AMBASSADOR COLLEGE
BIG SANDY, TEXAS 75755

HERBERT W. ARMSTRONG, *Chairman*

AGRICULTURE DEPARTMENT

INTRODUCTION TO SOIL PRINCIPLES

Productive farming is based on the law that life comes only from pre-existing life. Soil fertility is a LIVING PROCESS. Living organisms provide for living plants which in turn provide living food to support the life of animals and men.

Mr. Herbert Armstrong approved and appointed a committee to look into and reevaluate our agriculture problems and questions. Much valuable study and research had already been done, and other study and experiments were being carried on by staff members of the Colleges.

The purpose of the committee was to meet, discuss and consolidate the thinking and findings of all and present the material at a coming conference.

By "putting our heads together" and comparing information we found some beginning and basic steps to proper, tangible agriculture methods.

Results of Experiments and Studies at Big Sandy

We feel a real breakthrough in changing from artificial to natural methods of farming is that of being able to shorten the length of time required to economically make the switch.

The soil beneath our feet is a marvelous and miraculous creation. There are three basic constituents of soil which much be in balance if health-sustaining crops are to be produced. These are: minerals -- dirt and rock particles which form the foundation of "skeleton"; organic matter, which is decomposed excretions and the dead remains of plants and animals; and a community of living organisms. The organisms convert both the minerals and the organic matter -- or humus -- into plant food.

When soil is out of balance through use of poisons, soil life is killed and most of the minerals of the soil are "locked up" and unavailable for use of plants. The object of soil redevelopment is to restore this natural soil life and balance and thus release the potential productivity. Chemicals and poisons have been forced into our soils, resulting in mass slaughter of its living organisms.

There are three basic constituents of soil which must be in balance if health-sustaining crops are to be produced. These three are: 1) the dirt or rock particles which form the foundation or "skeleton"; 2) the organic matter -- wastes or dead remains of plants and animals; 3) and a vast community of living organisms.

A way has now been made possible to begin restoring this living culture of soil organisms at a much speeded-up rate which will in turn help speed soil rebalancing. This is not a panacea to soil restoration. It is, however, an important aid in accelerating the process. Proper tillage methods, organic matter, land rest, proper use of natural rock fertilizers, good management are still a must.

Here are some of the results after six months of "restoration." At the time of the conference we had taken crops from two fields and the garden area with other crops still in process. The first crop harvested was a 27-acre field of silage sorghum. We had planted leftover seed of this same crop planted on the same field the preceding year (1965). The 1965 crop grew to approximately three feet in height, turned a yellowish-red color and grew no more. This was baled for hay and produced only 12 tons. In February 1966, we ran soil tests and found an unbalanced condition, the soil being highly acid and almost void of life. We applied 2,000 pounds of crushed limestone per acre, a heavy application of the bacteria culture, and disced it in. About a month later we applied 500 pounds of "organic," and 500 pounds of diatomaceous earth per acre and disced it in.

The crop raised this year was quite different. It grew 14 to 15 feet high, had a beautiful green color, and produced 260 tons.

However, most soils would not be as expensive to condition as ours. We had only loose sand as a base. Many soils already have sufficient minerals and need only organic matter to produce living organisms and a natural balance.

Another interesting result was with our milo crop. Our neighbor across the road planted his crop "at just the right time," a good three weeks before we did. He used heavy amounts of chemical fertilizer. For a while his crop looked, and was, way ahead of ours. We were pressed for time and were able to apply only the soil bacteria culture. When harvest time drew near, both crops looked similar from the road, maybe his looked better. The difference was quite revealing when we began to harvest. We had gotten two or three "unseasonal" showers which helped us greatly. Mold formed between the berries on his milo and as it ripened the mold turned to a black, dusty blight. When harvested it was lightweight and made 12 bushels per acre. The berries on ours were large, bright, firm and made 41 bushels per acre.

Our wheat and oats were harvested after the conference. According to our local county agent, wheat is not grown in this area. Our wheat made 31 bushels per acre, and the oats made 45 bushels per acre. These would not be outstanding quantities in some areas of the country, but for an area that doesn't grow wheat it is pretty good.

Society has promoted highly specialized occupations not only in the fields of the arts, business, technical science and industry, but just as much as in the field of agriculture. Educators in this field gloss over and depress the need for diversification and true fundamental knowledge.

Since the conference much has been learned concerning the ecology -- or environmental balance -- of plants in relation to each other, to the soil, to animals -- and their relative values. This is basic in that proper soil, plant and animal ecology maintain the soil and begin to build new soil once it has been restored to a balanced state. It takes the interrelationship and interdependency of all facets of the field of agriculture to finally produce healthy human lives.

What Is Soil?

The soil is not, as many suppose, a dead, inert substance merely supplying mineral elements and providing a place for plants to anchor their roots. A healthy soil is full of living organisms.

There are three basic constituents of soil which must be in balance if health-sustaining crops are to be produced. These three are: 1) the dirt or rock particles which form the foundation or "skeleton"; 2) the organic matter -- wastes or dead remains of plants and animals; 3) and a vast community of living organisms.

The difference between sick soil and healthy soil is BALANCE -- in essence, LIFE. A lack of organic matter, with a subsequent lack of micro-organisms will throw soil out of balance. Soil is out of balance when most of its minerals are "locked up." This occurs when there are not enough soil bacteria to change the minerals into food for plants.

The object of soil redevelopment is to restore soil to its natural former balance and thus release the potential productivity of the stored-up minerals. A balanced soil is one that has the correct amount of minerals, organic matter and living organisms to produce the kind, variety and amount of vegetation for which it was created.

Many think a balanced soil is one with a "pH" level (degree of acidity or alkalinity of soil) of 7. A soil with a pH of 7 is simply a neutral soil, but not necessarily a balanced one.

The soil has varying degrees of acidity and alkalinity. Many types of plants need varying pH levels (some 7, some other than 7) to produce healthy, quality plants. However, an abundance of humus will enable plants to tolerate different pH levels.

