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 is a privately owned company with its corporate headquarters in 1 Younger Street, Suite 1801, Toronto, M5E1W7 Canada. It is incorporated with the Corporate Affairs Commission in Nigeria with its operating office at 1 Communal Center, NNPC Housing Estate, Area 11, FCT Abuja.

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

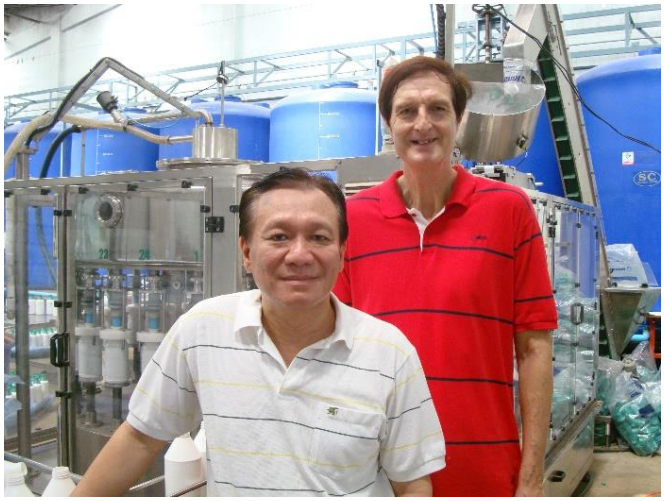
- For the treatment of rubbish dumps; and municipal, sugar mill, and distillery waste water. The water can be used afterwards in agriculture. Bio-Plant can also be used very effectively for these purposes.

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

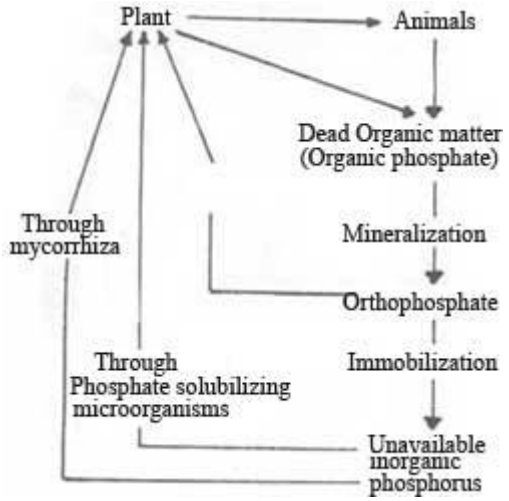
Part 2
What is a Bio-fertilizer?

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

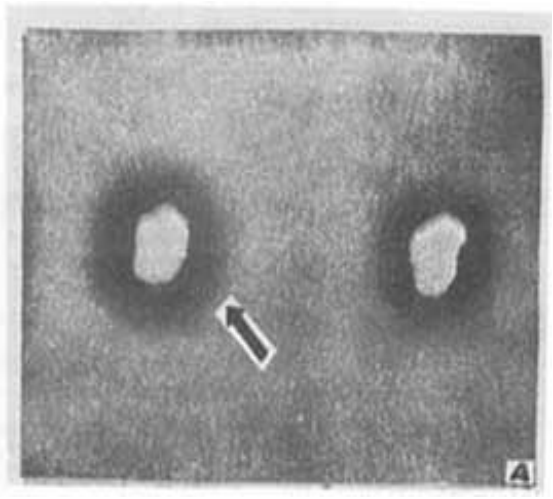
- Bio-fertilizer is a 100% natural and organic fertilizer that helps to provide all the nutrients and micro-organisms required for the benefits of the plants. It contains a large population of beneficial micro-organisms that enhance the productivity of the soil and increase plant growth either by fixing 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

