizer. We encourage farmers not to use chemical sprays, though.
- If there is disease, mix 5 cc - 10 cc of Bio-Plant with 20 cc of Pro-Plant per 20 litres of water. 10 cc is in the case of serious disease. Cut off the affected leaves before spraying.

## **Part 15**

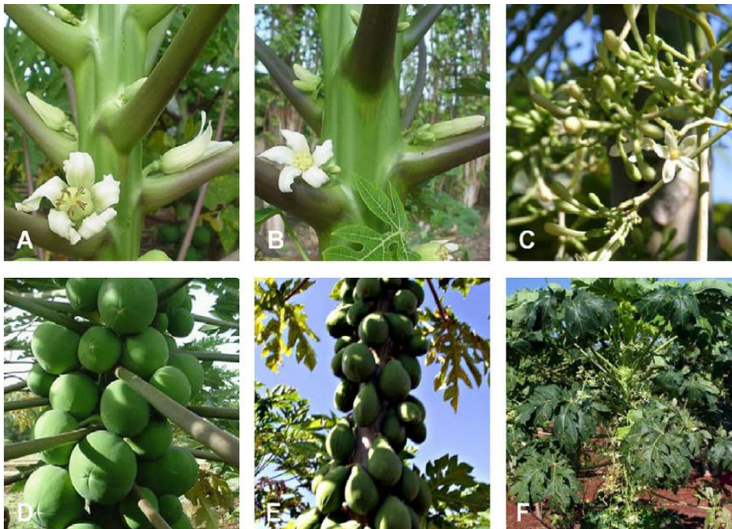
### **Using the Bio-fertilizers for Growing Papaya**

#### **1. Preparing the Soil and Planting the Trees**

- See the *Compost and Soil Preparation Methods* guidelines in Part 8 on page 43. Method 2 on page 55 is better than Method 1 because the soil preparation uses bio-compost.
- Prepare the land by mixing in 5 MT of organic matter and the land for a week to dry and to kill off the weeds.
- Raise the soil 60 cms. Each row of raised soil should be 1.5 metres wide. The trees should be 3 m x 3 m apart, and no less than 2.5 m x 2.5 m.
- Dig holes 50 cms. deep. Separate the top soil from the lower level soil.
- Place 5 kgs of organic matter mixed with Bio-Plant in the hole. Take a young tree from its bag and plant it in the hole. Cover this with the lower level soil from the hole and then put the top soil on top.
- Place 5 kgs or more of compost around the tree. Do not let the compost touch the tree. Add more compost each month.
- Remove the weeds regularly or mulch the trees to prevent weeds growing. 4 inches will suppress weeds.
- Plant banana trees around the papaya field to attract insects away from the papaya trees. They also help to increase the humidity of the papaya field. This helps flowering. Also plant lemongrass between the trees to keep insects away.

#### **2. Preparing the Seeds** (See Part 9, Seed Preparation on page 60.)

- Soak the seeds from a papaya for 24 hours in water mixed with Bio-Plant (20 cc per 20 litres of water).
- Then soak them for a day or two in the fridge. Afterwards, put them in a plastic bag. Take them out one day before planting. Soak them in warm water overnight. Then you will have hermaphrodite seeds (male and female together).
- Put 3-5 seeds in each potting soil bag. Water the bags 2-3 times per day. Keep them in the shade. The seeds will germinate within 15 days. Spray them with Pro-Plant every 7 days during this period.
- Then remove the shade cover. Spray them with Pro-Plant every 7 days. Transplant them when they have 5-6 leaves, which will be between 30-60 days.



The flowers and fruits of male, female, and hermaphrodite papaya. (A) Female flowers; (B) hermaphrodite flowers; (C) male flowers; (D) female fruit; (E) hermaphrodite fruit; (F) male tree

### 3. After Planting

- After about 4-5 months flowers will appear. Inspect the 3 or 4 trees growing together. Remove the male and female trees. Keep the hermaphrodite tree.
- Place 5 kgs or more of compost around the tree each month. Spray Bio-Plant over the compost, if it has not been made with Bio-Plant already.
- You can water the trees for 15-30 minutes every day under the leaves or for an hour every 2 days. Sprinklers are best. If the leaves are pointing upwards, it means that they are receiving enough water, so you can judge how often to water the trees.
- Mix liquid pig dung with the water. Together with the Bio-Plant mixed compost this will ensure that there are lots of leaves and that the fruit is sweet.
- Spray Pro-Plant every 14 days on the leaves. Spray every 7-10 days once you have cut down the male and female trees, which you do not want.
- If you provide the trees with lots of food, there is an 80% chance that the trees will become bisexual.
- If disease appears spray the tree with Bio-Plant (5 cc) and Pro-Plant (20 cc) mixed with 20 litres of water.
- Remove the weeds from around the trees with a hoe. You could mulch the trees by covering the compost with 4 inches of straw in order to prevent weeds growing.
- Provide a support for the trees as they produce fruit.

### 4. Grafting

- Cut a 5 cms. slit upwards on the thicker part of the trunk, place a small twig at the top of the slit, and place a bag with coconut coir soaked in water mixed with Bio-Plant over the slit. After 20 days roots will appear. After 34 days cut the grafted tree just below the roots in the coconut coir. You can then plant or sell the bisexual graft.
- The fruit will appear after 1 month on the grafted trees as opposed to 4-5 months. You can harvest the fruit after 4 months instead of 8 months.
- Instead of cutting down and throwing away the rejected trees at flowering, graft them, and then plant or sell the grafted trees.



**Part 15**  
**Using the Bio-fertilizers for Growing Cocoa Trees**

Stage When to Use the Bio-fertilizers	How to Use Them	Benefits
<b>1. Nursery Stage:</b> Seed Preparation	<ul style="list-style-type: none"> <li>• Soak up to 20 kgs of seeds for 24 hours in 20 litres of water that contains 20 cc of Bio-Plant before planting. Use this ratio for smaller amounts of seeds.</li> <li>• They can be kept in sacks afterwards for up to 48 hours to germinate before planting in black, plastic potting soil bags.</li> </ul>	<ul style="list-style-type: none"> <li>• This softens the seed coat for easy germination.</li> <li>• It also fills the seeds with micro-organisms, which prevent disease, increase the survival rate of the seeds, and enable healthy growth.</li> <li>• This inoculates the seeds against disease and ensures that the trees will become healthy.</li> </ul>
<b>2. Nursery Stage:</b> Planting the Seeds	<ul style="list-style-type: none"> <li>• Make 5 MT of rich bio-compost with Bio-Plant mixed with water. Ratio 1 litre: 1,000 litres of water. (<i>See p. 6.</i>) Leave it for 14 days for the micro-organisms to multiply.</li> <li>• Plant the seeds in black, plastic bags in potting soil made with the bio-compost.</li> <li>• Spray Bio-Plant mixed with water twice daily. When the leaves appear stop spraying Bio-Plant. Spray Pro-Plant on the leaves every 7 days instead. Ratio of 1 litre per 1,000 litres of water.</li> </ul>	<ul style="list-style-type: none"> <li>• Bio-Plant's micro-organisms ensure strong root development; dissolve the nutrients in the soil and from Pro-Plant; make them available to the plant; and fix extra Nitrogen from the air.</li> <li>• Pro-Plant provides the seedlings with over 50 nutrients, including those essential for cocoa trees.</li> <li>• Both develop a strong immune system and protect the seedlings from disease.</li> </ul>
<b>3. Nursery Stage:</b> Growing Seedlings	<ul style="list-style-type: none"> <li>• As the seedlings grow, spray Pro-Plant mixed with water every 2 weeks until they are transplanted into a field.</li> <li>• Spray with a fine, hazy spray before about 9 AM.</li> <li>• Direct the spray diagonally upwards so that the spray hits the underside of the leaves as well because this is where the pores (stomata) are.</li> <li>• Be thorough and generous when you spray.</li> </ul>	<ul style="list-style-type: none"> <li>• Bio-Plant's micro-organisms ensure strong root development; dissolve the nutrients in the soil and from Pro-Plant; make them available to the plant; and fix extra Nitrogen from the air.</li> <li>• Pro-Plant provides the seedlings with over 50 nutrients, including those essential for cocoa trees.</li> <li>• Both develop a strong immune system and protect the seedlings from disease. Pro-Plant coats the leaves with micro-organisms, which prevent disease.</li> </ul>
<b>4. Transplanting</b>	<ul style="list-style-type: none"> <li>• Fill the holes with soil and bio-compost made with Bio-Plant and Pro-Plant. Be generous with the bio-compost. 5 – 10 kgs per tree.</li> <li>• Mulch around the trees, but leave a space between trunk and mulch.</li> </ul>	<ul style="list-style-type: none"> <li>• This will add disease protection and increase the multiplication of micro-organisms around the plant. Bio-Plant's micro-organisms ensure strong root development; dissolve the nutrients in the soil,</li> </ul>

Stage When to Use the Bio-fertilizers	Method	Benefits
	<ul style="list-style-type: none"> <li>Water the base of the trees with a mixture of 1 litre of Bio-Plant in 1,000 litres every 14 days. This could be provided by drip irrigation when the trees are watered.</li> </ul>	<ul style="list-style-type: none"> <li>make them available to the plant; and fix extra Nitrogen from the air.</li> <li>Each month the soil will become more fertile. Fertile soil leads to earlier flowering and fruiting.</li> <li>Mulching will preserve moisture and prevent fungus diseases when rain splashes on the soil.</li> </ul>
<b>5. Planting Shade Trees</b>	<ul style="list-style-type: none"> <li>Provide shade for the sapling.</li> <li>Prepare the soil for the shade trees with compost made with Bio-Plant and Pro-Plant. 1 litre of Bio-Plant and 1 litre of Pro-Plant mixed with 5MT of organic matter. More bio-compost can be added monthly.</li> <li>Spray the leaves of the shade trees with Pro-Plant mixed with water. The frequency depends on the crop.</li> <li>Ratio: 1 litre Pro-Plant mixed with 1,000 litres of water per hectare with 450 trees (2 litres per tree).</li> </ul>	<ul style="list-style-type: none"> <li>This enriches the soil with micro-organisms, increases root development, increases the absorption of nutrients, and strengthens the immune system.</li> <li>Pro-Plant's nutrients are instantly usable by the leaves. Spraying Pro-Plant also adds nutrients to the soil.</li> <li>The cocoa trees will benefit from the extra micro-organisms and nutrients.</li> </ul>
<b>6. Growth Stage:</b> Apply compost made with Bio-Plant	<ul style="list-style-type: none"> <li>Spread 10-15 kgs of compost around the base of each tree on a regular basis, ideally once per month.</li> <li>Alternatively, mulch leaves around the trees, and place compost in a trench either close to a row of trees, or in the middle between two rows.</li> </ul>	<ul style="list-style-type: none"> <li>This will increase nutrients absorbed by the roots, increase disease protection, aerate the soil, increase the microbial life of the soil, increase flowering pod-bearing rates, the pods will be shinier, larger, and of greater quality.</li> </ul>
<b>7. Flowering and Fruiting Stages:</b> a) Apply Bio-Plant	<ul style="list-style-type: none"> <li><b>Main Crop Flowering and Fruit Stages (Sept-March)</b> 7 months.</li> <li><b>Mid-Crop Flowering and Fruit Stages (May-August)</b> 4 months.</li> <li>Spray Bio-Plant around the base of the trees 1 month before the flowers appear. Spray 1-2 times during the flowering stage. Spray 2 times during the fruiting stage.</li> <li>If you wish to reduce costs, halve the number of applications to 3 during the main crop and to 2 during this period of the mid-crop.</li> <li>Pile up the leaves on the ground around the trees, and spray the pile around the tree with Bio-Plant</li> </ul>	<ul style="list-style-type: none"> <li>When cocoa leaves and charrelles fall to the forest floor, they mix with the leaves of other trees and decay. The fungi and other micro-organisms in Bio-Plant will decompose this debris, which will feed the soil with essential nutrients, thus fertilizing the trees.</li> <li>In addition, decaying leaves provide the perfect breeding ground for midges, the tiny insects that pollinate cocoa flowers. The sticky charrelles contribute to leaf litter and provide nice, juicy homes for the midge population.</li> </ul>