The Soil Particle

The soil under our feet is not solid! It is actually a layer of billions of grains, or soil particles, ranging in size from finest clay

particles smaller than 1/2000 of an inch in diameter to coarse sand particles up to 1/12 of an inch across, some of which are decomposed rock.

A continuous supply of minerals is being made available as long as the soil is in balance. According to some authorities, the supply of minerals in the soils covering the earth is inexhaustible. But, only the living faction of the soil, the microbes and earthworms, can make these minerals available in the right balance for healthy and health-sustaining crop growth.

Each of the tiny mineral particles in the soil is covered with a tight-fitting film of oxides, water, and bits of organic matter. This film provides a habitation for the teeming life in the soil underfoot.

To show the tremendous capacity the soil has for containing organic matter, and the fantastic surface area of the soil particles on which multitudes of organisms live, notice this example! One ounce of soil, sampled at Britain's Rothamsted Experiment Station, was found to have surfaces adding up to 250,000 square feet, about six acres!

When we notice the awesome capacity of the soil for life, it becomes apparent that we need to farm in such a way as to allow these organisms to carry on their natural functions of providing soil fertility! Soil life isn't something insignificant or trivial! This life is the difference between vibrant health and wretched degenerative disease in the plant, animal, and human realms.

Organic Matter

In healthy soil, each particle of dirt or mineral matter is coated with organic matter.

Organic constituents of the soil are obtained from living and dead plants and animals, plant roots, green manure crops, animal manure, crop residues, fungi, bacteria, worms, and insects. The importance of organic matter in the soil cannot be stressed too strongly.

Organic matter supports the soil's living organisms; aids in the bringing of insoluble soil minerals into solution and holding them; improves the physical condition of the soil; increases water-holding capacity; improves aeration; regulates soil temperature; and serves as an important source of nitrogen and other plant food elements. It also reduces erosion and increases productivity. Normally the more organic matter a soil contains, the healthier it is.

When rains come, soils with ample organic matter soak up the water. Where organic matter is lacking, water runs off the land wasted, and carries topsoil with it, producing erosion. No mineral mass, regardless of how fine its particles, can absorb as much water as does an equal weight of organic matter, for the mineral can hold water only on the surfaces of the particles. Most of the crop land in the United States has suffered moderate to severe erosion.

Organic matter is about 50 percent carbon. Carbon acts as a buffer to excessive acidity or alkalinity and helps keep the soil sweet and maintains conditions most favorable to good plant growth.

As organic matter decays in the soil, the most bulky product of this decay is carbon dioxide gas. This gas disolves readily in soil water to produce carbonic acid -- a natural reagent for dissolving plant nutrient elements from the mineral particles and making them available to plants.

Organic decay, through the working of soil bacteria and soil acids, unlocks minerals and makes them available for plant usage. There is usually little shortage of plant minerals in most farm soils.

Much of our land has been seriously depleted of organic matter chiefly because of improper cultivation, erosion, and the use of chemical fertilizers, herbicides and insecticides. Large, unnecessary losses in organic matter are caused by "burning over" land and by burning crop residues. We cannot improve and maintain the productivity of our soils without regularly replenishing the organic matter!

Practices of maintaining and replenishing organic matter include: 1) growing sod, cover, and green manure crops; 2) the proper use of weeds; 3) conserving and applying manure and composts; 4) conserving and applying crop residues; 5) controlling erosion; 6) right tillage practices; 7) and the replacement of soil bacteria. Applying the first four principles automatically replaces soil bacteria, or the process can be speeded up by applying bacteria as a liquid culture. A major key to maintaining soil balance is ample organic matter.

The Living Soil

A healthy soil is very much "alive" and dynamic, teeming with bacteria, actinomycetes, fungi, molds, yeasts, protozoa, algae, worms, insects, and other minute organisms which live mostly in the top few inches of the soil.

This hive of living things in the soil, the eaters and the eaten, adds up to incredible numbers. The bacteria alone may range from comparatively few up to three or four billion in a single gram of dry soil. In good soil the bacterial matter, living and dead, may weigh as much as 5,600 pounds per acre.

The fungi may add up to a million in a gram of dry soil, weighing over 1,000 pounds to the acre.

Among the most important of the soil-making crew is the humble earthworm. He is nature's own plow, chemist, cultivator, maker and distributor of plant food. Humus-rich soil easily supports a worm population of 26,000 per acre. Worms eat inert minerals and organic matter and mix these digested minerals with their bodily secretions. Each year they deposit as much as 10 to 20 tons of castings on the surface of an acre!

Worm castings are shown to contain 40 percent more humus than the surface soil. They are a humus factory manufacturing vast amounts of balanced plant food. The Connecticut Experiment Station shows that the casts of earthworms are five times richer in combined nitrogen, seven times richer in available phosphate, and eleven times richer in potash than the upper six inches of soil. Depositing castings is only a part of the good that earthworms do. They pull organic matter down under the soil, and by their digestive juices break it down into a form usable to the plants. They burrow down to eight feet or more below the surface and bring up rich minerals that plants need. The burrows improve aeration of the soil, permit the penetration of surface water, and help facilitate the downward growth of roots.

"Myriads of small creatures spend parts of their lives in the soil; ants, beetles, wasps, spiders, and many others. About 95 percent of the roughly one million insect species spend part of their lives in the soil." (Living Earth by Farb, p. 5).

The activity of these creatures combines to carry on the work of plowing, mixing, and fertilizing as they add their remains to the land. If these living organisms use up all their food supply, billions of them die or become inactive. The life processes in the soil slow down until further stores of food are added. As in most of nature's activities this whole life cycle in the soil becomes a self-regulating system, an organized community, adjusting its numbers to the food supply so long as it is undisturbed by outside forces.

While the soil lives, stored-up energy is constantly being used for food by the teeming hive. A good soil's health is actually a matter of life and death to the plants and animals that live on its surface. Our health is also dependent on its health.