- 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

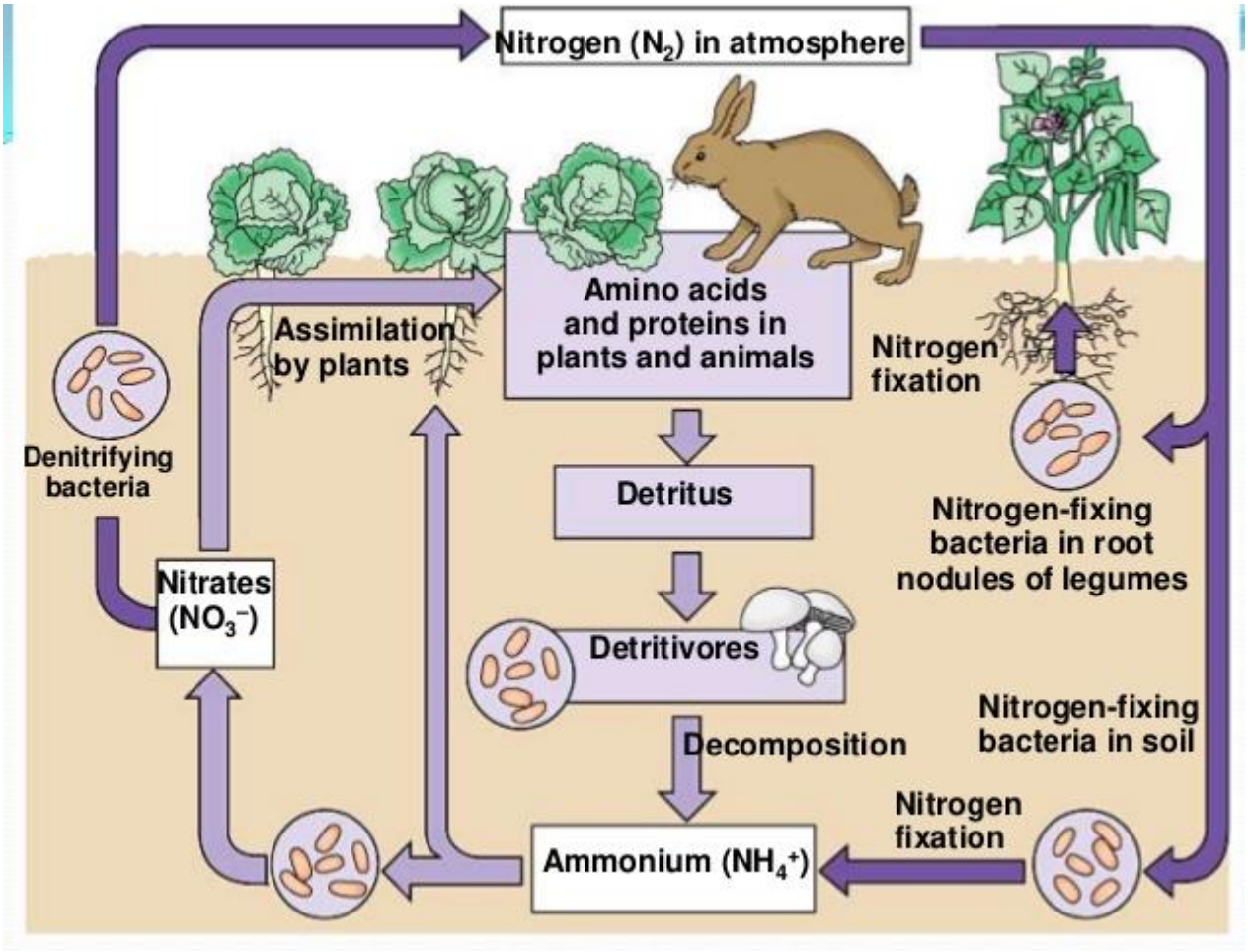
2. Some General Benefits of Bio-fertilizers Compared to Chemical Fertilizers

- 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 is 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 chemicals 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 3
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_2 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, expect 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.
- 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 4
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.
- In 1996 a UK investigation by the Ministry of Agriculture, Fisheries and Food showed that over 4% of the milk supply contained amounts of Lindane above the maximum recommended levels, and in 2 samples DDT was detected even though it has been banned for over 10 years. [The Food Magazine, Issue 34, 1996]

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.

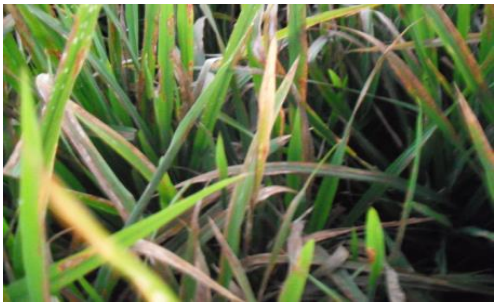
1.5 Organic Food Keeps Longer

- 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 the latter's susceptibility to 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, Chlorpyriphos, 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 Cow-Grazing Land

- Organic farming practices not only benefit farmers and consumers; but the dairies can 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 5
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 at least 30% above what chemicals achieve
(often more, depending on how the bio-fertilizers are used). Costs are reduced very 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 or10^6.

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.
- 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 2nd 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

+

=

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

330 cc Bio-Plant

+

50 kgs Urea/NPK

+

Spraying Pro-Plant (500 cc per hectare)