Stage When to Use the Bio-fertilizers	Method	Benefits
<b>7. Flowering and Fruiting Stages:</b> a) Apply Bio-Plant <i>(cont.)</i>	mixed with water (1 litre with 1,000 litres of water). 1-2 litres per tree. <ul style="list-style-type: none"> <li>• Instead of spraying Bio-Plant onto leaves piled around the trees, spread 10-15 kgs of compost around the base of the cocoa trees.</li> </ul>	<ul style="list-style-type: none"> <li>• Spraying Bio-Plant the maximum number of times will provide more nutrients, thereby increase the yield, and protect from disease.</li> </ul>
<b>7. Flowering and Fruiting Stages:</b> b) Apply Pro-Plant	<ul style="list-style-type: none"> <li>• Spray Pro-Plant on the trees one month before the flowers appear.</li> <li>• Spray 1-2 times on the buds and flowers during the flowering stage.</li> <li>• Spray the leaves and pods 2 times during the fruiting stage. One litre will cover 1 hectare with 450 trees.</li> <li>• Ideally, spray (5 times) once: <ul style="list-style-type: none"> <li>• Before the flowers form.</li> <li>• When the buds have formed, but not opened.</li> <li>• When the flowers have opened fully.</li> <li>• When one-third of the flowers have fallen off.</li> <li>• When the pods have formed.</li> </ul> </li> <li>• Dosage: <ul style="list-style-type: none"> <li>○ A. 5-10 cc/20 litres of water. Spray on the tree. Avoid the leaves as much as possible. (For prevention.)</li> <li>○ B. 10-20 cc/20 litres of water. Spray on the tree, if there is some fungus already. Try to avoid the leaves.</li> <li>○ C. If the whole tree has fungus: <ol style="list-style-type: none"> <li>1. Spray 50 cc/20 litres of water only on the branches. <i>Or:</i></li> <li>2. The farmer can scrub or brush on the branches 50 cc/20 litres of water. Avoid the leaves. Spray every 7-10 days for better effect, if the trees have fungus already.</li> </ol> </li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Pro-Plant provides an abundance of instantly usable nutrients to increase flowering and fruiting. The trees will receive adequate Potassium and Phosphorus, if the farmer sprays Pro-Plant often.</li> <li>• Spraying Pro-Plant during the fruiting stage reduces the competition for nutrition resources amongst the pods as they mature.</li> <li>• The abundance of nutrients will increase flowering and fruiting by providing more nutrients when they are needed.</li> <li>• The pods will be shinier, larger, and of greater quality.</li> <li>• Usually in trees the use of the bio-fertilizers reduces the number of flowers which drop off before turning into fruit.</li> <li>• Pro-Plant coats the leaves and flowers with micro-organisms, which prevent disease.</li> </ul>
<b>8. Spray Bio-Plant as a Fungicide</b> <i>(instead of chemical sprays)</i>	<ul style="list-style-type: none"> <li>• Replace any chemical fungicides used, with Bio-Plant mixed with water.</li> </ul>	<ul style="list-style-type: none"> <li>• Farmers will be able to reduce their spraying costs significantly.</li> <li>• There will be fewer chemicals in use to kill the microbial life of the soil.</li> </ul>
<b>9. Note for Stages 1-7.</b>	<ul style="list-style-type: none"> <li>• By using the two bio-fertilizers regularly from the seed stage, the farmers will be able to phase out</li> </ul>	<ul style="list-style-type: none"> <li>• After about 2 years of using the bio-fertilizers, the farmers should have phased out the use of chemical</li> </ul>

Stage When to Use the Bio-fertilizers	Method	Benefits
	<p>the use of the chemical insecticides and fungicides. By the time the trees flower and fruit, there will be no need to use chemical sprays as their immune system will be strong.</p> <ul style="list-style-type: none"> <li>• If the farmers have used the bio-fertilizers regularly with grown trees for at least 6 months already, they can start off by halving the use of chemical sprays.</li> </ul>	<p>sprays. This will not only save a lot of money, but also improve the soil's fertility.</p> <ul style="list-style-type: none"> <li>• Bio-Plant is 100% organic and chemical-free.</li> <li>• Spraying Bio-Plant will add micro-organisms to the soil with all the benefits that this entails.</li> </ul>



## Part 17

### Using the Bio-fertilizers for Growing Rubber Trees

#### 1. Soil Preparation

- See the *Compost and Soil Preparation Methods* guidelines in Part 8 on page 43. Method 2 on page 55 is better than Method 1 because the soil preparation uses bio-compost.

#### 1.1 Soil Improvement

- If the trees are small, spray the soil at a suitable distance from the tree where the roots are and the leaves have fallen (up to the Drip Line usually) once every 2-4 weeks (every 2 weeks is better) with a mixture of 100 cc of Bio-Plant in 100 litres of water. Pour about 2-3 litres of the mixture at the base of each tree.

Rubber Tree Age in Months	Fertilizing Area (Away from the trunk)
2 Months	Starting 30 cms. from the tree trunk.
4 Months	Starting 35 cms. from the tree trunk.
6 Months	Starting 35 cms. from the tree trunk.
11 Months	Starting 50 cms. from the tree trunk.
14 Months	Starting 60 cms. from the tree trunk.
18 Months	Starting 1 metre from the tree trunk.
54 Months	Fertilize Around the Tree at a Radius of 2.5 metres.

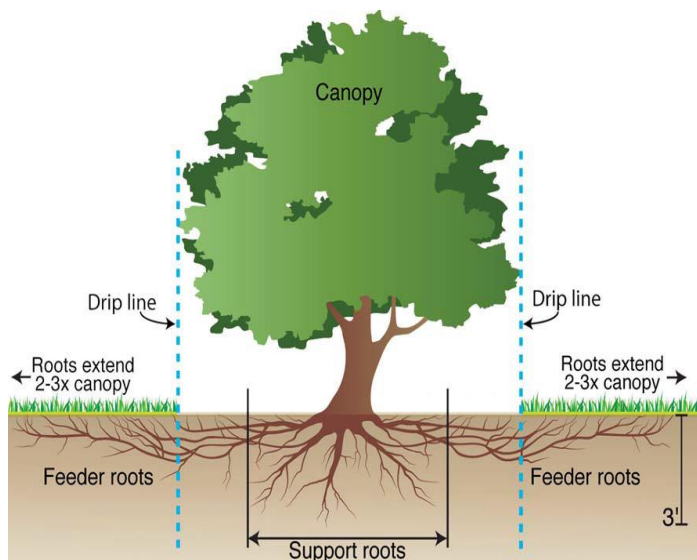


Diagram showing the Drip Line for placing compost for the support roots and feeder roots.

- The Bio-Plant provides extra nutrients by dissolving the leaves. The Bio-Plant is applied to the base of the trees in the same row. *It is beneficial to add more micro-organisms often as this enriches the soil and increases the growth of the trees and yield of latex. Leaves fall during the growth of the trees, and if you add Bio-Plant, ideally by spraying, as this spreads out the micro-organisms better, the micro-organisms will dissolve the nutrients in the leaves and add these to the soil by the roots.*
- We recommend this because often chemical fertilizers have been used for so long that the micro-organisms in the soil have mostly been killed off, and there is a lack of minor minerals. The farmer needs to try to restore the soil as quickly as possible so that it does not need a “fix” of chemical fertilizer in order to produce growth in the trees.
- We also recommend mixing the 2-3 litres of water mixed with Bio-Plant with organic matter and placing this in a ring around the base of the tree at a distance suitable for the tree’s age. This is better than just pouring the 2-3 litres around the base of the tree without organic matter.

The fallen leaves could be raked into a ring around the tree at the suitable distance and the Bio-Plant could be sprayed on the ring of leaves. The Bio-Plant's micro-organisms will then have organic matter to multiply in. The farmer could do this once a month and spray once a month or apply the bio-compost once every two months.

## **2. Spraying the Leaves With Pro-Plant (See *Part 9. How to Apply Pro-Plant* on page 64.)**

**2.1** *If the tree is not too tall to spray (including seedlings in a nursery)*, mix Pro-Plant (100 cc) in water (100 litres). Spray the Pro-Plant on the leaves every 14 days. 10 days is better as the tree will obtain more nutrients. This increases the yield.

- Spray the leaves of the trees. Spray before 9 a.m. when the pores are open most for better results. Please spray Pro-Plant using spraying equipment that gives a fine, misty spray, and that the spray is directed diagonally upwards so that it hits the pores of the leaves underneath as well as lands on the leaves.
- Be generous when you spray a tree. You do not have to spray every leaf.

**2.2** *If the trees are too tall to spray the leaves (e.g. 3-year old trees)* with Pro-Plant, then mix 100 cc of Pro-Plant with 100 litres of water and spray 2 litres of the mixture about a metre from the trunk of each tree every 14 days. (See **1.1** for guidelines about where to spray.)

- After 4 years and 6 months you should spray about 2.5 metres from the tree trunk.
- For an area of 1,600 square metres where you are pouring the Pro-Plant mixture at the base of the trees, you should mix 100 cc of Pro-Plant in 100 litres of water and pour the water at the base of the tree - about 2 litres per tree. There will probably be about 100 trees on this area of land. You should apply this every 2 weeks.
- For a hectare, you would multiply this by 6.25 (625 cc of Pro-Plant in about 625 litres of water). Normally, 340 litres of water is enough for spraying over a hectare, but if the trees are too tall for spraying, you will have to use more water.

## **1.3 Applying Bio-Plant as a Fungicide**

- Mix Bio-Plant (5 cc - 10 cc) in 20 litres of water and brush this on the area where the tapping has been done and the bark has been removed, once per week. 20 litres of water will be enough for a lot of trees. It acts as a fungicide and makes the latex softer and flow easier. The farmers apply this to the trees immediately after collecting the latex from the tree and before proceeding to the next tree.
- When you spray Pro-Plant the leaves get coated with micro-organisms that protect the trees from disease. The Bio-Plant strengthens the immune system so that the trees are less susceptible to disease.
- If there is a need to spray pesticides, please spray them at least 3 days apart from when you apply the bio-fertilizers as the chemicals kill the micro-organisms that will now be multiplying in the soil and being sprayed onto the leaves.

## Part 18

### How to Use the Bio-fertilizers for Growing Sugarcane

#### 1. Soil Preparation

- See the separate *Compost and Soil Preparation Methods* guidelines. Making compost for use in the soil preparation is preferable.
- **Scenario 1: There is Not Enough Compost.** In the event that a sugarcane farm is very large, and not enough organic matter can be obtained to make enough compost, then the solution to the soil preparation would be to grow a cover crop mixture of various legumes and pulses so as to provide Carbon and Nitrogen to the soil, and to terminate the cover crop about 2 weeks before the sugarcane crop is planted. The cover crop could be sprayed with Bio-Plant and water (1 litre in 500-1,000 litres of water per hectare) as it is ploughed into the soil when the furrows are made to speed up the breakdown of the cover crop and to increase the microbial life of the soil..
- **Scenario 2: Leave the Trash on the Ground.** After harvest, leave the sugarcane leaf trash on the ground. Do not burn it or throw it away. Leave the leaf trash on the soil surface to break down until the next planting period, and then plough it into the soil during the next soil preparation period. If you plant a cover crop, plant the cover crop seeds into the soil through the leaf trash without tilling the soil.
- **Scenario 3: You Plough in the Leaf Trash Immediately.** If you plough in the sugarcane leaves immediately after harvest, then the soil will be left bare until the next planting time. To avoid leaving the soil bare, plant a cover crop and plough it into the soil at the next planting period. Spray water mixed with Bio-Plant (1 litre in 500-1,000 litres of water per hectare) on the cover crop as it is ploughed in.
- **Scenario 4: You Use Compost.** Cover with compost the bottom of the planting trenches, and place the bud setts on top. Then cover over the trenches with soil. If you wish, you could place cut up or ground organic matter, such as sugarcane leaf trash (*see the photograph below*), mixed with manure in the planting trenches instead.
- **Note:** Leave the field for 14 days before planting sugarcane so that the micro-organisms can multiply.



#### 2. The Benefit of 3-Bud Setts (Conventional Method)

- Cut the sugarcane poles into sections with three buds on each sett. (*See photo below.*) The middle bud of a 3-bud sett has the highest germinating capacity followed by the top end bud and the bottom end bud respectively. The middle bud has an advantage in germination because, as a non-terminal bud having nodes on either side, its moisture resources are better protected than those of the terminal buds.



**The middle bud has the highest germinating capacity in a 3-Bud Sett.**

### 3. Soak the Sugarcane Setts

- If you soak the setts in water before planting, soak them in sacks in water mixed with Bio-Plant (20 cc in 20 litres of water) for up to an hour, and then leave the sacks covered with branches so that they are warm for 6 days before planting so that they germinate and roots form. Water the sacks in the morning and evening. The Bio-Plant will provide anti-fungal protection and help the sugarcane to sprout roots.
- To save the sugarcane setts from the attack of termites and ants, the following practice may be adopted. Prepare neem cake slurry by mixing 1 kg. of neem cake in 5 litres of water. Leave the setts in it for a period of 18-24 hours.

### 4. Making and Planting One-Bud Setts (New Approach)

- Many farmers nowadays are planting single-bud setts instead of three-bud setts because of the financial savings and higher yield with one-bud setts.
- Soak the one-bud setts as explained above. Plant them in potting trays in a mixture of coconut coir, soil, and compost made with Bio-Plant. Cover over the setts with the soil and compost mixture.