Why Soil "Wears Out"

Soils become "worn out" when they no longer contain sufficient organic matter to maintain an adequate population of soil organisms to make mineral nutrients available to plants.

As virgin land is plowed up, the increased oxygen made available greatly stimulates the bacterial crews into breaking down the organic matter at a more rapid rate. Unless organic matter is returned to the soil in the form of crop refuse, animal wastes, compost, cover crops, etc., the supply of organic matter is eventually used up.

In nature we find a variety of plants growing together and animals wandering about eating a selection of herbage and pausing here and there to "pay their dues." Plant and animal litter accumulate together on the surface to compost and decay, feeding the micro-organisms a balanced diet and making a health-sustaining humus-rich soil.

Without food, the population of soil microbes (millions per gram in healthy soil) diminishes and no longer makes available sufficient nutrients to grow crops.

Symptoms of Sick Soil

Healthy soil, as we have seen, requires a balance of minerals, organic matter and living organisms. When this balance is disrupted, low-quality, disease-ridden, insect-infested crops, which do not sustain health in man or beast are the result. This is caused by allowing the organic matter to become depleted and by poisoning the soil with wrong types of fertilizers which destroy the living organisms.

Sick soil becomes hard, difficult to work. It fails to absorb rainfall. Erosion is the result. It becomes either too acid or too alkaline and vital trace elements are "locked up," and thus become unavailable to plants.

Sick soil produces sick plants which produce sick animals and humans. Thus sick soil becomes largely responsible for the increasing worldwide plagues of disease that are threatening mankind in this age.

How to Revitalize Sick Soil

To heal sick soil and bring it back into profitable production of high-quality, health-sustaining crops, it is necessary to stop using the farming practices which have caused the trouble.

We have successfully rejuvenated some soil in three to four months on the college farm in Texas and harvested good crops the following season without using any artificial fertilizers. The cost was less than half the expense of using artificial fertilizers.

There is always the question, "where to begin?"

The first step is to determine as much as possible where your soil presently stands, so a plan of action can be formulated. A soil test is helpful here. It will give a guideline to the available N-P-K (nitrogen, phosphate, potash) and the pH level. As mentioned before, organic matter is the key to soil balance. This should always be increased. A soil test will help tell you what is "locked up."

For example, if the soil is too acid, organic matter and ground limestone will bring it back into the growing range so soil organisms can multiply rapidly and begin to work efficiently.

Soils low in phosphorus or potash may need an application of ground rock phosphate or potash rock. Since one application of these minerals lasts for a number of years, in most cases the soil organisms will begin to liberate sufficient supplies from the earth itself so further applications will not be needed.

Nitrogen-fixing bacteria (rhizobia) live in nodules on the roots of legume plants such as clover, peas, peanuts, soybeans, cowpeas, vetch, and alfalfa. These bacteria are capable of adding as much as 200 pounds of nitrogen to an acre of soil each year.

Nitrogen can also be added by applying manure and compost. Most nitrogen of plant and animal remains is locked up and must be liberated by the living bacteria.

Still other forms of nitrogen-fixing bacteria make nitrogen available to a plant directly from the air.

Tillage Methods

The methods and practices used in preparing the soil for planting have a considerable effect on the natural processes going on in the soil to produce fertility.

Many different types of plows and other tillage implements are on the market but not all are equally efficient in putting the crop's refuse and organic matter where it will do the most good. Disc plows, rotor tillers, chisel plows, and that type are very useful and effective. They chop and mix crop residues into the topsoil which aids greatly in the process of decomposition.

The moldboard plow, however, is quite different. This type plow turns under and buries all protective mulch material in a layer several inches below the surface of the earth. It packs the surface trash into a narrow layer subject to great pressure both from the weight of the soil above and the wieght of the tractor and machinery passing over it. This pressure produces heat which "burns up" this material rather than allowing it to decay or ferment (which is the natural and beneficial process). This "burning" creates harmful acids and reduces the production and availability of beneficial nitrogen.

Still further, the compacted layer of trash serves to create a barrier which prevents moisture from "wicking" from the subsoil below to the roots of the plants growing above. It hinders the roots of the plants from finding the moisture that lies below. At the same time, the earth above the compacted layer is left bare to all the processes of wind and water. This creates a condition of drought between the surface of the soil and the compacted layer of organic material below.

In some few cases the use of a moldboard plow may be effective to break up a very hard soil to permit the mixing of organic material to improve the hardened condition.

Proper tillage practices leave a mulch on or chopped into the soil's surface. This prevents the evaporation of rainfall, vastly increasing the soil's ability to absorb and hold water. It aids greatly in controlling the blowing or washing away of the soil, and produces best conditions for a steady rate of decay -- a moist seed bed and plant food supply.

Restoration

The system of rehabilitation we have described recognizes the fact that the average farmer is economically forced to grow a revenue crop from his land while he is restoring it.

Through proper tillage methods, cover cropping, and the application of soil bacteria, diatomaceous earth (mineral source), "organic" (organic and mineral source), we were able to produce two quality crops in a year on our experimental plot from once poor, sandy soil.

In our greenhouse we presently have tomatoes that weigh one-half pound to one and one-half pounds of excellent quality. Our soil was on its way to normality in less time than it could have been under conventional organic methods.

Costwise - production expenses of natural farming are less, and should be.

This system of soil development employs the methods which are designed in nature to rejuvenate topsoil, simply speeding up the process. One inch of topsoil residue per year can be established if these natural principles are followed properly.

This process achieves a kind of resurrection in which dead soil once again becomes alive!

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MICROORGANISMS OF THE SOIL

Soil Bacteria -- How They Help Plants Grow

Bacteria are minute forms of life that live abundantly in healthy soils. They, along with millions of other living organisms such as fungi, algae and protozoa, make up the life in the soil.

Each particle of soil under our feet is a little world of its own. Over each particle's surface is a thin film of water, teeming with many types of microbes. Bacteria are some of the smallest forms of these microorganisms. They are so small and complex that science still has a great deal to learn about them.