=

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

Section 3

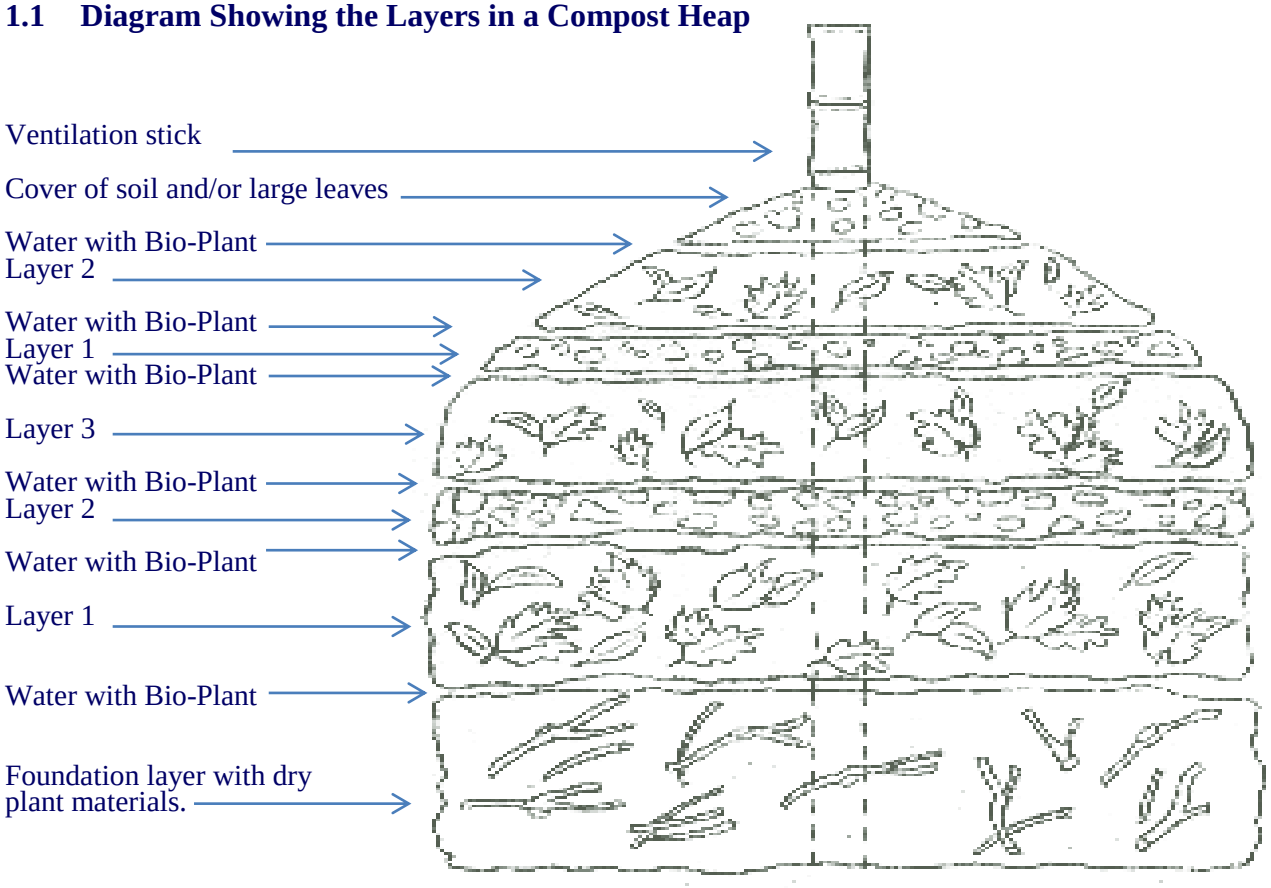
How to Use the Bio-fertilizers to Grow Crops

Part 6
Compost and Soil Preparation Methods, Cover Crops, and Mulching

1. The Heap Compost Method

- This method is most suitable for the rainy season when there are plenty of materials, e.g. weeds, to put into the compost. However, the place for making compost should be well-drained and easy to protect from floods and excess rain.
- This method can also be used by vegetable growers when they clean their fields before the next crop is planted. The residues left after the crop is finished and harvested, such as stems and leaves from pumpkins, potatoes, tomatoes, chili peppers and courgettes/zucchini, leaves and stalks from cabbage, etc., and any damaged crops that cannot be sold or eaten, can be collected together and organized for making 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.

1.3 Preparing the Site

- Clear the site of stones, weeds and grasses, but do not cut down any young trees. Instead, set up the site in the shade of trees. The trees will grow, provide shade and protect the compost heap.

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. If you want to make more than 5 MT, make each layer thicker than 25 cms.
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 pit so that moisture with nutrients does not leak out of the base of the compost heap.
3. The foundation layer of compost-making materials is placed in the trench or pit. *(See below.)*
4. The trench holds moisture during the dry season.
5. Materials are added in layers to make the heap, as shown in diagram above and described in more detail below.

1.5 The Layers in Making the Compost Heap

1.5.1 The Foundation Layer

Dig the trench for the foundation layer.	Add dry plant material to make the foundation layer.	Sprinkle water + Bio-Plant over each layer of plant material.	The finished compost heap.

1. Dry plant materials, e.g. 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. Walking cattle over the stems and stalks is a good way of breaking up the stalks.
2. Spread the dry materials evenly over the bottom of the trench to make a layer about 25 cms. thick, as deep as a hand. Then sprinkle water 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 dry plant materials so they are moist, but not soaking wet.
3. The foundation layer provides ventilation for air to circulate, and excess water to drain out of the upper layers.

1.5.2 The Three Basic Layers

- The compost heap is then built up of layers of materials. The basic sequence contains 3 layers (brown, green, and manure). To increase the height, add another Layer 1, Layer 2, and Layer 3 on top of the first set of 3 layers. Or make each layer higher than 25 cms.

Layer 1 (Carbon - Brown Material):

- Place a layer of dry plant materials, such as dry leaves, crop residues, crushed sugarcane waste, straw, dried grass, dried weeds, and dry hay. You can add here compost-making aids, such as good soil and wood ash. The layer should be 25 cms. thick, i.e. as deep as a hand.

Layer 2 (Nitrogen - Green Material):

- Add a layer of moist, **green** plant materials, either fresh or wilted, e.g. weeds or grass, plants from clearing a pathway, stems and leaves left over from harvesting vegetables, damaged fruits and vegetables, or waste fruit from a fruit processing factory. Leafy branches from woody plants can also be used as long as the materials are chopped up; and green banana tree leaves. The layer should be 25 cms. thick.

Layer 3 (Manure):

- 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 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, 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.

Notes:

- Layers are added to the heap in the sequence, Layer 1, Layer 2, 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 much 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, but Layer 3 can be left out if there is a shortage or absence of animal manure.
- 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 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 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 Section 3 below for how to check on the heat and moisture in the compost.
4. The compost heap can be protected further by making a small fence around it.
5. The compost heap is best left untouched until there is mature compost inside it, or it can be turned over. If 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 20–25 cms. Thick, and water sprinkled or splashed over them.