- Keep the germinating setts in the shade. Water them daily until they have sprouted several roots and leaves appear. Then transfer the setts to larger trays. Water them twice a day.
- Once the leaves have appeared and have grown a few inches, spray them every 10 days with Pro-Plant mixed in water (20 cc in 20 litres of water).
- Transplant the setts from the potting trays into the field after about 30 days. Plant them 2 feet apart in the trenches where compost has been laid already. Space the rows 90 cms apart.



## 5. Leaf Trash Mulching to Keep the Weeds Down

- Mulch the ridges uniformly with cane trash to a thickness of 10 cm within a week after planting. This helps to conserve moisture, reduce weed population, and minimise shoot borer incidence.
- Mulch the inter-row area of the sugarcane field with 10 cms. deep of leaf trash after 21 – 25 days of planting to keep down weeds; to add additional nutrients; and to conserve soil moisture
- The farmer can strip the dried lower leaves of the standing sugarcane crop and spread it as mulch in the inter-row spaces.
- Mulching helps:
  1. To release nutrients from the waste foliage slowly over a few months. As sugarcane is a long-term crop mulching is suitable.
  2. To protect soil from sunburn and to reduce evaporation directly from the soil. It keeps soils damp and warm, which is the best condition for root development.



## 6. Intercropping

- Alternatively, the farmer could plant an intercrop in the open space between rows in order to smother the weeds.
- Mung beans could be intercropped as the photograph on the right shows.
- Pulses, such as soya beans grow well without affecting the sugarcane yield.



**Sugarcane intercropped with mung beans.**

## 7. Applying Pro-Plant

### 7.1 Normal Procedure

- Spray the leaves with water that contains a ratio of 20 cc of Pro-Plant per 20 litres of water.
- For a hectare, mix 500 cc of Pro-Plant with 500 litres of water. For an acre, mix 250 cc of Pro-Plant with 250 litres of water. For half an acre, mix 125 cc of Pro-Plant with 125 litres of water. For 200 sq.m. mix 35 cc with 35 litres of water.
- Spray the leaves before 9 a.m. when the stomata pores are open most. Direct the spray onto the leaves as well as diagonally upwards so that the spray hits the underside of the leaves because this is where the pores (stomata) are. Make sure that the spray is a very fine, misty, foggy kind of spray. Be thorough and generous when you spray.
- Spray on top of the leaves as well because the micro-organisms in Pro-Plant will coat the leaves and protect the plant from fungal diseases.
- By spraying Pro-Plant the nutrients will be available immediately and much more quickly by means of solid fertilizer through the roots, which takes at least a week.

- Spray the sugarcane plants with Pro-Plant once a month in months 1, 2, 3, 4, and again in month 7 when the farmers thin out the sugarcane. The application in month 7 will increase the yield.
- If you cannot spray Pro-Plant at all during the crop, then he should choose a way to apply it to the base of the sugarcane plants.
- Pro-Plant can also be mixed with Bio-Plant and applied to the base of the sugarcane plants.

## **7.2 How Much to Spray per Plant**

- When the sugarcane is very small and in the Nursery you do not need to spray much of the Pro-Plant / water mixture. But as the sugarcane grows taller, spray a bit more. The key point is to cover as many of the leaves as possible with the spray without trying to drench them.

## **8. Applying Extra Bio-Plant**

- Add another litre of Bio-Plant to the soil during the crop. This should be in Month 3; and ideally also in Month 7 when the leaves are being cut.
- This could be done either by applying compost mixed with Bio-Plant around the sugarcane plants or by spraying Bio-Plant on the soil around the sugarcane plants at the usual ratio of 500 cc in 500 litres of water



**Sugarcane after the leaves have been thinned out in Month 7.**

## **Part 19**

### **Using the Bio-fertilizers for Growing Cotton**

#### **1. Soil Preparation**

- See the ***Compost and Soil Preparation Methods*** guidelines in Part 8 on page 43. Method 2 on page 55 is better than Method 1 because the soil preparation uses bio-compost made over about 7 weeks.

#### **2. Seed Preparation** (See Part 9, Seed Preparation on page 60.)

- Put the seeds in a plastic bag; or in a cloth or sack and tie up the ends so that the seeds cannot escape. Water should be able to enter through holes. Soak them for 18-24 hours (no longer) in water that contains 20 cc of Bio-Plant and 20 cc of Pro-Plant per 20 litres. (The ratio is 10 cc per 10 litres of water.) If the amount of seeds is small, reduce the water to just a few litres, but do not reduce the amount of the bio-fertilizers. *The amount of Bio-Plant can be increased to 100 cc for a better effect.*
- If you are going to plant the seeds directly in a field, then plant them in furrows. If the field has not been prepared with bio-compost made with Bio-Plant, then place compost in the furrows and place the seeds in groups of 3 in the compost. They will germinate in 7-14 days.
- If you wish to plant seedlings in the field, then transfer the soaked seeds after 24 hours to a growing pot in black poly bags or a large tray and leave them to grow. After 32-35 days transplant them into furrows in a field.



**Planting cotton seeds in furrows in a field.**

#### **3. Spraying Pro-Plant**

- (See ***Part 9. How to Apply Pro-Plant*** on page 64.)
- The farmer can decide how often to spray. Every 15 days will give a higher yield than every 30 days. Ideally, spray Pro-Plant every 15 days from Day 15 after planting.
- About two months after planting, flower buds called squares appear on the cotton plants. In another three weeks, the blossoms open. Their petals change from creamy cotton bolls to yellow, then pink and finally, dark red. When the flowers start to appear spray every 10-15 days until the bolls are open. There is no need to spray anymore when the bolls crack open and the fluffy white cotton is exposed.



**A Cotton Flower.**



**A Closed and an Open Cotton Boll.**



- About 40-50% of the flowers and bolls are shed due to boll worm attack or due to nutritional stress. Hence there is need to supplement the plant with proper micronutrients to produce more flowers and to retain them on the plant to develop into bolls for final harvesting.
- The optimal growth stages in cotton for foliar-applied K is during the flowering and the period of boll growth starting soon after flowering, with the optimum stage occurring three weeks after the first flower.
- The farmer can choose the frequency of spraying that suits him best. If the farmer chooses to spray every 30 days, then when the flowers appear, he should change to spraying every 10-15 days and continue spraying every 10-15 days until the bolls are open. Spraying the bolls every 10 days would increase the yield more though as the bolls will benefit from the high supply of nutrients. In short, the more nutrient applications, the better.
- Make sure that the spray is a very fine, misty, foggy kind of spray. Be thorough and generous when you spray.

#### 4. **Spraying Additional Bio-Plant**

- Because cotton grows for 6-7 months, additional micro-organisms should be added to the soil, ideally once a month (every 30 days) on Day 30, Day 60, Day 90, Day 120, and Day 150. Compost made with Bio-Plant would be an effective way to do this. Apply around 10 kgs per cotton plant.
- If the farmer prefers, he could to apply Bio-Plant by spraying it mixed with water at the base of the plants. Do not spray on the leaves as they will turn yellow.
  - Hectare: Spray 500 cc of Bio-Plant mixed with 500 litres of water, or better 1 litre of Bio-Plant mixed with 500-1,000 litres of water per hectare.
  - Acre: Spray 250 cc of Bio-Plant mixed with 250 litres of water. You could spray 500 cc in 500 litres of water in order to provide more micro-organisms.



**A Cotton Field Ready for Harvest.**



## **Part 20**

### **Using the Bio-fertilizers for Growing Coffee**

#### **1. Soil Preparation**

##### **1.1 Preparing the Compost**

- *See the **Compost and Soil Preparation Methods** guidelines in Part 8 on page 43. For trees, you need to prepare bio-compost with Bio-Plant. The Heap Method explains how to do this.*
- Put the compost on the top soil, which goes at the bottom of the hole.

##### **1.2 Preparing the Seeds**

- *(See Part 9, **Seed Preparation** on page 60.).* Coffee plant seeds will benefit from soaking in later mixed with Bio-Plant. Place the seeds in potting soil or sand. Leaves will appear after about 2 months.
- Then plant 2 seeds in each plastic bag filled with a compost mixture. Leave them to grow for 5-6 months to form 2 branches before planting them in the farm.

##### **1.3 Applying Additional Bio-Plant During the Growth of the Trees** *(See section 1.2 on page 77.)*

- The key to high-quality coffee and bumper harvest from every stem is to nourish the crop through application of manure and timely weeding. When coffee is well fed, the stems do not shed leaves even in dry season, providing cover for the seeds and ensuring they are of high quality.
- Make sure that you place plenty of compost in the planting hole; on top of the top soil, which should be placed at the bottom of the hole under the compost. The soil, which was at the bottom of the hole should be placed on top of the compost. More compost can be placed on top.
- Place 5 - 10 kgs of compost made with Bio-Plant around trees (a minimum of 5 kgs if the trees are under 1 metre and about 10 kgs around trees over 1 metre, but 10 kgs can be applied to trees under 1 meter as well). Applying compost once a month is enough.
- If you are not using compost and are placing organic matter around the tree (without it touching the trunk), spray the organic matter with water that contains 500 cc. of Bio-Plant per 500 litres of water. Spray just enough to soak it. 1 litre of the mixture should be enough.

##### **1.4 Applying Additional Bio-Plant During the Flowering Stage of the Trees**

- *See section 1.3 above on page 78.*

#### **2. Spraying Pro-Plant** *(See **Part 9. How to Apply Pro-Plant** on page 64.)*

- Spray the coffee trees every 14 days once the leaves have appeared in the nursery. For a hectare, mix 500 cc of Pro-Plant with 500 litres of water.
- **Amount of Pro-Plant:** For a hectare, mix 500 cc of Pro-Plant with 500 litres of water before the flowers and coffee cherries appear, and 750 cc if the flowers or coffee cherries have appeared. For an acre, mix 250 cc of Pro-Plant with 250 litres of water before the coffee cherries appear and 375 cc if the flowers or coffee cherries have appeared. If you are going to spray at the ratio of 35 cc per 20 litres, add an extra 250 cc of Pro-Plant per hectare and 125 cc per acre.
- In Year 1 and Year 2 before the first buds appear, you could spray once every month because the plants are obtaining nutrients through microbial action from the compost. But when the buds start to appear and when the flowers and coffee cherries are on the trees, spray the whole

tree with no less than 30 cc and no more than 35 cc per 20 litres of water every 2 weeks; or just once a month, if you wish to reduce your costs. Every 2 weeks will provide more nutrients and increase the size of the coffee cherries, but your costs will be higher.

- If you wish to reduce your costs in Years 1 and 2 by spraying Pro-Plant every 2 months, consider spraying it every 2 weeks in the last 32 weeks before the harvest. After the flowers blossom there are 32 weeks until harvest. This is an important period for spraying Pro-Plant on the flowers and cherries.
- Spray at the ratio of 20 cc of Pro-Plant per 20 litres of water. Spray the leaves and the flowers or coffee cherries. Continue spraying until 7-14 days before the coffee cherries are harvested.
- **Very Important Note:** Please spray Pro-Plant using spraying equipment that gives a fine, misty spray, and that the spray is directed diagonally upwards so that it hits the pores of the leaves underneath as well as lands on the leaves. Spray the leaves well, and ideally before 9 a.m. when the leaf pores are open most.

### 3. **Mulching**

- It is important to mulch the soil between the coffee trees or to grow a legume crop there so as to suppress the growth of weeds. (*See Part 8. Compost and Soil Preparation Methods, Cover Crops, and Mulching on page 43.*)

## Part 21

### Using the Bio-fertilizers for Growing Potatoes

#### 1. Soil Preparation

- See the *Compost and Soil Preparation Methods* guidelines in Part 8 on page 43. Method 2 on page 55 is better than Method 1 because the soil preparation uses bio-compost made over about 7 weeks.
- Soil preparation with a lot of compost made with Bio-Plant will be invaluable in increasing growth. The soil must be soft so that the roots can spread out and form potatoes.
- Plant the potatoes in trenches. Each trench should be about 30 inches apart.
- Dig trenches about 12 inches deep for your seed potatoes. Add a thick layer of compost in each trench and plant the seed potatoes into this compost. Cover the seed potatoes with about 4 inches of soil. As the potatoes grow you will cover them with a further 4 inches of the remaining soil so that the potatoes are never exposed to the sun.
- Do not fertilize with fresh manure, as this can cause scab.
- **Cover Crops:** One of the best ways to prepare the ground for potatoes is to grow a cover crop. Cover crops or “green manures” greatly improve the soil’s tilth, organic matter, microbial activity, and water holding capacity, and significantly increases nutrient availability for the next crop.
- Legume cover crops (peas, vetches, clovers, alfalfas, etc.) have the unique ability to extract Nitrogen from the air and return huge amounts of it to the soil in plant-available form. Rye, buckwheat and sweet clover mine insoluble phosphorus from the earth and return it in plant-available form. In most areas, a cover crop which contains cowpeas (for Nitrogen) and buckwheat (for phosphorus), will provide an easy and cost-effective way to prepare the ground for potatoes.
- Before you plant the potatoes (or vegetables) wait for 2-4 weeks after turning under your cover crop, to allow time for it to break down in the soil. It would be beneficial to spray the cover crop with Bio-Plant in the usual dosage of 20 cc in 20 litres of water just before ploughing it into the soil in order to increase the microbial life of the soil and to speed up the decomposition of the turned over cover crop.