Although little is known about their anatomy, much is known about their effect on all living things. Only recently have we realized how dependent quality crops are on the bacterial population of the soil. Without soil bacterial activity it would be useless to dung crops, to try to improve land by tilling a legume cover crop into the soil or any attempt to fertilize soil. There is no dispute over the prominent role soil bacteria play in soil fertility. The types discussed can thrive either in the presence of air (aerobic) or if air is excluded (anerobic). They fall into several major classes with hundreds of varieties in each class.

The first major type of bacteria we're concerned with are decomposition and decay organisms which live on dead plant and animal remains in the soil. They are called saprophytic bacteria. Their function is very important in the process of soil building. As they decompose organic debris nitrogen, carbondioxide and many minerals are liberated. Stems, leaves, roots, and virtually all vegetable and animal matter is turned into humus vital in maintaining soil condition and fertility.

> Simple carbohydrates and many proteins are decomposed by many soil microorganisms, but cellulose and nucleoproteins are difficult to decompose and relatively few soil organisms can do it. Cellulose may be digested by members of the genera Cellulomonas, Cellvibrie, Clostridium, Pseudomonas, Actinomyces, some molds, etc. This decomposition of cellulose which is found as plant residues in large quantities in soil, results in the production of acids which react

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> with insoluble material rendering them available as plant foods. . . Cellulose ferments are used in waste disposal, water purification, and soil humus formation.
> --Bryan and Bryan, Bacteriology, pp. 114-115.

Another major type, nitrogen-fixing bacteria, convert atmospheric nitrogen to compounds utilizable by plants. Nitrifying bacteria also convert ammonia to utilizable nitrates. Without soil microorganisms continually at work replenishing the supply, plants would soon totally deplete nitrogenous substances from the soil. The mutually beneficial (symbiotic) nitrogen-fixing bacteria (of the genus Rhizobium) live in nodules on the roots of various leguminous plants. Legumes help replenish soil with this type of bacteria. The aerobic Azotobacter and the anaerobic Clostridium are non-symbiotic nitrogen-fixing bacteria. Nitrification or conversion of ammonia to nitrates occurs in two steps accomplished by autotrophic bacteria of the genera Nitrosomonas, Nitrosococcus and Nitrobacter. (Ibid. pp. 104-109).

Disease fighting microorganisms of the soil exert a natural biological control (antibiosis) on many of the parasitic organisms responsible for soil-borne diseases of plants. Antibiosis is accomplished in several ways. Sometimes they produce destructive toxic materials or antibiotics such as chloromycetin from the soil-borne Streptomyces venezuelae useful against brucellosis, typhoid and other microbial diseases (Bryan & Bryan, Bacteriology, p. 13). Some produce antibiotics to combat fungus diseases, nematodes, root rot and insects. In still other instances nonparasitic disease fighters compete more successfully for oxygen and nutrients and thus cause suffocation or starvation of parasites. "When fresh organic material, such as green manure, is added to the soil the nonparasitic microorganisms multiply rapidly, and whatever ill effects they exert on parasites are intensified" (Soils, 1957 Yearbook of Agriculture, p. 338).

A culture containing many varieties of these types of microorganisms is available on request from the Ambassador College Agriculture Department, Big Sandy, Texas. If a farmer does not have enough manure and compost filled with bacteria to spread on his land to restore bacterial life in the soil, a special culture of soil organisms will be very beneficial. The culture may be added for speeding the restoration of soil balance and fertility for growing abundant disease-free crops.

In summary, soil bacteria benefits you by (a) overcoming and breaking down harmful chemical residues from previous wrong practices, and (b) encouraging higher soil life such as earthworms which will create new balanced soil. Once you have the needed soil bacteria--continue adding plant and animal residue to feed and keep the soil life cycle going. Simple methods of farming, incorporating the life designed to help nature work for you, reap rich dividends.

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GUIDELINES FOR GROWING MICROORGANISMS OF THE SOIL

Soil Bacteria -- How They Help Plants Grow

Instructions upon receiving one pound of bacteria material:

1. Add material to one gallon of water.
2. Add one pint (or about 3/4 lb.) of yeast or bloodmeal. (Do not use the yeast commonly sold under the name brewer's yeast. It has been heated to remove the bitter flavor and in so doing the yeast cells are killed.)
3. Add one-half pint (one lb.) of sugar or molasses. This feeds the bacteria allowing them to multiply.

Care

1. Let the mixture set about four days at around 70° F. It will multiply best at this temperature but will not die at another temperature.
2. After four days, add this to 50 gallons of water. Use a wooden or cement container. A plastic garbage container will also be fine.
3. Add about five pounds bloodmeal or natural yeast and five pounds of sugar or molasses. Be careful you do not over-feed the bacteria. Extreme over-feeding causes the culture solution to sour or form a thick scum on its surface. The scum reduces the availability of air and may cause the culture to die. Under-feeding may cause starvation.
4. Let the mixture set until bubbles begin rising. After 30 hours or longer (can be up to 7 days) depending upon the temperature, it is ready for application. The bacteria should be re-fed in about three weeks if not used. You can save a gallon if you wish to begin a new batch. The above is simply a feeding guide. Larger quantities may be made by increasing items proportionately. With proper care, the liquid culture teems with bacteria. Solid matter at the bottom of a container need not be saved for starting a new quantity. When spraying the culture, just pour the liquid off the settled material and apply.

Water varies in different areas in regard to acid and alkaline content. The bacteria may die in highly acid conditions. We have found ground limestone acts as a buffer to help control the pH or acid balance. If you have trouble keeping your culture alive, we recommend you add one-half pound of limestone to 10 gallons of water. In case you need to replace your bacteria, we can mail you another starter culture with a small amount of yeast for your first gallon for $1.50 (prepaid).