6. A mature compost heap is about half the height of the original heap, and the inside is full of a dark brown or black 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.
7. This mature compost can be used immediately in the field, 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 so the sun and wind do not damage it, and the Nitrogen does not escape to the atmosphere. Therefore, it is best to put compost on the field just before ploughing, or at the same time as sowing the crop. For row planted crops, it can be put in the furrow with the seed. For transplanted crops, it can be put in the hole with the seedling.

2. The Compost Pit Method

- The Pit Method is best done at the end of the rainy season or during the dry season. It is important to make the pits where there is sufficient water available; for example, by a pond, small dam, run-off from a road or track, etc. Women should not be expected to carry water just for making compost. Waste water and urine from people and animals can be collected in old containers, and used in making compost.
- The main reasons for making pit compost in the dry season are as follows:

1. If farmers have a bio-gas digester, the bio-slurry from the digester can be used to make high quality compost at any time of the year, but particularly during the dry season.
2. The pits can be filled two or more times so that a large quantity of compost can be made over the duration of the dry season.
3. If pit compost is made during the rainy season or in very wet areas, water can get into the bottom of the pit. This will rot the materials producing a bad smell and poor quality compost. In wet areas, it is better to make compost through the piling method. Poor quality compost will not be productive and this can discourage farmers from trying to make better quality compost.

2.1 Selecting and Preparing the Site

1. The site should be accessible for receiving the composting materials, including water and urine, and for frequent watching/monitoring and follow-up.
2. The site should be protected from strong sunlight and wind. It should be in a protected area, for example, in the shade of a tree, or on the west or north side of a building or wall.
3. The pit or pits should be marked or have a ring of stones or small fence around it or them so that people and animals do not fall into it or them.
4. The site should NOT be where floods can come.

2.2 Digging the Pits

- The aim is to have a series of three pits, one next to the other. The minimum size for each pit should be:
  - 1 metre deep (pits should NOT be deeper than 1 metre).
  - 1-1.5 metres wide.
  - 5 metres long (or longer).
- However, the pits can be dug as they are needed. Small pits usually dry out too quickly so good quality compost is not made, and this will discourage the farmer from making and using compost. Pits deeper than 1 metre can be cold at the bottom and the micro-organisms cannot get enough oxygen to work properly.
- After the pit or pits are dug, they should be checked carefully to make sure there is no leakage of water into the pit which could spoil the compost making process.

2.3 Layers for Filling the Pit

- Before the pit is filled, the bottom and sides should be covered with a mixture of animal dung and water – a slurry. If animal dung is not available, a mixture of top soil and water can be used. This plaster helps seal the sides of the pit so that moisture stays in the compost materials.

a) The Foundation Layer

1. Dry plant materials, e.g. strong straw and stalks of maize and sorghum, which are thick and long, 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 or two nights. Walking cattle over the stems and stalks, as in threshing, is a good way of breaking up the stalks. The cattle will add their dung and urine to the stalks making them more valuable for making compost.
2. Spread the dry materials evenly over the bottom of the pit to make a layer 20–25 cms. thick. Then sprinkle water with a watering can or scatter water evenly by hand over the dry plant materials so they are moist, but not wet.
3. This is a very important layer in making pit compost as it makes sure that air can circulate through to the bottom of the pit.

b) The Three Basic Layers

- The compost heap is then built up of layers of materials. The basic sequence contains 3 layers (brown, green, and manure). To increase the height, add another Layer 1, Layer 2, and Layer 3 on top of the first set of 3 layers. Or make each layer higher than 25 cms.

Layer 1 (Carbon - Brown Material):

- Place a layer of dry plant materials, such as dry leaves, crop residues, crushed sugarcane waste, straw, dried grass, dried weeds, and dry hay. You can add here compost-making aids, such as good soil and wood ash. The layer should be 25 cms. thick, i.e. as deep as a hand.

Layer 2 (Nitrogen - Green Material):

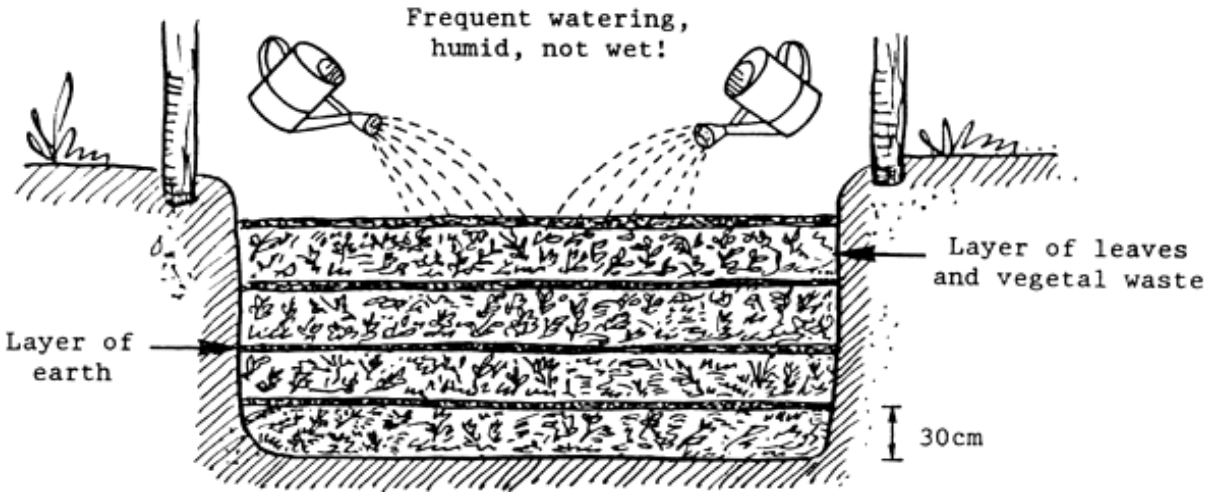
- Add a layer of moist, **green** plant materials, either fresh or wilted, e.g. weeds or grass, plants from clearing a pathway, stems and leaves left over from harvesting vegetables, damaged fruits and vegetables, waste fruit from a fruit processing factory. Leafy branches from woody plants can also be used as long as the materials are chopped up; and green banana tree leaves. The layer should be 25 cms. thick.