#### 2. Prepare the Seed Potatoes

- Lay out your seed potatoes in a single layer on the floor, on a planting tray or on flats and expose them to indirect sunlight. If you have a large amount, the trays can be stacked on racks or similar, as long as there is good ventilation and equal light. Let the potatoes sit in that warm environment for a week or two, until the eyes start to sprout. The sprouts will start to green up and you should let them grow to at least 1/2 inch (13 mm) long before planting.



**Potatoes in flats being greened ready for planting.**

- Short, stout, green sprouts are reasonably tough and can be handled without being broken. If the potatoes have started sprouting in the dark they will likely be too long for good greening. It is best to rub them off and let them sprout again under the correct conditions. Long sprouts are much more delicate and are easily broken off during handling and planting.

### 3. **Cutting Seed Potatoes**

- You do not need to cut potatoes before planting. But, if the seed potato is very big and has several eyes, cut it into small pieces, each with an eye, to make the potato go further. If you plant a large potato, you will get multiple smaller potatoes. If you plant a small potato with an eye, you will get large potatoes. Make sure that they have enough time before planting for the cut surfaces to harden. The cut pieces should be left to dry out for 2-4 days before planting. Provided that each piece has an eye or two for the new growth to develop, the cut potatoes will grow well.

### 4. **Apply an Organic Fungicide**

- If you wish to apply a fungicide to the cut area, before you plant the cut piece of potato, dip it in an organic fungicide. Refer to page 34 for examples of organic fungicides.
- You could dip the cut area into wood ash to protect it. Leave the potatoes afterwards for a day with the ash on them before planting.
- Sulfur in powdered form is often applied to cut potatoes to hasten healing. Apply it to the cut area and allow it to dry for 3-4 days.
- The best way to apply the wood ash or the Sulphur is to apply it right after the cuts are made while they are still damp so that the ash or powder will stick.

### 5. **Planting the Potatoes**

- Once the trench is dug, line the trench with compost and place the seed potatoes on the compost.
- Place the seed potatoes in the trench with the suckers (eyes) facing up. It is important that the suckers face up.
- Space your potatoes in the trench about 12 inches apart, if you want to produce high yield with large potatoes. If you want to produce small-sized potatoes space the seed potatoes about 6-8 inches apart.
- If you add field peas (6-7 per foot) among the cut potatoes, you will increase the growth because the peas will add mycorrhizal fungi to the soil, and the potatoes will receive more nutrients.



### 6. **Spraying Pro-Plant** (See ***Part 9. How to Apply Pro-Plant*** on page 64.)

- *Shake the bottle vigorously before opening it.* Pour it into a suitably-sized container and mix it with water according to the amounts below. Turn on the water tap so that the water pours into the container very rapidly.
- For one hectare spray 500 cc of Pro-Plant mixed with 500 litres of water onto the leaves before 9 a.m. on Days 20, 30, 34, 50, 60. Once the potatoes start to flower after about 60 days, spray every 7 days for a better yield. Continue spraying until 7-10 days before the potatoes are harvested.
- Wait 7-10 days after the leaves have appeared before starting the spraying.



## 7. Hilling the Potato Plants

- Once you have placed your seed potatoes in the ground cover them with soil, and continue covering the plants in each trench with a few inches of soil as the stem emerges and grows.
- Once the plants have grown the full height of the trench let them grow up to be about 8 inches tall, and then hill a mound of soil all around the plant almost covering it again. Let it grow another 8 inches and then hill again with a hoe. Sprinkle more compost on the top of the soil around the plants each time you hill the potatoes to ensure proper nutrients. The larger the hills and the looser the soil, the better the crop will be.



- Hilling helps to support the green stems as they grow taller. Also, if the potatoes get exposed to the sun for long, they will turn green, and eating green potatoes will make you ill.
- Never hill potatoes that have started to bloom. Once a potato plant has started to flower, the tender suckers that produce new potatoes are developing. Hoeing around the plants to form a hill could sever these tender suckers killing all of your new potatoes.
- Potatoes need a steady supply of moisture in order to develop into good sound vegetables. Good moisture combined with good nutrition will produce the best potatoes around. Keep up the hard work until the blossoms die on the plants and then you can harvest your potatoes.

## 8. Harvesting Potatoes



- **Harvesting New Potatoes:** After 60 days or so, the plants will flower and little tubers will begin to form. You can harvest new potatoes usually about two to three weeks after the plants flower.

- **Harvesting the Main Crop:** In order to get larger potatoes, leave the potatoes until the vines naturally wither or until the tubers have reached the desired size. Allow the tubers to remain in the soil at least two weeks after the vines have died back. Do not water plants during this period. This provides time for the skins to "set," which increases storage life. Dig deeply and at a distance of up to 18 inches from the plant to locate all the tubers.

## **Part 22**

### **Using the Bio-fertilizers for Growing Cassava**

#### **Notes**

- The production costs will be lower than with chemical fertilizers. Chemical sprays will not be needed, so money can be saved there.
- The cassava yield and quality will be higher than with chemicals. The key to success lies in preparing the soil with bio-compost as described below. If the soil has been used for chemical farming before, it will need restoring to fertility, which is where the bio-compost will help.
- The farmers should get a higher price for chemical-free cassava. After 3 years it will be recognized officially as “100% Organic”

#### **1. Soil Preparation**

- See the ***Compost and Soil Preparation Methods*** guidelines in Part 8 on page 43. Method 2 on page 55 is better than Method 1 because the soil preparation uses bio-compost made over about 7 weeks.
- To produce a high yield the farmers should make lots of bio-compost made with Bio-Plant – one heap per hectare with more compost being made ready to place around the plants once per month during the crop.
- Prepare the soil with at least 5 MT of compost mixed with Bio-Plant so that the soil is rich. The better it is prepared, the less likely the cassava will experience disease. Leave the field for 7-14 days in the sun in order to kill the weeds before planting.

#### **2. Planting the Cassava**

- Cut the cassava poles into 20 cms. sections. Each section should have at least 5 nodes.
- When you soak the cut cassava soak them in water mixed with Bio-Plant (20 cc in 20 litres of water) for 2 days and 2 nights and then leave them in the shade to dry. The Bio-Plant will provide protection and help the cassava to sprout roots.
- Plant the cassava 80 cms. from each other; 20 cms. into the soil; and at 45 degrees. This forces the cassava to sprout roots.



#### **3. Applying Pro-Plant** (See Part 9. How to Apply Pro-Plant on page 64.)

##### **3.1 General Guidelines**

- Spray Pro-Plant on the leaves after 7-14 days of them appearing, ideally every 7 days at the beginning so that the cassava becomes well established, and then every 14 days from then onwards.
- Spray the leaves with water that contains a ratio of 20 cc of Pro-Plant per 20 litres of water.
- For a hectare, mix 500 cc of Pro-Plant with 500 litres of water. For an acre, mix 250 cc of Pro-Plant with 250 litres of water. For half an acre, mix 125 cc of Pro-Plant with 125 litres of water. For 200 sq.m. mix 35 cc with 35 litres of water. For an area of 10 metres x 10 metres (100 sq.m.) mix 20 cc in 20 litres of water.
- Spray the leaves before 9 a.m. when the pores are open most. Direct the spray diagonally upwards so that the spray hits the underside of the leaves because this is where the pores (stomata) are. Make sure that the spray is a very fine, misty, foggy kind of spray. Be thorough

and generous when you spray. Spray on top of the leaves as well because the micro-organisms in Pro-Plant will coat the leaves and protect the plant from fungal diseases.

### 3.2 Spraying Cassava Seedlings in a Nursery in Black Bags

- Spray the seedlings every 7 days while they are in the plastic bags. The ratio is 20 cc of Pro-Plant per 20 litres of water, but you will not need to spray much of the mixture because of the size of the seedlings. Spray the leaves thoroughly.

### 3.3 How Much to Spray per Plant

- When the plants are very small you do not need to spray much of the Pro-Plant / water mixture. The key point is to cover as many of the leaves as possible with the spray.
- Cassava takes 180-210 days. Spray the seedlings every 7 days in the first month after transplanting them into a field, and then every 14 days afterwards. Continue spraying until a week before harvest.




## 4. Mulching and Adding Bio-Plant

- Mulch the soil around the cassava plants or use one of the other methods in **5** below to control weeds. If you mulch, it is beneficial to spray Bio-Plant on the mulch around the cassava (without touching the leaves) every 30 days until the branches become too dense.
- Extra Bio-Plant should be added monthly either by spraying it on the mulch around the base of the cassava plant, or apply it in the form of bio-compost made with Bio-Plant. Extra bio-compost should be added as the buds for the flowers appear and then every 30 days afterwards as the cassava tumors grow.
- If the farmer uses drip-feed pipes, the Bio-Plant could be fed through the pipes. It is better to spray Pro-Plant, though, because it coats the leaves with micro-organisms, which protect the cassava from fungal diseases.



## 5. How to Control Weeds

- **Mulch Cassava Fields With Dead Plant Foliage:** Mulching increases crop yield, Nitrogen, and reduces weeds significantly. It involves covering the soil surface with very large amounts of plant foliage, such as rice straw. It improves the soil's properties and reduces weed problems.
- Good sources of mulch materials are foliage from leguminous plants, rice straw or husks, coffee hull, and crop and weed residues. Maize stubble is usable, but it takes a long time to rot.

 	<h3>Impact of Weeds in Cassava</h3>	
<ul style="list-style-type: none"> <li><input type="checkbox"/> Weeds causes low productivity of cassava in Africa.</li> <li><input type="checkbox"/> Hand weeding is predominant weed control practice.</li> <li><input type="checkbox"/> Farmers weed <b>3X</b>, but more where <b>Imperata, Cyperus</b> spp, etc. are predominant.</li> <li><input type="checkbox"/> Weeding takes 50 to 80% of total labor budget.</li> <li><input type="checkbox"/> Women do &gt;90% of the hand-weeding</li> <li><input type="checkbox"/> 69% of farm children (ages of 5-14) skip classes in school and used in weeding.</li> </ul>		
A member of the CGIAR Consortium		





**A mulched cassava field. No weed problems.**

- **Use Cover Crops as Live Mulch on Seedbeds:** You can use food crops such as egusi melon as cover crops, and/or plant intercrops (such as maize) to reduce weed infestation in cassava farms. Egusi melon is a good “live mulch” in cassava farms. If you decide to use egusi melon as live mulch you should plant it before planting the cassava. The egusi melon should be planted very closely spaced on the seed beds to enable it to spread and cover the soil very quickly.
- **Plant Cassava in Association With Other Crops:** You can also reduce weed problems by inter-cropping cassava with other crops at planting. Crops commonly intercropped with cassava are maize, rice, grain legumes, and vegetables. It is helpful to intercrop cassava with grain legumes such as cowpea and groundnuts, which manufacture and release nutrients into the soil. Cassava + cowpea leads to a greater reduction of weeds.



**Cassava intercropped with maize.**

## **Part 23**

### **Using the Bio-fertilizers for Growing Yams**

#### **1. Soil Preparation**

- See the *Compost and Soil Preparation Methods* guidelines in Part 8 on page 43. Method 2 on page 55 is better than Method 1 because the soil preparation uses bio-compost made over about 7 weeks.
- Prepare the soil with at least 5 MT of compost mixed with Bio-Plant so that the soil is rich. The better it is prepared, the less likely the yams will experience disease. Leave the field for 7 days in order to kill the weeds before planting.

#### **2. Planting Yam Mini-Sets**

- Use the mini-set method created by the IITA ([www.iita.org](http://www.iita.org)). After cutting the mini-sets leave them to dry for 24 hours.
- Soak the cut sets in Bio-Plant (20 cc in 20 litres of water) for 10 minutes before planting them in a nursery in soil for germination, which has been mixed with Bio-Plant and water.
- You can also dip them in wood ash for more protection before planting.
- Experiment with soaking the cut yam mini-sets in water mixed with Bio-Plant (20 cc in 20 litres of water) for 2 days and 2 nights. Then leave them in the shade to dry for 24 hours. The Bio-Plant will provide protection and help the yam to sprout roots.



**Mini-setts planted to germinate.**



Transplant pre-sprouted mini-setts after 1 month into the field. Plant at a spacing of 25cm on ridges. Plant at a depth of 5-7cm below the soil. Place some compost in each planting hole, if the soil on the ridge has not been mixed with compost.

#### **3. Applying Pro-Plant**

- See the guidelines on how to apply Pro-Plant on page 64.
- Spray Pro-Plant (20 cc in 20 litres of water) on the leaves after 7-14 days of them appearing, ideally every 7 days at the beginning so that the yams become well established, and then every 14 days from then onwards.
- The yams will continue to grow in size throughout the growing season, but will reach maturity when there are large spots of yellowing on the leaves. The vines and leaves will eventually die



off as the yams reach full mature. The yams will not increase greatly in size the final month before the vines and leaves die away, so there is quite a bit of latitude for when the yams can be harvested. Ideally, stop spraying Pro-Plant a month before the signs of maturity start.