To check if the bacteria is alive it may be observed under the microscope, or if lacking a microscope, one might try the following:

1. Put a drop on a glass slide. If the droplet has some body to it and does not spread out flat, it is most probably teeming with bacteria. (You may compare it with a regular drop of water.)
2. After the mixture has set for 30 hours to a week (depending on the temperature), bubbles will rise. This is a sign of life.
3. If the mixture is cloudy and moving, it is a sign of life.
4. A noticeable odor is also a sign of an active culture.

We have completed numerous tests determining how long bacteria live in the package in which sent out. After many months in a hot, dry place, the bacteria will live and remain active. Though the carrier material may become dry, when water is added, the bacteria is fine.

Bacteria can be kept alive throughout the winter months.

Some keep an active liquid culture of it in their basement, covering the container to prevent freezing. If one does not need an active culture for application to plants or indoor gardens, a small amount may even be kept in a freezer. The culture will also remain alive, though dormant, if frozen in an organic carrier material. You need not be concerned about the condition of the bacteria outdoors as its activity simply slows down during the winter months.

When should the bacteria be applied?

The bacteria may be applied at any time, though a warm, moist soil with plenty of organic matter will produce best results. It is good to disc the soil following application; however, we have applied it with helpful results on crops, such as wheat and oats, after they were several inches high.

Application

Bacteria may be used in fields at the rate of 20 to 30 gallons per acre with a regular sprayer (garden rates - ½ gallon per square yard). It is helpful to disc it in. On pasture land, apply when the soil is wet or apply more gallons of water to the mixture per acre. It may also be applied by letting it drip into irrigation water when irrigating crops.

The bacteria may be applied on gardens, shrubbery, flowers, and lawn with a sprinkling can or small hand sprayer. Be sure your sprayer is clean and free of insecticides. If in doubt about it being clean, baking soda and warm water solution is very effective in clearing and neutralizing the sprayer. Agitate this solution in your sprayer about 15 minutes and drain it out completely. After this, the sprayer is ready for use.

If you have lifeless, sterile soil, applying soil bacteria (as well as organic matter on which bacteria can feed) will give you a resurrection and rejuvenation of topsoil. Following the process outlined will help dead soil become alive. It is one of the first steps in the restoration of poisoned lifeless soil. Soil bacteria represents only one facet in maintaining a balanced and living soil, but it is basic for right agriculture.

F O O D F O R B A C T E R I A G R O W T H

The Use of Yeast and Bloodmeal in Soil Bacteria Reproduction

We have found three types of material which may be purchased as food for culturing soil bacteria. They are bloodmeal, natural livestock yeast, or non-debittered brewer's yeast.

One of these products will generally be available at local feed stores. You should plan ahead if you desire or need many pounds of yeast or bloodmeal for culturing large quantities of soil bacteria. Make sure the food source is available and adequate before you begin.

Natural Livestock Yeast

Natural livestock or poultry yeast is becoming increasingly popular as a feed supplement. It is also an excellent food for culturing soil bacteria. If you use this feed supplement type yeast, the quantity of yeast fed the culture may be cut down by one-fourth because of the more active enzymes.

Bloodmeal

Through experiments at Big Sandy we have found that bloodmeal is a most satisfactory food for growing bacteria. It is a high protein organic material containing many enzymes. It does an excellent job and in some parts of the United States may be more readily available than yeast. It is somewhat cheaper and may be purchased at almost any feed store.

Non-debittered Brewer's Yeast

Natural yeast contains many enzymes and unidentified vitamins needed by living things. Brewer's yeast also contains many enzymes if it is not debittered. It is a natural brewer's yeast after it has fermented grain.

In drying or debittering the yeast it is commonly heated sufficiently (pasteurized) to kill the yeast cells and destroy the fermenting power. After this it may be used as a food supplement. Without this debittering or pasteurization process, fermentation might be produced in the digestive tract, causing severe indigestion if used as a food.

Debittered yeast is the commonly purchased dried brewer's yeast which has had the life taken out of it. Some types of yeast cells cause a bitter flavor and so they are killed by heat. Often the yeast is also fortified with vitamins. Because a high heating process kills the cell life, the yeast will not work in rapid reproduction of your bacteria culture for lack of the needed enzymes. Therefore, non-debittered brewer's yeast works best. Large quantities generally cost 15-30¢ per pound. One source from which you may order non-debittered brewer's yeast is: St. Louis Brewer's Yeast Corp., Box 65, St. Louis, Missouri, 63119.

Enough yeast is included with the initial package of bacteria culture for you to grow and feed five gallons of active soil organisms if you only need a small quantity (i.e. for a flower bed or garden plot). After adding the bacteria carrier material and the yeast to the first gallon of water (as per instructions) an additional four gallons of water may be added and after a few days you will have liquid bacteria culture to cover about 100 square feet. Please check in your local area if you need additional yeast or any of the above mentioned materials for culturing or reproducing large quantities of soil bacteria.

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COMPOST AND SOIL LIFE

Composting is necessary to build and maintain fertility in the soil. Nature is continually rebuilding the soil through composting. It is a vital part in maintaining balance. If composting were not taking place, the entire earth would be covered with dead plants. In converting dead plants into available nutrients, this process (composting) makes humus, builds fertility and supplies the food for more plant growth.

Some may wonder, "If composting is so important, why isn't it mentioned in Scripture?" The answer: It is. Quite prominently. But it is easy to read over because of changes in the language. Psalm 83:10 and Jeremiah 8:2, just in passing, mention that dung is intended for fertilizer, that it is "for the earth." But the best-known scripture, Luke 13:8, specifies manure as the supreme fertilizer. If "digging and dunging" a particular tree does not make it bear fruit, you may as well get rid of the tree because nothing will make it productive.

But these scriptures do not by any means indicate that manure should always be used in the uncomposted state, although in some cases it can. Compost piles are prominently mentioned in the Bible, but under another name -- dunghills. Dunghills are always compost piles. Pile up dung and barnyard litter and you can't get anything out of it but a compost pile. The frequency of the mention of compost piles in Scripture -- and the manner in which they were mentioned -- show that a writer could mention composting and the reader knew both what it was and how it was made. Notice!