Layer 3 (Manure):

- 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 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, old compost and some wood fire ash and 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.

Notes:

- Layers are added to the heap in the sequence, Layer 1, Layer 2, 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 much 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, but Layer 3 can be left out if there is a shortage or absence of animal manure.
- 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 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.



2.4 Covering the Pit

- After the pit is full of compost-making materials, the top should be covered with wet mud mixed with grass and/or cow dung, and/or wide leaves such as those of banana, pumpkin or even from fig trees, and/or plastic so the moisture stays inside the pit, and rain does not get in to damage the decomposition process.
- Note: Mark the place and/or cover the top with branches so animals and people do not tread on the cover and break it.
- The progress in making compost should be checked regularly by taking out the ventilation or testing stick and checking it for heat, smell and moisture. The inside of the pit should be hot and moist with a good smell. The top of the pit will also sink down as the composting materials get decomposed.

2.5 Turning Over and Making Compost Throughout the Dry Season

1. About one month after the pit has been filled the compost can be turned over and checked.
2. The rate of decomposition can be checked through the use of the testing stick. A good farmer or gardener will soon learn how to judge the best time to turn over the compost.

3. Following Up During the Compost Making Process

3.1 Procedure

- When the compost pit has been filled or the piling of materials is complete, it should be checked regularly (once a week) to make sure that there is enough but not too much moisture, and that it is getting hot, at least in the first two to three weeks.
- For compost made by piling materials on the ground (Heap Method):
  - The stick can be inserted horizontally between two layers about half-way up; or,
  - The stick can be pushed in vertically in the centre of the heap so it goes through all the layers. However, it is best if the stick or length of bamboo is placed in the centre after the foundation layer has been laid and then the layering process is completed with the stick remaining vertical.
  - The stick must be longer than the height of the heap so that it can be pulled out and examined.
- For compost made in a pit:
  - The stick or length of bamboo is pushed in vertically through all the layers, or put in place while the compost pit is being filled. The stick must be longer than the depth of the pit.

3.2 Checking the Heat and Moisture

- One week after all the materials have been put in a heap or pit, and it has been covered, remove the inserted stick and immediately place it on the back of your hand.

1. If the stick feels warm or hot and the smell is good, the temperature is normal for the compost and good decomposition has started.
2. If the stick feels cool or cold and there is little smell, 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 3.3.)*
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.

3.3 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 or cattle urine diluted with water on the material in 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.
  4. 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. Collect some more dry plant materials and/or some old dry compost. Break up and mix the materials. If old dry compost is not available, use only the dry plant materials.
  2. Lift off the top of the heap or take out the top half of the materials from the pit and put them to one side. Mix the new dry materials with the wet compost materials in the bottom.
  3. Put back the materials from the side of the heap or pit. If these materials are wet and decaying, put in alternate layers of new dry plant materials with the wet materials.
  4. If the top materials are moist and brown showing compost making has started, put them back as they are.

5. Put back the vertical testing stick.
6. Do NOT seal the top but make a new test after a week.

- If the stick is warm or hot and the smell is good, good compost making has started and the heap or top of the pit can be sealed and covered.
- Testing for heat and moisture should be done every 7-10 days until mature compost is made.
- Although the quality of compost is best evaluated through the growth and productivity of the plants grown on soil treated with it, it is possible to evaluate compost quality through seeing, touching and smelling:
- Good quality compost is rich in plant nutrients and has a crumb-like structure.
- It is black or dark brown and easily holds moisture, and it does not dry out fast.
- It has a good smell, like clean newly-ploughed soil, with a smell somewhat like that of lime.

4. 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 for farmers.
- **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

- Burned rice husks (1 part).
- Coconut coir (3 parts).
- 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.

5. Soil Preparation With Organic Matter and Bio-Compost

5.1 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 instead even if it has not composted it beforehand.
- If the farmer is applying compost, which has been made with Bio-Plant, then he does not need to spray the field with Bio-Plant again when he is preparing the soil with it. But if he decides to do so, the soil will love the extra infusion of micro-organisms!
- **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.

5.2 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

- Spread this uncomposted organic matter sprayed with Bio-Plant over the soil 2 weeks before the planting starts, and plough it in. This will make the soil very rich in micro-organisms, and 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 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.