**A trellis increases the yield and makes it easy to spray Pro-Plant.**

#### **4. Mulching and Adding Bio-Plant**

- **Mulch the soil** around the yams or use one of the other methods in 1.2 (*see the section on cassava*) to control weeds. Dry coconut fronds, corn stalks, rice straw and other similar materials may be used as mulch. If rice straw or similar material, which rots readily is used, add bio-compost once every 30 days around each yam vine.
- Mulch should be made thick (about 10 cms) so that it will not rot completely within four or five months. Further to protecting the soil from excessive loss of moisture, mulching tends to add some nutrient to the soil from the decaying materials used.
- Extra Bio-Plant should be added every 30 days either by spraying it on the mulch or, even better, by placing bio-compost around the base of the yam plant.
- If the farmer uses drip-feed pipes, the Bio-Plant could be fed through the pipes. It is better to spray Pro-Plant because it coats the leaves with micro-organisms, which protect the yams from fungal diseases.



## **Part 24**

### **Using the Bio-fertilizers for Growing Sweet Potatoes**

#### **1. Soil Preparation**

- The soil should be mixed with compost to make it rich in nutrients and loose. *See the **Compost and Soil Preparation Methods** guidelines in Part 8 on page 43. Method 2 on page 55 is better than Method 1 because the soil preparation uses bio-compost made over about 7 weeks.*
- The field is ploughed and harrowed. Plant the sweet potato slips on ridges. The growing of sweet potato on the flat seed bed is not recommended because the resulting yields are usually low.
- Crop residues and other organic matter can be placed in between the ridges or mounds to facilitate moisture conservation and reduce soil erosion, and it can become additional source of nutrients when decomposed. It also suppresses weeds.
- If the soil is not prepared with compost, add it along the ridges where the slips are planted.



#### **2. Producing “Slips” from Tubers**

- Sweet potatoes are usually grown from slips.
- Start by planting healthy sweet potatoes in the ground (medium-sized – large) in potting mix soil prepared with Bio-Plant. You can cut the sweet potatoes in half, but you will get fewer slips growing off the sweet potatoes. Make sure that the soil is mixed with compost.
- Keep them watered and they will start producing suckers which can be used as “slips” within a week. Twist them off gently when they are 6-8 inches long and have roots. Cut off the bottom half an inch, even if there are roots there, so that any disease in the original sweet potato does not get transferred to the slip.
- Put the slips in large clumps in buckets of water mixed with Bio-Plant (20 cc in 20 litres of water) so that roots can grow. White roots will start to form within a week. When the roots are about 3 inches long they can be transplanted into soil. Remove all of the leaves except two at the top, and plant them directly into the soil composted with Bio-Plant with the top leaves just above the soil surface. Water them every day until they become established. Spray Pro-Plant every 14 days (20 cc mixed with 20 litres of water).





- If you are planting the slips in a field, dig a long trench down the field. Lay compost along the trench, place the slips on the edge of the trench with their roots touching the compost, and cover them with soil.

### 3. Choosing Vines

- Select clean, healthy (free from virus and pests) vines 25-30 cms. Long from the growing sweet potato plant. Longer vines result in wastage of planting material while shorter ones establish more slowly and give poorer yields.
- Pieces from the stem apex are preferred to those from the middle and basal portions of the stem although, where planting material is in short supply, middle and basal vine cuttings may be used with little reduction in expected yields.
- Lay each vine on the ridge of soil and use a stick with a V-shaped gap at the end and push down the middle of the vine so that it folds down in two into the soil.

### 4. Spacing

- Space plants about 12-18 inches apart with 3-4 feet between rows. The vines will spread and fill in the space, so give them plenty of room.

### 5. Applying Pro-Plant

- (See *Part 9. How to Apply Pro-Plant on page 64.*)
- Spray Pro-Plant every 14 days.

### 6. Maintenance

- Sweet potatoes can be slow starters and they do not like to compete with weeds. So, mulch thickly between the plants (ideally use bio-compost made with Bio-Plant) and even between the rows to initially keep the weeds down. Once the sweet potatoes grow they will choke all weeds down themselves. Keep the area clear until the top growth fills in and acts as a natural mulch.
- Weeds are a problem in sweet potato only during the first two months of growth.
- After this period, vigorous growth of the vines causes rapid and effective cover-age of the ground surface and smothers the weeds present. 2 hand-weedings after planting are recommended. First weeding is done within 2 weeks after planting and the second weeding two weeks after the first one when earthing-up is being done.
- Sweet potatoes can tolerate periods of drought, but regular watering is the best way to prevent splitting. Tip: Do not water your sweet potatoes during the final 3-4 weeks prior to harvest, to keep the mature tubers from splitting.



## **Part 25**

### **Using the Bio-fertilizers for Growing Pumpkins**

#### **1. Soil Preparation**

- See the *Compost and Soil Preparation Methods* guidelines in Part 8 on page 43. Method 2 on page 55 is better than Method 1 because the soil preparation uses bio-compost made over about 7 weeks.

#### **2. How to Germinate and Plant the Seeds** (See Part 9, Seed Preparation on page 60.)

- Soak the seeds for up to 24 hours in warm water, which has some Bio-Plant and Pro-Plant in it (Ratio 10 cc per 10 litres of water.). Wait until the seeds germinate and plant the seed with the germinated part pointing down.
- You can also use the Baggy Method. (See page 60.)
- If you have soaked the seeds, plant the seeds 1 - 2 inches deep in compost potting soil, which has been prepared with Bio-Plant (20 cc in 20 litres of water). Your seeds should sprout in 7 - 10 days.
- Plant the seed with the pointed end down because the roots come out of the pointed end. Then fill the pot to within 1 inch of the top with more of the compost potting soil. Water thoroughly, and then move to a warm and sunny position.
- Transplant the seedlings into potting soil trays or polybags. The soil should have been prepared with compost made with Bio-Plant (20 cc in 20 litres of water). For pumpkins it is beneficial to add Pro-Plant to the potting soil (20 cc in 20 litres of water).
- When seedlings have the fifth leaf, transplant them into a field where the soil has been prepared with compost made with Bio-Plant. Prepare soil, which is rich in compost (made with Bio-Plant), manure, and nutrients, so it would be beneficial to prepare the soil with Pro-Plant as well as Bio-Plant (500 cc mixed with 500 litres of water per hectare).
- Add additional compost around each plant every month. Alternatively, if you have added mulch around each plant to keep weeds down and retain moisture, you could spray Bio-Plant onto the mulch every month to add extra micro-organisms to the roots (20 cc in 20 litres of water or 1 litre in 1,000 litres of water).



**Young Seedlings in Potting Soil Trays**



**Pumpkins need a lot of compost, so add plenty to the planting hole.**

#### **3. How to Water the Pumpkins**

- Pumpkins are about 80% - 90% water, so as you can imagine they use a lot in their growth. The secret is to water the pumpkins only when they need it. Usually once per week is fine. Check the soil with a trowel or a hoe. As long as the moisture is good and your plant looks happy,

leave it alone. When the soil is starting to dry out, or the plant starts to look a bit droopy, give it a long deep drink. Deep but infrequent watering results in a healthier plant.

- Pumpkin seedlings will need to be watered every couple of days after planting due to their high rate of growth, but allow the surface to dry off before re-watering as this could cause fungal infections.
- Pumpkins need ample water when flowers and fruits are forming. It is best to use a drip system or soaker hose to directly water soil at the base of vines so as to avoid wetting foliage. Try to water in the early morning, so that any water that splashes onto leaves can soon dry. Wet foliage is more susceptible to fungus, such as powdery mildew, which can slowly kill all the leaves on a vine. Most vines wilt under the bright, hot afternoon sun, but if you see foliage wilting before 11:00 a.m., that is a sign that they need water.
- When your pumpkin fruit starts to turn orange, gradually decrease the amount of water. Your pumpkins will store longer, if you cut off water 7 - 10 days before you harvest the pumpkins.

#### 4. Looking After the Growth

- Pumpkin vines grow aggressively, covering lots of ground. To keep your rows from being engulfed by vines, direct them in a line outwards from the row.
- Some farmers promote branching to get more pumpkins by pinching the tips out of main vines when they reach about 2 feet long. You can also increase the yield on a vine by removing all female flowers (these have a small swelling at the base of the bloom) for the first 3 weeks. These practices may produce a sturdier vine that can set more, albeit smaller, pumpkins during the growing season if you have good soil, sun, and moisture.
- If your goal is fewer, larger pumpkins per vine, once you have 3 to 4 fruits on a vine, pinch off all remaining flowers as they form.



#### 5. Applying Pro-Plant

- (See *Part 9. How to Apply Pro-Plant* on page 64.)
- Pumpkins need a lot of nutrients, so spray Pro-Plant onto the leaves every 7 days. Every 7 days is best for large pumpkins. If you spray every 10 days, be sure to spray every 7 days when the buds start to appear, and from then onwards.
- You need about 100 to 120 days for most varieties of pumpkins. Giant pumpkins and other giant varieties require 130 to 150 days.

#### 6. Disease

- An important aspect to watering is not to over-water. Pumpkins are susceptible to a fungal disease called powdery mildew. Powdery mildew looks like your pumpkin leaves were dusted with talcum powder. The leaves will gradually wither and die. Sometimes the whole vine will die as a result.
- A warm moist environment encourages mildew growth. Keeping water off of the leaves, and watering in the morning instead of late in the evening, can help stave off this disease. If you have a bad outbreak of powdery or downy mildew, it can kill your vine and affect crop quality and production.

## **Part 26**

### **Using the Bio-fertilizers for Growing Onions**

#### **1. Soil Preparation**

- See the ***Compost and Soil Preparation Methods*** guidelines in Part 8 on page 43. Method 2 on page 55 is better than Method 1 because the soil preparation uses bio-compost made over about 7 weeks.
- Soil preparation with a lot of compost made with Bio-Plant will be invaluable in increasing growth. In a garden the farmer could mix the soil of the field with compost.
- In a large field the farmer might choose to plant the onion seedlings on both sides of a raised mound the length of the field. Then he would use a furrow hoe to create a furrow down the middle of the mound, and line it with compost. The roots of the onions on both sides of the furrow can receive the benefits in this way.
- **Good soil:** Sandy loam soil is the best for large onions. Compaction in the soil will lead to a pinched onion, and this will reduce the size of the onion. A bulb that will freely expand in the soil will be the biggest.



#### **2. Planting Onions From Seeds**

- Avoid onion sets and start from seed. Onion sets are great if you are a lazy farmer, but just because they are already started and easy, does not mean they will give you the best results.
- Sow seeds densely because of low germination rates for onion seeds about 1/2 inch deep.
- Onions are usually transplanted after 30 to 35 days. When the seedlings are about 4 inches high, transplant them into the field. Cut the tops off before planting them. This trimming encourages strong new growth which will result in robust bulbs when mature. Make planting holes 2 inches deep. Thin the seedlings to 5-6 inches apart. Each row should be 8 inches apart.
- To encourage development of bulbs, soak the seedlings in water mixed with Bio-Plant and Pro-Plant at a ratio of 20 cc of each in 20 litres of water for about 15 minutes before planting.

#### **3. Applying Pro-Plant**

- (See ***Part 9. How to Apply Pro-Plant*** on page 64.)
- Many people think that onions require lots of phosphorus because they are a root vegetable, however you want growth, so you will need a lot of Nitrogen. Each leaf the onion puts out is a ring on an onion, this means the more leaves, the bigger the onion. Therefore, spray Pro-Plant every 7 days.

#### **4. Growth Maintenance**

- **Watering:** Water frequently. Onions like lots of water, because the more water, the more plump the onion can get. The soil should never be allowed to get bone dry.
- The growth periods of an onion crop with a growing period of 100 to 134 days in the field are: establishment period (1) from sowing to transplanting 30 to 35 days; (2) vegetative period 25 to 30 days; (3) yield formation - bulb enlargement 50 to 80 days; and (4) ripening period 25 to 30 days. Pro-Plant should be sprayed every 7-10 days.



- The crop is most sensitive to water deficit during the yield formation period (3), particularly during the period of rapid bulb growth which occurs about 60 days after transplanting. - The crop is equally sensitive during transplantation. For a seed crop, the flowering period is very sensitive to water deficit. During the vegetative growth period (1) the crop appears to be relatively less sensitive to water deficits.
- For high yield of good quality the crop needs a controlled and frequent supply of water throughout the total growing period; however, over-irrigation leads to reduced growth.
- **Weeding.** Keep onion beds well-weeded. Onions are shallow rooted. Cultivate often and shallowly. Pull weeds by hand close to bulbs to avoid up-turning plants. Use a sharp hoe only to cut off weeds at soil level. Because onions leaves are thin and strappy they do not block the sun from the soil which, in turn, allows weed germination. Onion beds require more weeding than other vegetable beds.
- **Mulch:** Mulching will eliminate weeds. Weeds not only steal nutrients and water from the onion, but it will transmit viruses and diseases to the onion. Place a 1- to 2-inch layer of mulch around onions to discourage weeds and conserve soil moisture. Use aged compost or chopped leaves around onions. Keep the mulch back from the bulb tops once they start to develop. (To grow large onions, keep both mulch and soil pulled back from the top two-thirds of developing bulbs.)