Isaiah 25:10 mentions the raw materials: "As straw is trodden down for the dunghill." This comparison is useful only in a society in which the reader understands the composting technique well enough to get the point. Luke 14:34-35 tells us that if salt hasn't lost its flavor -- if it hasn't had any of its ten-to-fourteen minerals "refined" or leached out -- it is good for the compost pile. The same three basic ingredients -- manure, vegetation, minerals, including salt -- are still used today in making compost. Natural, unrefined salt has been used ever since ancient times both in compost heaps and as a fertilizer in its own right.

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Mr. Turner says in his book, Fertility Farming: "... when compost is spread on the surface of the soil, and not ploughed in, it has the ability of increasing not only the nitrogen content of the soil, but also the phosphorus and calcium and potash. My knowledge of science is insufficient to explain why ... The fact is that they appear in abundance where surface organic matter is adequate ..." (pp. 34-35). On pages 39-40 he explains how: "Problems of so-called soil deficiencies --- certainly as far as the main elements are concerned -- have only arisen with the increasing failure to acknowledge and act upon this law" (that all which is removed from the soil must be returned to it) ... "Phosphate deficiency is one of the outstanding fallacies of science (in soil as distinct from certain types of solid rock). There is no such thing; or at least none that science can measure. All that the soil analyst can measure is availability. When the soil analyst tells us a field is suffering from phosphate deficiency he merely means that insufficient phosphate is available; in other words, that the soil does not contain enough organic matter to produce the necessary mineral-releasing acids in the soil. A soil only becomes 'deficient' when there is insufficient decaying organic matter upon it to release the mineral nutrients already present in an unavailable form....

"The solution therefore, to all apparent deficiencies, is adequate organic matter in the right place."

"Experience has shown me that the right place for organic matter is on or very near the surface of the soil."

From his conclusion: "We have had the audacity to assume that we know better than God. We have believed we could improve on the ways of nature and we find ourselves under the threat of famine, in spite of so-called scientific genius. God in His goodness has provided the means to abundance; we in our greed and arrogance have perverted and destroyed. The only way we can repair the harm we have done is to give nature a chance to work in her own way and, as far as we must interfere by way of farming and gardening, let it be in imitation of nature rather than in battle against nature" (pp. 248-249). Thus, we see the reason for Mr. Turner's wisdom and success. He realized God's way is best.

HOW TO MAKE COMPOST

One can obtain better results by decomposing an assortment of organic matter in a compost pile and then spreading the finished product in his fields. One who doesn't have enough livestock to supply all the manure he needs can usually scout around the countryside and find a few dairies and feed lots -- or poultry farmers -- with manure to sell inexpensively. Supermarkets usually allow one to haul off their vegetable trimmings at no cost. These two items -- manure and supermarket trimmings -- will form a pretty good basis for a compost pile even if you find little else. I have composted manure with just a little bit of garbage, leaves, and dirt in it. And even if these items should happen to be polluted with a little insecticide, that will not outweigh the advantages. The decomposition of the materials will generate many more microbes than the insecticide residues destroy. And the microbes will eventually break down and nullify most insecticides. Some insure best quality compost by growing cover crops to be mown and put in the pile.

Getting your next crop started off properly toward a good harvest depends largely upon getting a good supply of decaying organic matter--manure or preferably finished compost--into your soil before planting time. A compost pile is simple to work with, and utterly fascinating once you get started and see its results. It is as much fun as a new toy and as beneficial as a bank account. Even a beginner can make good compost.

The compost pile should be about five feet wide or more and built up in layers, like a cake--and can be either round or long and rectangular. For ideal results, the first layer should consist of about six inches of vegetation, preferably coarse, to let air in and excess water out. Next, put on a layer of manure, one or two inches thick, depending upon its type and richness. Dampen each layer of dry material as it is added to the pile. (Preferably with bacteria culture -- otherwise just water). On top of the manure put a very thin layer of topsoil -- a fraction of an inch -- and, if you have it, a few shovelfuls of compost from a previous pile. If you have none, use topsoil with decomposing vegetation in it -- such as is found in a forest floor or a littered barnyard corner. Next, put on a few handfuls of pulverized -- but otherwise untreated and unprocessed -- natural rock fertilizer if you have them -- such as rock phosphate, potash, limestone, marine sediment, diatomaceous earth, or even common dirt. The minerals and old compost are the "salt and pepper" of a compost pile. Now repeat the layering process all over again as long as you have materials or until the pile is about four feet high. The proportions of the material can be varied considerably as long as there is a good variety, so there will be a balanced meal for microorganisms and plants.

For ventilation of the pile, drive a husky stake or two down into it and shake them occasionally to keep air holes open. Or, you could build a four-inch flue of narrow boards, drill holes in its sides, and put it in the middle of the pile for ventilation. Even with proper ventilation, however, the temperature of a healthy compost pile will rise to about 160-180° Fahrenheit. This heat together with the fermentation of the pile will destroy all disease organisms and parasites, even tapeworms cysts. After several weeks the temperature will drop and the compost on the inside of the pile will be decomposed. The pile should then be torn down and repiled, with the undecomposed inside material put on the outside. Or, the outside material can be used to start a new pile and the fully decomposed inside material can be used immediately for fertilizer. A skiploader is useful when large amounts of compost must be made. The whole process of decomposition takes from two to six months -- or if the bacteria culture is used it can be ready in two to four weeks.

By working compost and manure into the top layer of your soil, its natural fertility will literally skyrocket and your plants will become healthy and insect repellent the very first season. You should, if possible, apply these principles to all your land and incorporate cover crops which are disked into the top few inches of your soil when the proper stage of development is reached. Cover cropping in this way is known as sheet composting.

Instead of burning or discarding leaves, garbage, and other refuse put it to use -- compost it. Every soil can use and needs the organic material compost supplies.