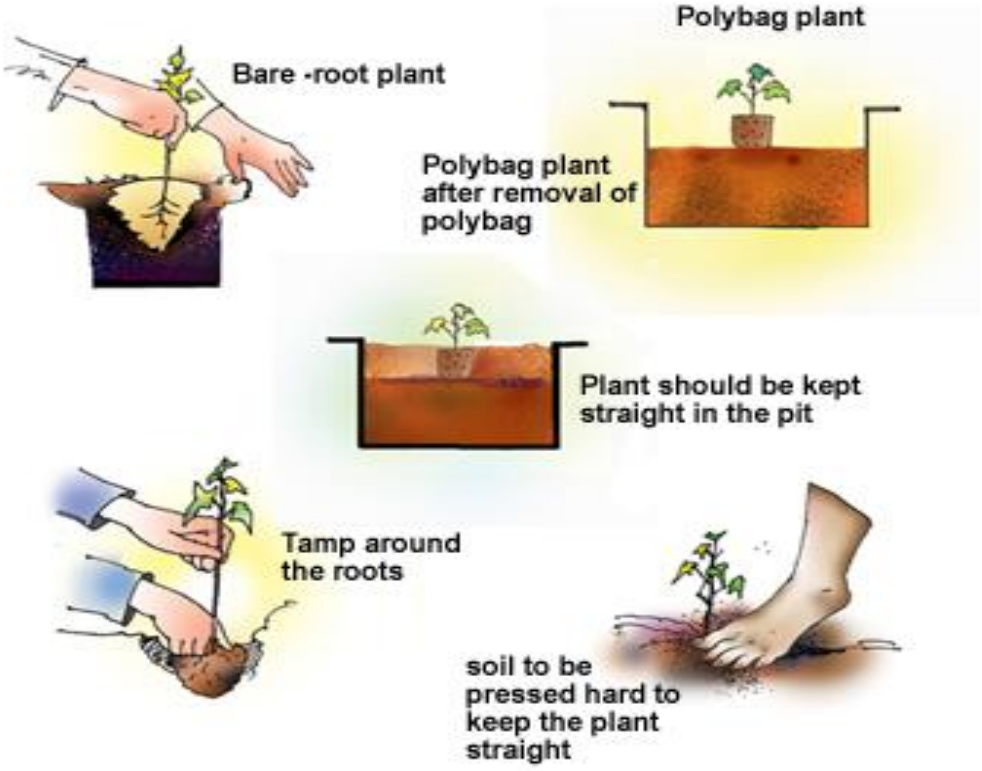
Method 2: Preparing the Soil with Bio-Compost

- 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 hotels, 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.

5.3 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.

6. 10 Benefits of Planting a Cover Crop

6.1 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.

6.2 Prevent Erosion

- Bare earth is something to be avoided. Ground 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.

6.3 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, erosion and, in some cases, livestock. The passages and pore spaces that the roots create allow for moisture percolation and aeration of the soil, as well as means by which insects and other microorganisms, which are themselves essential to the health of the soil, can move through it.

6.4 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.

6.5 Suppress Weeds

- Cover crops are sometimes referred to as 'living mulches'; one of the reasons being 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.

6.6 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.

6.7 Nutrients

- Another of the benefits that cover crops bring to the soil is to add valuable nutrients, such as Nitrogen, an essential element that all plants need. Species in the legume family of plants have a special ability to 'fix' Nitrogen in the soil. 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, after harvesting for example, the Nitrogen is released into the soil and becomes available for other plants to use, 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.
- Farmers and gardeners do not always have to let these leguminous crops grow through their life cycle; they can be periodically slashed back and the stems and foliage left to rot in order to release their nutrient load into the soil. 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. Examples of leguminous cover crops include vetch, field peas and clover.

6.8 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. And by suppressing weeds, it reduces the need to sheet mulch an area.

6.9 Produce

- It is not only the soil that benefits from the presence of a cover crop; it may add something to your kitchen as well. Certain species of cover crops can provide an edible harvest. Legumes such as peas and beans perform both functions, while mustard plants and daikon are also suitable cover crops that you can eat. For larger areas in zone 3 of your permaculture plot, you might consider a grain crop such as wheat, barley or rye.

6.10 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.

6.11 Insects

- This biodiversity is a major part of attracting a wide variety of insects to your plot. By planting cover crops rather than leaving bare earth, you will bring more species of insect to your site. 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 on your site, helping propagate your plants. The increased organic matter and nutrients in the soil also feeds beneficial microbes that can keep fungal and bacterial infections in check, and limit the number of nematodes, microscopic organisms that feed on plant roots and stems, and which can carry viruses that they transmit to the plants.

7. Mulching - Benefits of Mulching the Soil

7.1 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.

7.2 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.

7.3 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 two to three times the crown spread of the tree, mulch as large an area as possible.

7.4 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 7
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 12-24 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 12-24 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 12-24 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 12-24 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 8
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 48 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.

Vegetables	Days from Seed to Harvest (Depends on the Variety)
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 9
Using the Bio-fertilizers for Growing Rice

1. Soil Preparation

1.1 Make Compost

- See the **Compost and Soil Preparation Methods** guidelines in Part 6 on page 28. Method 2 on page 38 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 28.

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^2 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^3 of soil mix is needed for each 100 m^2 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^2 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 8. How to Apply Pro-Plant** on page 47.)*

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	1. ***See* 1.1 Compost and Soil Preparation Methods (Land Area 1 Hectare)** in Part 6 on page 28, especially Method 2 on page 38**.** 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. 2. Add 500 cc of Pro-Plant per hectare, if the soil is short of minerals. 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. **Note:** 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. 4. **Seeds:** 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. *The amount can be increased to 100 cc of Bio-Plant for a better effect.* Then leave them for 2 days in a sack to germinate and then sow them the same day. • 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. **Notes About Actual Practice in Vietnam** • 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.	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. 2. Spray on Day 15 (Optional): Equals 500 cc in 500 litres of water per hectare. 3. Spray on Day 30: Equals 500 cc in 500 litres of water per hectare. 4. Spray on Day 34: Equals 500 cc in 500 litres of water per hectare. 5. Spray on Day 50: Equals 500 cc in 500 litres of water per hectare. 6. Spray on Day 60: Equals 500 cc in 500 litres of water per hectare. 7. Spray on Day 70: Equals 500 cc in 500 litres of water per hectare. **Note:** If the rice is the 110-day kind, then also spray on Days 80 and 90. **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.