#### 5. Tips to Increase the Size of the Onions

- When the stalks of the onions are 9 inches long, cut them in half.
- When the stalks of the onions are 12 inches long, cut them in half.
- When the stalks of the onions are 15 inches long, cut them in half.

#### 6. Diseases

- In case the onions get affected by rust, use this homemade remedy: Soak 1kg of pounded pawpaw leaves in a litre of water for six hours. Strain it through a cloth and add two tablespoons of liquid soap. Add five litres of water and spray every three days in the later afternoon.

#### **Fungal Diseases**

- Onion thrips might be a problem. The leaves will turn silverish and dry. Boil a cup of chopped rhubarb leaves in six cups of water. Leave to cool, add some liquid soap, strain and spray. But be careful, this concoction is poisonous.
- If mildew or other fungal diseases become a problem, spray with copper. On soils with boron deficiency, a foliar feed with 20g boric acid per acre is necessary. Sulphur or calcium deficiencies also need to be addressed if shown by a soil test. Spraying Pro-Plant should deal with these issues though.

#### 7. Harvest

- Leave the plant until the tops become like paper. Even once the tops die back, the onion will continue to absorb water for up to 2 weeks. So, an onion should be left in the ground till the tops fall over and become like paper.

## **Part 27**

### **Using the Bio-fertilizers for Growing Tomatoes**

**Note:** Here are some guidelines, ideas, and tips to produce a successful tomato crop.

#### **1. Soil Preparation**

##### **1a. Making Potting Soil for Seed Trays**

###### **Method 1 – Potting Soil for Seed Flats or Potting Soil Bags**

1. Rice husks – burned or not burned (3 parts)
  2. Coconut coir (1 part)
  3. Soil (2 parts)
  4. Bio-Plant mixed with water (20 cc in 20 litres)
- Soak the coconut coir in warm water.
  - Mix the ingredients well and then place them in the seed flats.
  - Water the potting soil well. Cover the seeds over with more potting soil. Plant 1 or 2 seeds in each section.
  - Water with a fine spray because this will ensure that more seeds germinate. Put the seeds in the shade until they grow about 0.5 cm. Then put them out in the sun. Spray them each time with the fine spray.
  - **Note:** You could add 1 part of bio-compost made with Bio-Plant.

###### **Method 2 – Potting Soil for Seed Flats or Potting Soil Bags**

1. Compost made with Bio-Plant (1 part)
  2. Soil (2 parts)
  3. Coconut coir (1 part)
  4. Bio-Plant mixed with water (20 cc in 20 litres)
- Soak the coconut coir in warm water. Mix the ingredients well and then place them in the seed flats. Water the potting soil well.

##### **1b. Soil Preparation for a Field**

- See the **Soil Preparation** guidelines on pages 43++. Section 1 shows how to make bio-compost with Bio-Plant. Section 5 (page 55) shows how to prepare the soil. The farmers can choose Method 1 or Method 2. Using the compost in Method 2 is highly recommended.
- The farmer has to decide when he is going to apply the bio-compost. It is best to plough in the bio-compost and to leave it for about 12-14 days before planting the tomatoes seedlings. This is so that the micro-organisms have enough time to multiply.

#### **2. Seed Preparation**

2.1 See the video at <https://www.youtube.com/watch?v=ZuBv-OpZ-8s&feature=youtu.be>

- Put the seeds in a plastic bag with holes punched into it. Water should be able to enter through holes. Soak them for 4 hours.
- Take the plastic bag out of the water. Wrap it with a wet cloth. Then place the cloth with the plastic bag of seeds in direct sunlight for 12 hours, and then leave them overnight in a warm place for 12 hours.

- Soak the seeds in water that contains 20 cc of Bio-Plant and 20 cc of Pro-Plant per 20 litres. (The ratio is 10 cc per 10 litres of water.) If the amount of seeds is small, reduce the water to just a few litres, but do not reduce the amount of the bio-fertilizers.
- After 24 hours take the germinated seeds out and plant them in a seed potting soil tray where there is potting soil in each small section of the tray. Place one seed per small section or two seeds if the section is large. Then cover them over with more soil.
- If you do not have a tray with sections for the individual seeds, place them in a deep basket kind of tray. Put some newspaper on the bottom and cover the newspaper with potting soil. Use a stick and create a small ditch from one side of the tray to the other. Place the seeds in the ditch and then cover them over with the soil.
- Cover the soil with wet paper or a wet cloth. Leave them for about 5 days. Take off the cloth or paper cover. After about 9 days dip the seedlings one by one in water that contains 20 cc of Bio-Plant and 20 cc of Pro-Plant per 20 litres. (The ratio is 10 cc per 10 litres of water.). Then plant each sprouted seed in a large potting soil tray, which has large, individual sections for each seedling. Or, if you wish, plant each seedling in an individual black planting bag filled with potting soil. Let them grow for about 25 days before transplanting them to a field.
- Transfer the soaked seeds after 24 hours to a growing pot in a black plastic bag or a large tray and leave them to grow. After 22-25 days transplant them into furrows in a field.

### 3. Spraying Pro-Plant

- Spray the plants with water that contains a ratio of 20 cc of Pro-Plant per 20 litres.
- For a hectare, mix 500 cc of Pro-Plant with 500 litres of water. For an acre, mix 250 cc of Pro-Plant with 250 litres of water. For half an acre, mix 125 cc of Pro-Plant with 125 litres of water. For 200 sq.m. mix 40 cc with 40 litres of water. For an area of 10 metres x 10 metres (100 sq.m.) mix 20 cc in 20 litres of water.
- Spray on the leaves before 9 AM when the pores are open most. Direct the spray diagonally upwards so that the spray hits the underside of the leaves as well because this is where the pores (stomata) are. Make sure that the spray is a very fine, misty, foggy kind of spray. Be thorough and generous when you spray.
- **70-Day Variety:** Spraying them every 7 days from when the leaves appear will give the best yield. Spray the short duration varieties every 7 days from Day 7.
- **110-Day Variety:** In the case of the longer duration varieties, spray them on Days 20, 30, 40, 50, 60, 70, 80, 90, and 100.
- The farmer can choose the frequency of spraying that suits him best. Spraying every 7 days will give a higher yield than every 10 days. If the farmer chooses to spray every 10 days, when the flowers appear, he should change to spraying every 7 days and continue spraying every 7 days.
- Make sure that the spray is a very fine, misty, foggy kind of spray. Be thorough and generous when you spray.

### 4. For Extra Yield - Spraying Additional Bio-Plant

- Because tomatoes grow for up to about 3 months, additional micro-organisms should be added to the soil, ideally once a month (every 30 days) on Day 30 and Day 60. Compost made with Bio-Plant would be an effective way to do this. Several kgs per tomatoes plant.
- If the farmer prefers, he could to apply Bio-Plant by spraying it mixed with water at the base of the plants. Do not spray on the leaves as they will turn yellow.
  - Hectare: Spray 500 cc of Bio-Plant mixed with 500 litres of water, or better 1 litre of Bio-Plant mixed with 500-1,000 litres of water.
  - Acre: Spray 250 cc of Bio-Plant mixed with 250 litres of water. You could spray 500 cc in 500 litres of water in order to provide more micro-organisms.



## Part 28

### Using the Bio-fertilizers for Growing Flowers

#### 1. Soil Preparation

##### 1.1 Preparing the Soil

- See the *Compost and Soil Preparation Methods* guidelines in Part 8 on page 43. Method 2 on page 55 is better than Method 1 because the soil preparation uses bio-compost.

#### 2. Planting the Flowers

- John Jeavons, in his groundbreaking book *Grow More Vegetables: Than You Ever Thought Possible*, outlines an intensive approach to gardening revolving around close plant spacing. His discovery was that most plants only need a small amount of space to thrive. The key is planting on a grid versus side-by-side rows. A secondary bonus to increasing the amount of plants grown in a small space is that as they fill in their foliage canopy covers the soils surface and blocks out weeds.



- Someone who applied the guidelines with great success has written: “We quickly realized that we could double; possibly even triple our production by adopting this new method of growing. It took a bit of trial and error to figure out exactly how close each variety could be planted without diminishing production or inviting in disease. We finally settled on what worked the very best and simplified things by creating just six separate spacing regimes: 6” ×6”, 8”×12”, 9”×9”, 12”×12” and 18”×18”, with the 9”×9” spacing being our most popular.”



- If you aren’t able to plant an entire bed with only one variety, be sure to plant varieties with the same spacing requirements, and roughly the same amount of days to flower in the same bed.



- 6" x 6" spacing = 7 rows per bed
- 9" x 9" spacing = 5 rows per bed
- 12" x 12" spacing = 4 rows per bed
- 18" x 18" spacing = 3 rows per bed
- For vines: 8" between plants and 12" between rows = 2 rows per bed, one on each side of the trellis

### 3. Compost the Soil



- To start, put down a thick layer (3"-4") of compost across the top of each bed, making sure to spread it out as evenly as possible.
- Till the compost into the soil and lay down irrigation lines. If the soil is sandy, put down four lines of drip, a foot apart. If you have clay soil, you could probably get away with only two or three.

- In the case of raised beds that are not covered in landscape fabric, mulch the new plantings thickly with straw, shredded leaves or grass clipping to help retain moisture and suppress weeds.

#### 4. **Seed Preparation**

- *(See Part 9, Seed Preparation on page 60.)*

#### 5. **Applying Pro-Plant**

- *(See Part 9. How to Apply Pro-Plant on page 64.)*
- Spray the flowers well with a fine, misty spray and ideally before 9 a.m. when the leaf pores are open most. Spray the leaves, buds, and flowers.
- Spray Pro-Plant every 7-10 days. The productivity increases with more Pro-Plant, but so do the costs. Spraying every 7 days is better for the yield than every 10 days or 14 days, for example. But you could experiment. Spray the flowers every 7 days. Continue until a week before the flowers are picked.
- For an area of about 100 square metres (10 m x 10 m), spray the flowers every 7 days with water that contains 20 cc of Pro-Plant per 20 litres on Day 1 and Day 8. Double the dose for an area of 200 square metres.
- Spray Pro-Plant 125 cc mixed with 125 cc of water for a half acre. For an acre spray Pro-Plant 250 cc mixed with 250 litres of water. For a hectare, mix 500 cc of Pro-Plant and 250 cc of Bio-Plant with 500 litres of water.
- **Roses:** Spray roses on Day 30, 34, 50, 60, and every 10 days until about Day 130. To reduce costs, spray the roses every 15 days from Day 30.

#### 6. **Hydroponics**

- Spray Pro-Plant on the leaves of the plants every 7 days. Mix 20 cc of Pro-Plant in 20 litres of water. For an acre spray 250 cc in 250 litres of water. Spraying on the leaves is more effective than mixing Pro-Plant in the water which the plants are placed in. There is no need for Bio-Plant unless the plants get fungus. Then add 5 cc to each 20 cc of water used for the roots.

#### 7. **The Benefits for Flower Growers**

- a) The flowers look fresher. The colours tend to be brighter than chemical flowers. There is more of a shine on the leaves that you get with chemical flowers.
- b) Increased bloom set and size of flowers.
- c) The overall quality of the flowers is better than with chemical fertilizers and sprays.
- d) The flowers stay fresher longer after being picked.
- e) The flowers can be marketed as “100% organic” or “Grown without Chemicals”.
- f) The growers do not have to use chemical sprays to prevent disease as Pro-Plant coats the flowers with micro-organisms that protect the plants while Bio-Plant strengthens the immune system. As a result, the customers can smell the flowers without having to worry about inhaling chemicals.
- g) The soil’s condition improves with each crop. It becomes crumblier and softer.
- h) Bushy flowers, such as bougainvillea bushes, produce many more branches and flowers.
- i) A rose grower in Multan, Pakistan reported that his rose crop had increased by 100%. He had been applying chemical fertilizers for several years, and his soil was probably very weak because of over-use of chemicals. When he used the bio-fertilizer on roses, the roses were fresher-looking and smelled nicer. The rose bushes grew more densely, and some of the stems appeared much thicker than the rest of the stems grown with chemicals. The height of the plants increased as well. Flower growers in North Thailand report the benefits outlined above.