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SOIL FERTILITY

One of the great deceptions of this generation is the concept that the application of man-made chemicals and manufactured fertilizers alone can supply what the soil needs to produce abundant healthy crops. Another deception is that methods of natural or "organic" farming are not practical on a large scale and that it would not be possible to stop using chemical fertilizers and pesticides without total crop failure and resulting starvation.

The truth is there are vast supplies of virtually untapped natural ORGANIC and MINERAL fertilizers and soil conditioners readily available throughout this country and the world. These fertilizer materials when used in conjunction with the natural principles and methods of building and maintaining soil fertility are more economical, easier to use, and more beneficial to soils and health than the manufactured chemical counterfeits. We strongly recommend that farmers use the natural mineral and organic materials when fertilizers are needed to improve their soils.

The natural rock fertilizers will supply a variety of mineral elements in a form that will be released slowly in the soil by microbial activity. Organic fertilizers enhance soil microbial activity and increase soil humus. Humus improves the physical character of the soil by increasing its capacity to take in and hold water and minerals. It improves aeration and temperature relations, tilth and prevents erosion. Decomposing organic matter also provides nitrogen and carbon dioxide and many minerals to stimulate plant growth.

The extensive use of chemical fertilizers and failure to maintain the organic component of soils is resulting in rapid depletion of soil fertility and destruction of physical properties. Many soils are literally becoming hard as iron (Deuteronomy 28:23). The limited application of naturally occurring chemical nitrogen fertilizers such as "Chilean Nitrate" can be used on depleted soils for the purpose of providing the needed initial boost. This will provide a valuable green manure crop to help start the soil life cycles. Naturally occurring fertilizer materials contain a greater variety of elements necessary in plant nutrition than manufactured products. However, it is still important that they be used in proper balance with other soil requirements especially organic matter. Once soil fertility is restored, need for fertilizers (other

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than the regular return of plenty of organic matter) will depend upon the original soil resources.

Studies have shown that highly soluble chemical fertilizers rapidly become locked up or leached from the soil. According to radioactive tracer experiments made at the U.S. Experimental Station, Beltsville, Maryland, only 2 to 10% of phosphate remains available. The following table is a comparison of the percentage of total mineral content remaining available to plants:

INORGANIC	ORGANIC
Nitrogen - 25%	Nitrogen - 100%
Phosphate - 10%	Phosphate - 80-90%
Potash - 10-15%	Potash - 80-90%

Using Soil Test Results to Restore Soils

To heal sick soil and produce profitable high quality, health-sustaining crops, it is necessary to stop using the farming practices that have caused the trouble, and begin farming in harmony with the natural laws God has set in motion. The big questions are, "Where and how to begin?"

Steps should be taken to determine the present condition of your soil so corrective measures can be formulated. Condition of plants and soil must first be examined in the field because of the many factors affecting crop production including: climate, soil structure and drainage, cultivation, insects, diseases, etc. Consideration of the types and varieties of crops suited to the soil types and climate should not be disregarded.

Hunger Signs in Plants

The health and productivity of plants are good indicators of the condition and needs of the soil; however, variations in temperature, moisture, light and disease can also cause similar symptoms.

Not Enough Nitrogen:

1. A sickly yellowish-green color.
2. A distinctly slow and dwarfed growth.
3. Drying up or "firing" of leaves which starts at the bottom of the plant, proceeding upward. In plants like grains and grasses, the firing starts at the tip of the bottom leaves and goes down the center or along the midrib.

Not Enough Phosphorus:

1. Purplish leaves, stems and branches.
2. Slow growth and maturity.
3. Small, slender stalk in grass; in small grains, lack of stooling.

4. Low yields of grain, fruit and seed.

Not Enough Potash:

1. Mottling, spotting, streaking or curling of leaves, starting on the lower levels.
2. Lower leaves scorched or burned on margins and tips. These dead areas may fall out, leaving ragged edges. In grains and grasses, firing starts at the tip of the leaf and proceeds down from the edge, usually leaving the midrib green.
3. Premature loss of leaves.
4. Plants like grain falling down before mature due to poor root development.

Not Enough Calcium:

1. Young leaves just beginning to bud become "hooked" in appearance and die back at tips and along the margins.
2. Leaves have wrinkled appearance.
3. In some cases, young leaves remain folded.
4. Light green band along margin of leaves.
5. Short roots.

Soil Testing

Simple chemical tests on soil samples can give you some guidelines by indicating the pH level (degree of acidity or alkalinity) and the relative availability of N-P-K (nitrogen, phosphorus, and potassium). Interpretation of test results must be made with regard to the testing method, soil type, crop and climate. As mentioned before, organic matter is the basic fertilizer necessary to establish and maintain soil balance. Organic matter should be supplied continually. A soil test will help tell you what is "locked up" or lacking in your soil.

Using Test Results

Proper use of test results will depend somewhat on the soil texture and type, intended crops and climate. A good husbandman will recognize and begin to understand these various factors by practicing the right principles of soil management. Man's responsibility is to dress (work) and to keep (preserve or protect) the earth (Gen. 2:15). Much of the work is performed by soil microorganisms, worms, etc. when we protect the soil by providing an abundant cover of organic matter.

Every seventh year the land is to have a rest and not be worked (Lev. 25:1-7). This will help restore the natural ecology and provide

new stores of organic matter necessary for soil balance and fertility. The sabbath year will also allow man to make repairs and improvements on the rest of his farm. "It is a sabbath of rest unto the land, a sabbath for the Lord:" The weekly and annual sabbaths also are essential to proper planning and management. Growing seasons and weather can be better discerned by planning around these seasons following the Hebrew solar-lunar calendar.

The system of cropping will be of particular importance when intertilled crops are grown. "The stirring of the soil in preparation of the seedbed and cultivation tends to break down the structure of the soil. . . . Intertilled crops such as peanuts, potatoes, tobacco, cotton, sugar beets, and vegetables are detrimental to soil structure because they require many tillage operations, return but little organic residue to the soil and generally have small shallow root systems" (Soil, 1957 Yearbook of Agriculture, page 389). Under conditions of intensive cultivation rotation systems and applications of manure have proven beneficial in maintaining productivity of the land. Proper use of soil is important. Certain types of plants are best adapted to acid soils (low pH). Some plants have higher requirements than others for nitrogen, phosphorus, potassium, and other elements. All of these factors should be considered to maintain production and fertility.