Crop Variety	Soil and Seed Preparation with Bio-Plant (1 Acre)	Application of Pro-Plant During Crop Growth
Rice	1. ***See* 1.1 Compost and Soil Preparation Methods (Land Area 1 Acre)** in Part 6 on page 28, especially Method 2 on page 38**.** 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. 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. 3 Add 250 cc of Pro-Plant if the soil is short of minerals. 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. **Note:** 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. 5. **Seeds:** 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. *The amount can be increased to 100 cc of Bio-Plant for a better effect.* Then leave them for 2 days in a sack to germinate and then sow them the same day. • 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. **Notes About Actual Practice in Vietnam** • 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.	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. 1. Spray on Day 15 (Optional): Equals 250 cc in 250 litres of water per acre. 2. Spray on Day 30: Equals 250 cc in 250 litres of water per acre . 3. Spray on Day 34: Equals 250 cc in 250 litres of water per acre. 4. Spray on Day 50: Equals 250 cc in 250 litres of water per acre . 5. Spray on Day 60: Equals 250 cc in 250 litres of water per acre . 6. Spray on Day 70: Equals 250 cc in 250 litres of water per acre . **Note:** 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. **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.

12. Bio-chemical Farming

12.1 Soil Preparation

- See the **Compost and Soil Preparation Methods** guidelines in Part 6 on page 28, especially Method 2 on page 38. Method 2 is better because the soil preparation uses bio-compost made over about 7 weeks.

12.2 Preparing the Seeds *(See also pp. 43.)*

- 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 47. 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 10
Using the Bio-fertilizers for Growing Maize

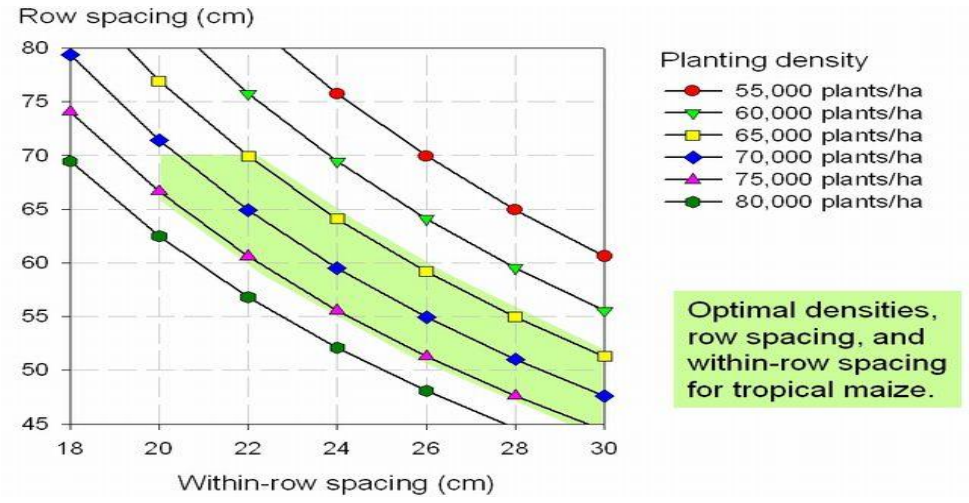
1. Soil Preparation

- *See the **Compost and Soil Preparation Methods** guidelines in Part 6 on page 28. Method 2 on page 38 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 8. How to Apply Pro-Plant** on page 47.)*

- 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.

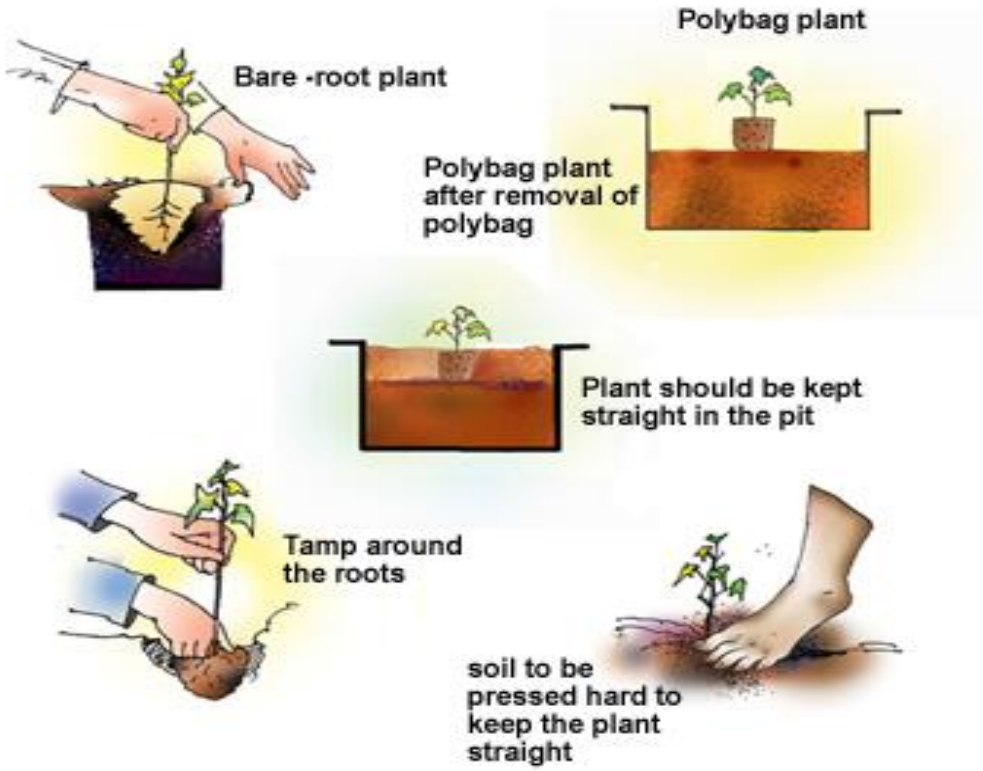
Part 11
Using the Bio-fertilizers for Growing Fruit Trees