## **Part 29**

### **Using the Bio-fertilizers for Growing Pineapple**

#### **1. Soil Preparation**

##### **1.1 Preparing the Soil**

- See the *Compost and Soil Preparation Methods* guidelines in Part 8 on page 43. Method 2 on page 55 is better than Method 1 because the soil preparation uses bio-compost.
- **Note:** It is worth watching this video by Dole, which shows how the company makes its compost and plants the pineapple slips in the compost:  
<https://www.youtube.com/watch?v=5VnXiP3RNSk>

#### **2. Preparing the Suckers for Planting:** <https://www.youtube.com/watch?v=wIhMTid0Ytg>

- Pull off the suckers from the pineapple plants. Remove the bottom leaves so as to expose the nodes. They can then be planted in the fields in the soil on the ridges, which you have prepared with compost.
- It is a good idea to dip the suckers in Bio-Plant mixed with water at the ratio of 20 cc in 20 litres of water before planting in the soil to provide disease protection.

#### **3. Spraying Pro-Plant**

- For a hectare, mix 500 cc of Pro-Plant with 500 litres of water. For an acre, mix 250 cc of Pro-Plant with 250 litres of water each time you spray the crop. For half an acre, mix 125 cc of Pro-Plant with 125 litres of water. For 200 sq.m mix 40 cc with 40 litres of water. For an area of 10 metres x 10 metres (100 sq.m.) mix 20 cc of Pro-Plant in 20 litres of water.
- Spray the leaves (including the flowers and fruit when they appear) before 9 AM when the pores are open most. Spray on the edges of the leaves as well. Make sure that the spray is a very fine, misty, foggy kind of spray. Be thorough and generous when you spray.

#### ***Pineapple Foliar Program of Fertilization + Flower Induction***

<b>Crop Stage</b>	<b>Application Method</b>
Plant Establishment	Start applications when the young plant has the first roots. Repeat during the next two months with 10-15 days intervals.
Vegetative Development	Apply at the sprouting time, repeat with 10-15 days intervals. Stop applications at the beginning of stem thickening due to flowering buds.
Flower Induction	Apply 2-4 times two months before flowering with 15 days intervals.
	Start applications during all the leaf growing period, with 15 days intervals.
Flowering	In order to induce flowering, apply one month before stem thickening with 15 days intervals.
	Apply at the moment of the stem thickening, repeat with weekly intervals until flower opening.
Fruit Growth	Start applications at the beginning of fruit filling; repeat with 7-10 days intervals until end of harvest.
	Apply at the beginning of fruit filling with 7-10 days intervals until harvest.
Fruit Growth (cont.)	Apply during all the fruit growth period with 15 days of intervals.

#### 4. **Chemical Sprays**

- There is no need to spray chemical pesticides. It is worth watching this video by Dole, which shows how the company uses natural pest repellants so that the pineapples are 100% organic: <https://www.youtube.com/watch?v=5VnXiP3RNSk>
- Plastic mulching is commonly used to prevent weed growth in very large pineapple plantations. If this method is not used and you have plenty of organic mulch, then place this on the ridges around the plants. If you do not mulch, you will have to carry out manual weeding. Herbicides cannot be used in 100% organic farming, of course, and their use has a detrimental effect on the soil's microbial life.



## **Part 30**

### **Using the Bio-fertilizers for Growing Tea**

#### **1. Soil Preparation**

##### **1.1 Preparing the Compost**

- *See the **Compost and Soil Preparation Methods** guidelines in Part 8 on page 43. For tea plants you need to prepare bio-compost with Bio-Plant. The Heap Method explains what to do.*
- *Make several compost piles at the same time because you will need an endless supply. (See below.)*
- *When planting, put the compost on the top soil, which goes at the bottom of the hole.*



#### **2. Preparing the Seeds**

- *(See Part 9, **Seed Preparation** on page 60.). If you propagate new tea plants from seeds, soak the seeds in water mixed with Bio-Plant for 24 hours. Only heavy seeds, which sink, should be used for sowing in beds. Germination will occur in 20-30 days. At that stage lift out the seedlings and transplant them in black plastic potting bags. They will be ready for planting in 9 months. The potting soil should contain compost made with Bio-Plant.*
- *If you propagate from cuttings, plant the cuttings in bags, which have soil which contains compost made with Bio-Plant.*

#### **3. Applying Additional Bio-Plant During the Growth of the Plants** *(See section 1.2 on page 76.)*

- *Make sure that you place plenty of compost in the planting hole. Place it on top of the top soil, which should be placed at the bottom of the hole under the compost. The soil, which was at the bottom of the hole, should be placed on top of the compost. More compost can be placed on top.*
- *A key to high-quality tea from every bush is to nourish the soil regularly through the application of compost, and timely weeding. Place plenty of compost made with Bio-Plant around each tea bush (without it touching the trunk) and apply compost once a month.*
- *If you are not using compost and are placing organic matter around the tree (without it touching the stem of the bush), spray the organic matter with water that contains 500 cc. of Bio-Plant per 500 litres of water. Spray just enough to soak it.*

#### 4. **Spraying Pro-Plant** (See *Part 9. How to Apply Pro-Plant* on page 64.)

- 4.1 Prior to Plucking the Leaves:** The tea seedlings will be planted onto nursery beds where they will remain for 12-18 months. Spray Pro-Plant on the seedlings every 2-4 weeks. As soon as they turn into young plants, plant them in the main plantation where they will be left for 4 years before any leaves can be plucked.
- Spraying Pro-Plant on the plants once per month during this period will be enough. But, spraying every 2 weeks will provide more nutrients and increase the rate of growth of the tea plants; however, your costs will be higher.
  - If you wish to reduce your costs in Years 1-4, spray Pro-Plant every 2 months, and then spray Pro-Plant every 2 weeks in the last 2 months before you start to pluck the leaves.
  - Spray at the ratio of 20 cc of Pro-Plant per 20 litres of water. For a hectare, mix 500 cc of Pro-Plant with 500 litres of water. For an acre, mix 250 cc of Pro-Plant with 250 litres of water each time you spray the plantation.
  - **Very Important Note:** Please spray Pro-Plant using spraying equipment that gives a fine, misty spray, and that the spray is directed diagonally upwards so that it hits the pores of the leaves underneath as well as lands on the leaves. Spray the leaves well, and ideally before 9 a.m. when the leaf pores are open most. Shake the bottle of Pro-Plant well before using it.

#### 4.2 **The Period When the Leaves Are Plucked**

- In Vietnam the tea growers spray Pro-Plant every 7-10 days and pick the leaves every 21 days. The tea growers in Vietnam usually spray every 7 days as they want the extra yield. They also water the tea plants every 2 days. They say that this contributes noticeably to getting the extra yield and other quality-related benefits.
- **If no organic matter can be applied to the ground for some reason:** Spray the leaves every 7 days with water that contains 10 cc. of Pro-Plant and 2.5 cc Bio-Plant per 10 litres. Better still: Spray a solution containing 20 cc of Pro-Plant and 5 cc Bio-Plant in 20-30 litres of water on the leaves.
- **Note:** The tea growers in Vietnam make sure that there are spaces for the foggy spraying by pruning the plants once a year and removing the old leaves.

#### 5. **Mulching**

- It is important to mulch the soil so as to suppress the growth of weeds. (See *Part 8. Compost and Soil Preparation Methods, Cover Crops, and Mulching* on 37.) So, immediately after planting, mulch the soil surface around the tea plants. Usually cut grasses are used for this purpose. Mulching in the Nursery is also beneficial. About 25 tonnes of grass are required to mulch one hectare. Care must be taken to keep the mulch materials away from the collar region last they may cause collar diseases.

#### 6. **Maintenance of the Tea Plants**

- The growers in Vietnam do the following to get their good results:
  - Over time the leaves of the tea plants get dusty, which inhibits the growth. They mix 1 litre of washing liquid in about 300 litres of water and spray or pour it over the leaves, followed by spraying water over the leaves. This cleans off the dust. Some tea growers may say that this is extra work, but the tea growers in Vietnam say it pays off in productivity.
  - The plants should be pruned once a year and the old leaves taken off. This needs to be done because if it is not done, when the tea growers spray Pro-Plant, the plants will be so thick that the spray cannot get through to the leaves.

**7. Main Benefits Compared to Using Chemical Fertilizers**

- The yield will be 20%-30% higher.
- The leaves will look fresher and shine more.
- The tea plants will have more leaves and branches.
- The quality and fertility of the soil will be superior.
- The quality of the tea will be higher.
- The tea will have a more pleasant scent.
- The tea will have less tannin.
- The Vitamin C level will be higher.
- Fungicides, and insecticides no longer need to be used (additional cost savings).

**8. General Notes**

- If you have cows or chickens, use their dung to make the compost. To further develop soil fertility, pruned leaves can be mixed with the dung and Bio-Plant in water at the usual ratio to provide organic fertilizer.
- Cow urine can be sprayed around the plants as an insect repellent.
- Neem can be sprayed to kill insect pests, if needed.

## **Part 31**

### **Using the Bio-fertilizers for Growing Palm Oil Trees**

#### **1. Soil Preparation**

- See the *Compost and Soil Preparation Methods* guidelines in Part 8 on page 43. Method 2 on page 55 is better than Method 1 because the soil preparation uses bio-compost.

#### **2. Applying Bio-Plant to the Soil of Growing Trees**

- Spray the soil in the root zone of the tree about 3 meters from the tree in the case of 3-year old trees ideally once every month with a mixture of Bio-Plant and water (ratio 1 litre of Bio-Plant in 1,000 litres of water). Spray about 2-3 litres per tree. 1 litre of Bio-Plant will, therefore, be enough for 2 hectares. Spraying in this way is necessary to increase and replace the concentration of micro-organisms, and to provide nutrients to the trees.
- The minimum number of times to spray Bio-Plant would be to apply it four times just before and during the fruiting season. During this period spray the soil in the root zone of the tree about 3 meters from the tree in the case of 3-year old trees once a month four times with a mixture of Bio-Plant and water (ratio 1 litre of Bio-Plant in 1,000 litres of water). Spray about 2-3 litres at the base of each tree.
- Because palm oil trees grow for a long time, the farmers should apply Bio-Plant to the soil regularly in order to increase the concentration of micro-organisms. Even if the soil is in good condition, it still needs to receive more micro-organisms regularly.
- If there are branches around the tree spray the Bio-Plant mixture on the leaves. The micro-organisms will dissolve the leaves and the nutrients will go into the soil together with the micro-organisms.

#### **3. Adding Decanter Cake Compost Made with Bio-Plant**

- 5 MT of palm oil mill decanter cake mixed with Bio-Plant (1 litre in about 300 litres of water per 5 MT) will make excellent compost for the trees. Place about 10 kgs around each tree. If you plant 150 trees per hectare, this will cover 3 hectares.

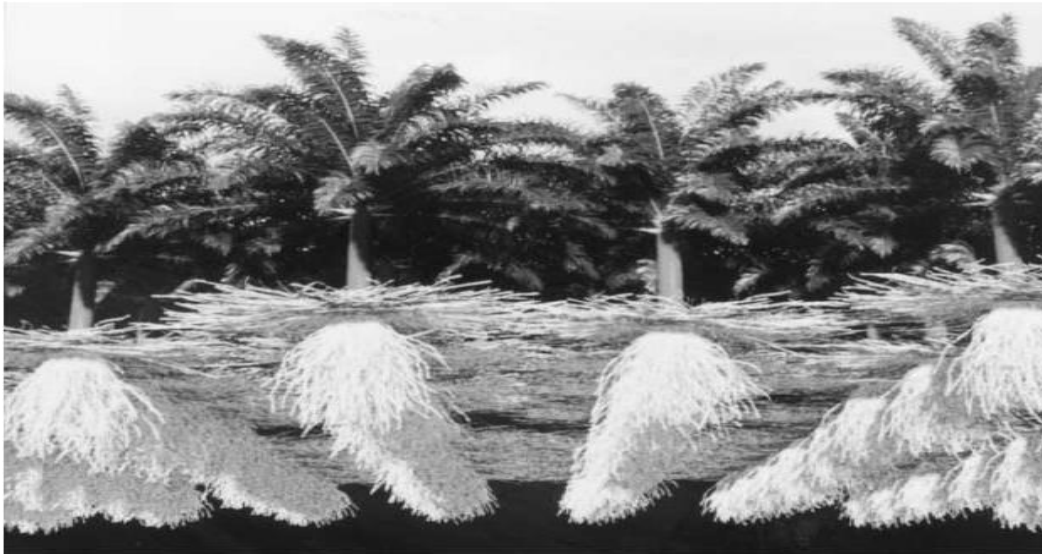
#### **4. Where to Apply Bio-Plant**

- 4.1 Spray on Piled Up Branches:** Cut the branches, which are piled up around the trees like in the photograph below, into small pieces with a machete. Then spray Bio-Plant mixed with water on the branches. Bio-Plant will percolate down to the ground more easily, if the branches are cut into small pieces. The micro-organisms will be able to break down the branches more easily, if the pieces are small. It will just take longer, if the branches are piled up as shown in the photograph.





- 4.2 Grind Up the Branches:** Ideally, the branches placed around the trees should be ground up with a machine and mixed with Bio-Plant and water. This compost can then be spread around the trees where the branches are shown. The yield of the trees will increase more in this way compared to piling up branches.
- 4.3 Place the Branches in the Rows:** Pile up the cut up branches and place them in the middle of the rows between each pair of trees. Spread out the piles so that the height of the piles is low and the width is wide as opposed to creating tall, narrow piles. Spray Bio-Plant mixed with water on the cut branches. As the diagram below shows, the roots will absorb the nutrients made available by the micro-organisms.



*Simulated 8-year-old oil-palm plantation.  
Planting density: 143 palms ha. From below.*

- 4.4 Use Decanter Cake as Compost:** Decanter cake is full of nutrients. Decanter cake mixed with Bio-Plant and water could also be placed in shallow pits between each pair of trees in the middle of each row. The micro-organisms will turn it into excellent compost. The reason for creating shallow pits is because over time the ground will become hard, and digging up the soil will aerate the soil for the roots. Aerating the soil will increase the yield and it should be done 2-3 times a year, if you do not create shallow pits and fill them with organic matter. Placing decanter cake (or even cut up branches) sprayed with Bio-Plant in the pits will increase the amount of micro-organisms and nutrients, which are made available to the roots.



*Decanter Cake*

**4.5 Use the Empty Fruit Bunches as Compost:** Empty fruit bunches from the palm oil mills can also be placed one bunch deep between the trees as compost. Ideally, break the bunches into small pieces or grind them up in a machine. There is no need to spray Bio-Plant on them, if you are applying Bio-Plant in other ways. But if you are not, then cut up the fruit bunches into small pieces (or grind them up) and spray Bio-Plant mixed with water on them. Applying about 40 MT of empty fruit bunches per hectare will supplement a lot of extra Nitrogen, Phosphorus, Potassium, and Magnesium. Apply them within 4 days of leaving the palm oil mill because the nutrients tend to leach quickly.

**5. Grind-up Palm Oil Tree Waste**

- A lot of organic waste is created by palm oil trees, such as the branches which are cut down, and the waste produced at the palm oil mills. If the organic matter from the plantation as well as the decanter cake is ground up, laid in long piles about 1.5 metres high, sprayed with Bio-Plant in water (ratio 1 litre in 1,000 litres of water), turned over, and left for 2 weeks or more, you would produce very good compost, which could be placed around the trees or in the middle of the rows between the trees

**6. Spraying the Leaves with Pro-Plant**

- Pro-Plant provides all the nutrients required by palm oil trees. (*See section 7 below.*) Consequently, spraying it regularly on the leaves is very beneficial to the health of the trees and to the crop yield.
- Mix Pro-Plant (1 litre) in water (1,000 litres). This should be enough for 2 hectares, if you spray Pro-Plant with a misty spray.
- Spray Pro-Plant on and under the leaves once per month before the fruiting period starts. If you wish to reduce costs, just spray four times starting just before and during the fruiting period.
- Spray the leaves with a misty spray. It is best to spray before about 9:30 a.m. when the stomata are open the widest. Be generous when you spray a tree. You do not have to spray every branch, though.
- Spray 1-2 litres of the Pro-Plant mixture per tree. Depending on the spacing of your tree and the mistiness of the spray head, you will most probably use only half a litre of Pro-Plant per hectare per time.

**7. Nutrients Required by Palm Oil Trees**

- Palm oil trees have the following nutrient requirements. Pro-Plant provides these nutrients whereas chemical fertilisers only provide a few of them. Bio-Plant will make the 80% of chemical NPK available to the roots as well as make available other soil nutrients through microbial action.
- **Macronutrients:** Nitrogen, Phosphorous, and Potassium.
- **Mesonutrients:** Sulphur, Calcium, and Magnesium. They are required in substantial amounts.
- **Micronutrients:** Iron, Zinc, Copper, Manganese, Aluminium, Boron, Molybdenum, and Chlorine.
- Pro-Plant provides a large range of other nutrients, which are very beneficial.

**8. Spraying Pesticides**

- When you spray Pro-Plant the leaves get coated with micro-organisms that protect the trees from disease. The Bio-Plant strengthens the immune system so that the trees are less susceptible to disease. Chemical sprays kill the micro-organisms, which will be multiplying in the soil and being sprayed onto the leaves, so please do not spray them.

## **Part 32**

### **The General Effects of Using the Bio-fertilizers With Some Crops**

#### **1. Typical Effects on Rice**

- Unlike chemical rice, which is tall and has many green leaves, rice grown with the bio-fertilizers is yellowish-green, shorter, and has fewer leaves.
- The stems are stronger, so the rice plants do not lean over like chemical rice.
- If you pull up a rice plant, you will see about 20% more roots than on a chemical rice plant.
- The roots are stronger and longer.
- The rice heads contain much more grain.
- The rice seeds do not tend to fall off during harvesting.
- The soil is softer and more fertile, and has a lot of worms and insect life.
- Bigger rice yields.
- There is no problem with the usual rice diseases because the micro-organisms develop in the rice plants a strong immune system.
- The quality of the rice is such that the seed becomes in demand as mother seeds.
- The taste of the rice is sweeter and more flavoursome.

#### **2. Typical Effects on Fruit Trees**

- Fruit trees produce more fruit, the fruit is larger, crispier, tastier, sweeter, and the Vitamin C level is higher by about 20%.
- The taste of chemical fruit pales in comparison.
- Mangoes grow large and become very sweet.
- Excellent for 100% organic fruit exports.

#### **3. Typical Effects on Pineapple**

- The fruit is much sweeter than pineapple grown with chemical fertilizer. About 35% sweeter.
- The pineapples are heavier.
- The pineapples look fresher and more attractive to eat.
- There are more suckers and slips so that more pineapple plants can be planted and grown.
- There are more roots and the roots are longer.
- The problems with disease disappear.
- The pineapples keep longer after harvest.

#### **5. Typical Effects on Rubber Trees**

- In Vietnam almost all rubber plantations use Bio-Plant and Pro-Plant now, and produce 100% organic latex for export.
- The trees produce more latex than when chemicals were used in the past. Much lower costs.
- The latex is softer and flows easier.
- The growth of young trees is usually 20% - 25% faster than normal, and the saplings can be transplanted a month earlier than normal.
- Bio-Plant stops the growth of fungus when brushed onto the trees.

#### **6. Typical Effects on Tea Bushes**

- There are qualitative and quantitative benefits when the bio-fertilizers are used on tea plantations. The following benefits are common in tea plantations in Thailand and Vietnam:
  - a. The yield is 20%-30% higher.

- b. The leaves look fresher and shine more.
- c. The tea bushes have more leaves and branches.
- d. The quality and fertility of the soil is superior.
- e. The quality of the tea is higher.
- f. The tea has a more pleasant scent.
- g. The tea has less tannin.
- h. The Vitamin C level is higher.
- i. Fungicides and insecticides are no longer needed.
- OCIRTHE, the main tea association in Rwanda, has carried out tea plantation tests with very positive physical and quantitative results.
  - j. The tea leaf colour in the test areas changed from a dark green shade to a lighter green with a distinct shine visible. The leaves were softer and looked fresher.
  - k. This change highlighted improvement in the health of the tea plants and a reduction in the tannin content.
  - l. A noticeable increase in the size of the tea leaves as well as evidence of more leaves per tea bush. This change co-relates to the effective increase in yield.

#### **7. Typical Effects on Chillis**

- Chillis are longer and heavier than chemical chillis, usually by 20% - 30% while the production costs are much lower both in bio-chemical farming and 100% organic farming.
- Like with all crops produced with the bio-fertilizers, the chillis keep fresh much longer – usually 1-2 weeks.

#### **8. Typical Effects on Coffee Trees**

- There are many farmers in North Thailand growing coffee with the bio-fertilizers in a 100% organic manner. The organic coffee has more aroma, a better flavour, more body, and a fresher after-taste.
- The yield of the trees is especially good when the trees are grown from the sapling stage with Bio-Plant and Pro-Plant. Almost all the berries turn dark at the same time.



## **Part 33**

### **Raising Your Vibration**

#### **1. The Quick Coherence Technique: An Emotion-Restructuring Technique**

##### **Benefits**

- The Quick Coherence Technique is especially useful when you start to feel a draining emotion, such as frustration, irritation, anxiety, or stress. The technique can keep the negative emotions from escalating. This technique brings you back into balance quickly. The increased physiological coherence generated reinforces and amplifies a positive feeling state of love, care, kindness, appreciation, and compassion, and changes the kind of energy that you are radiating by raising its frequency.
- You can do the technique anytime and anywhere and no one will know you are doing it. You do not have to close your eyes. In less than a minute it creates positive changes in your heart rhythms, sending powerful signals to the brain that can improve how you are feeling. Apply this one-minute technique first thing in the morning, during work, in the middle of a difficult conversation, when you feel under pressure, or anytime you simply want to practice increasing your coherence.

##### **Method**

##### **a. Heart Focus:**

Close your eyes or keep them open, if you prefer. Shift your attention to the area of the heart and breathe slowly and deeply. Breathe in deeply and slowly through your nose and out slowly through your mouth.

##### **b. Heart Breathing:**

Keep your focus in the heart. Breathe deeply, but normally, five seconds in and five seconds out. Imagine that your breath is coming in and going out through your heart area. Feel the breath going in and out of the heart area. Continue breathing with ease until you find a natural inner rhythm that feels good to you.

##### **c. Heart Feeling:**

Activate and sustain a genuine feeling of appreciation or care for someone or something in your life. One of the easiest ways to generate a positive, heart-based feeling is to remember a special place you have been to or the love you feel for a close friend or family member or treasured pet. This is the most important step. Focus on the good heart feeling as you continue to breathe through the area of your heart. Continue to focus on the feeling of joy. Breathe in and out with your eyes and mouth open or closed, just enjoying the euphoria running through you. You can also send this feeling to crops as mist flowing from the heart.

#### **2. Baha'i Prayers for Spiritual Happiness and a Higher Vibration**

##### **1. "From the Sweet-Scented Streams..." - Baha'u'llah**

From the sweet-scented streams of Thine eternity give me to drink, O my God, and of the fruits of the tree of Thy being enable me to taste, O my Hope!

From the crystal springs of Thy love suffer me to quaff, O my Glory, and beneath the shadow of Thine everlasting providence let me abide, O my Light!

Within the meadows of Thy nearness, before Thy presence, make me able to roam, O my Beloved, and at the right hand of the throne of Thy mercy, seat me, O my Desire!  
 From the fragrant breezes of Thy joy let a breath pass over me, O my Goal, and into the heights of the paradise of Thy reality let me gain admission, O my Adored One!  
 To the melodies of the dove of Thy oneness suffer me to hearken, O Resplendent One, and through the spirit of Thy power and Thy might quicken me, O my Provider!  
 In the spirit of Thy love keep me steadfast, O my Succorer, and in the path of Thy good pleasure set firm my steps, O my Maker!  
 Within the garden of Thine immortality, before Thy countenance, let me abide for ever, O Thou Who art merciful unto me, and upon the seat of Thy glory stablish me, O Thou Who art my Possessor!  
 To the heaven of Thy loving-kindness lift me up, O my Quickener, and unto the Daystar of Thy guidance lead me, O Thou my Attractor!  
 Before the revelations of Thine invisible spirit summon me to be present, O Thou Who art my Origin and my Highest Wish, and unto the essence of the fragrance of Thy beauty, which Thou wilt manifest, cause me to return, O Thou Who art my God!  
 Potent art Thou to do what pleaseth Thee.  
 Thou art, verily, the Most Exalted, the All-Glorious, the All-Highest.

2. **“O God! Refresh and Gladden My Spirit...” - ‘Abdu’l-Bahá**

O God! Refresh and gladden my spirit. Purify my heart. Illumine my powers. I lay all my affairs in Thy hand. Thou art my Guide and my Refuge. I will no longer be sorrowful and grieved; I will be a happy and joyful being. O God! I will no longer be full of anxiety, nor will I let trouble harass me. I will not dwell on the unpleasant things of life. O God! Thou art more friend to me than I am to myself. I dedicate myself to Thee, O Lord."

3. **“Create In Me A Pure Heart...” - Baha’u’llah**

Create in me a pure heart, O my God, and renew a tranquil conscience within me, O my Hope! Through the spirit of power confirm Thou me in Thy Cause, O my Best-Beloved, and by the light of Thy glory reveal unto me Thy path, O Thou the Goal of my desire! Through the power of Thy transcendent might lift me up unto the heaven of Thy holiness, O Source of my being, and by the breezes of Thine eternity gladden me, O Thou Who art my God! Let Thine everlasting melodies breathe tranquillity on me, O my Companion, and let the riches of Thine ancient countenance deliver me from all except Thee, O my Master, and let the tidings of the revelation of Thine incorruptible Essence bring me joy, O Thou Who art the most manifest of the manifest and the most hidden of the hidden!