1. Compost and Soil Preparation Methods

- *See the **Compost and Soil Preparation Methods** guidelines in Part 6 on page 28. For trees, you need to prepare bio-compost with Bio-Plant. The Heap Method explains how to do this.*

1.1 Planting Saplings

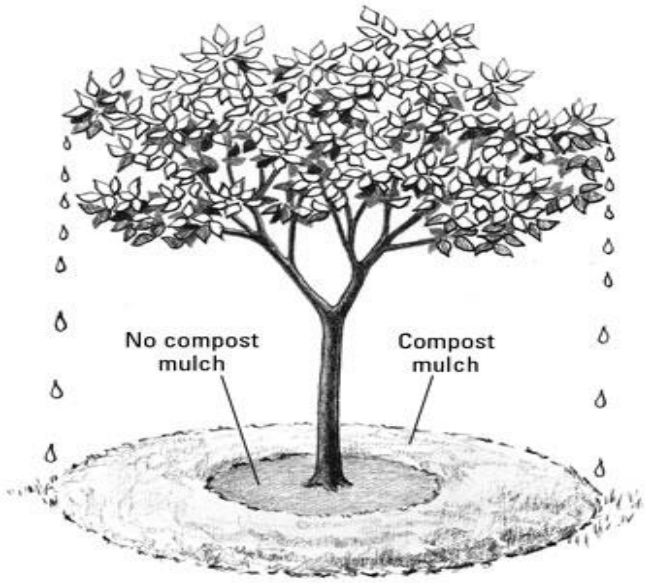
- When planting seedlings in holes, use a 1:1 mixture of bio-compost and soil in the holes. Make the hole about 60 cms. x 60 cms. x 60 cms., and fill the hole halfway up with the mixture. Then spread 5-10 kgs of bio-compost around the sapling while avoiding placing the bio-compost against the stem of 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. <u>Applying Pro-Plant</u> *(See **Part 8. How to Apply Pro-Plant** on page 47.)*

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 7, **Seed Preparation** on page 43.)*

- 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 12
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.

4. 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.

5. Typical Effects on Tea Bushes

- There are qualitative and quantitive 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.

6. 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.

7. 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 13
How to Use the Bio-fertilisers in Bio-chemical Farming

1. Preparing and Applying the Bio-chemical Fertilizer

- In bio-chemical farming halve the amount of chemical fertilizer that you normally use by mixing Bio-Plant with each bag of chemical fertilizer. The normal ratio is to mix 330 cc of Bio-Plant with each 50 kgs bag of Urea or NPK.
- You can mix in some water, but not so much that the chemical fertilizer takes a long time to dry out. Make sure that the Bio-Plant touches every granule.
- Prepare the mixture about an hour before using it. Place a 50 kgs/bag of the chemical fertilizer on a plastic sheet (1.5 m x 1.5 m) on the ground. Spread out the fertilizer and spray the bio-fertilizers on top. Then mix the two together well before using them. Make sure that every granule touches the Bio-Plant. Use it the same day.
- If the farmer wants to use it another day, they should let it dry in the wind, but this is not the recommended method.
- Make sure that the farmer shakes the contents of the bottle by turning it upside down and shaking it. If the contents go hard, dilute the bio-fertilizer with a little water.
- By mixing 330 cc of Bio-Plant with a 50 kgs bag, the farmers can use this bag over twice the usual area. (So, 1.5 x 50 kgs bags of the bio-chemical mixture can be used over the same area used by 3 x 50 kgs bags of chemical fertilizer.)
- By halving the amount of chemical fertilizer as described here for bio-chemical farming, the yield will increase more and more each season above chemical fertilizers when the latter are used on their own. The cost will be much less.
- The farmers should apply the bio-chemical mixture in the normal way and on the same days as they would apply urea or NPK.

2. Adding Organic Matter or Compost

- To increase the yield further, place organic matter mixed with Bio-Plant or compost prepared with Bio-Plant around the plants as they grow. This could be done monthly until up to a month before harvest.

3. Preparing the Seeds

- You can also increase the yield in bio-chemical farming by following the guidelines on preparing the seeds with Bio-Plant and water.

4. Spraying the Leaves With Pro-Plant

- To increase the yield further, spray the plants with Pro-Plant according to the recommended frequency. Be generous when you spray.