Greed to get all one can from the soil is the major cause of soil depletion. Chemical fertilizers are used to force that last ounce of production from the soil without leaving any residue to maintain the life of the soil.

A good husbandman will look first to his responsibility of keeping (preserving) the land for future generations. With the right goals in mind, he will not be blinded by greed and will recognize the importance of maintaining soil fertility through proper management. By understanding and applying these principles he will be able to properly evaluate test results to restore soil balance and maintain the mineral, organic and living portions of the soil. A good husbandman is always conscientious about his work and employs the valuable trait of "common sense."

Organic matter and more specifically humus (product of microbial breakdown of organic matter) is primary in correcting imbalances and deficiencies of the soil. Humus will serve to buffer an acid or alkaline soil to bring it back into the optimum growing range for most crops. It aids in unlocking unsoluble elements and also greatly increases the absorption capacity for high concentration of soluble salts such as occur in "alkaline" soils thus helping to balance all extremes of soil conditions.

When tests reveal an actual lack of certain elements they can be supplied by the moderate application of natural rock fertilizers. One application of these minerals lasts for a number of years. Once the soil balance and natural cycles for carbon, nitrogen and the various minerals are restored, further applications are not likely to be needed.

Fertilizer Materials

As already mentioned, the organic fertilizers are primary for providing nitrogen, making other minerals available and conditioning the soil. Some organic materials such as sawdust, straw and peat will require an extra source of nitrogen until the soil balance and life are restored. Nitrogen-fixing bacteria, some living in the soil and others in root nodules of legume plants, are capable of adding as much as 200 pounds of atmospheric nitrogen to an acre of soil each year. Most nitrogen of plant and animal remains is not available until liberated by the living bacteria. To help speed up the rejuvenation of dead soil, it may be advisable to spray a culture of soil bacteria on the fields. This is especially helpful if a farmer does not have enough compost to spread on the land to supply the bacteria. (Information on soil bacteria culture is available on request).

Mineral fertilizers are secondary to soil organic requirements and need to be applied only when there is an actual deficiency in the soil or to help restore the natural mineral cycles. Soils testing low in available minerals often contain ample. Once soil balance is restored these will become available for plant use and show high on the soil test.

Listed below are some of the natural products commonly used to supply the major elements. Composition may vary considerably from various sources. Natural products usually contain many other elements than those listed.

NITROGEN (Material)	Per Cent	PHOSPHORUS (Material)	Per Cent	POTASH (Material)	Per Cent
Chilean Nitrate	16.0	Phosphate Rock	30.0	Fly Ash	12.0
Bloodmeal	15.0	Bone Meal, Steamed	28.0	Wood Ashes	8.0
Guano	12.0	Bone Meal, Raw	24.0	Greensand	7.0
Animal Tankage	8.0	Animal Tankage	20.0	Granite Dust	5.0
Cottonseed Meal	8.0	Fish Scrap, Dried	13.0	Seaweed	5.0
Fish Scrap	8.0	Basic Slag	8.0	Fish Scrap, Dried	4.0
Bone Meal	4.0	Sugar Wastes, Raw	8.0		
Cowpea, Vetch, or Alfalfa Hay	3.0	Incinerator Ash	5.0		
		Cottonseed Meal	2.5		

4. Low yields of grain, fruit and seed.

Not Enough Potash:

1. Mottling, spotting, streaking or curling of leaves, starting on the lower levels.
2. Lower leaves scorched or burned on margins and tips. These dead areas may fall out, leaving ragged edges. In grains and grasses, firing starts at the tip of the leaf and proceeds down from the edge, usually leaving the midrib green.
3. Premature loss of leaves.
4. Plants like grain falling down before mature due to poor root development.

Not Enough Calcium:

1. Young leaves just beginning to bud become "hooked" in appearance and die back at tips and along the margins.
2. Leaves have wrinkled appearance.
3. In some cases, young leaves remain folded.
4. Light green band along margin of leaves.
5. Short roots.

Soil Testing

Simple chemical tests on soil samples can give you some guidelines by indicating the pH level (degree of acidity or alkalinity) and the relative availability of N-P-K (nitrogen, phosphorus, and potassium). Interpretation of test results must be made with regard to the testing method, soil type, crop and climate. As mentioned before, organic matter is the basic fertilizer necessary to establish and maintain soil balance. Organic matter should be supplied continually. A soil test will help tell you what is "locked up" or lacking in your soil.

Using Test Results

Proper use of test results will depend somewhat on the soil texture and type, intended crops and climate. A good husbandman will recognize and begin to understand these various factors by practicing the right principles of soil management. Man's responsibility is to dress (work) and to keep (preserve or protect) the earth (Gen. 2:15). Much of the work is performed by soil microorganisms, worms, etc. when we protect the soil by providing an abundant cover of organic matter.

Every seventh year the land is to have a rest and not be worked (Lev. 25:1-7). This will help restore the natural ecology and provide

"SOIL BACTERIA" is a culture of many varieties of natural soil microorganisms necessary for decomposing organic matter into humus, fixing nitrogen in the soil and combating many disease organisms. This in itself is not a "fertilizer," but serves to make elements available for plant use.

FERTILE MIX is a combination of 2 parts lignite and 1 part KMP innoculated with the soil bacteria.

Note: Chemical and spectranal analysis of these materials is available upon request.

How Much and When Should Fertilizers Be Applied?

Organic matterneeds to decompose to produce its effect as a fertilizer. The decomposed or composted products are effective immediately. Temperature, moisture and soil life will determine how rapidly other materials will become available to plants. For best results organic matter should be applied several months before planting in soils being restored. The amount need not be limited except by availability and rate it can be incorporated into the soil. Caution should be used with acid forming material, such as sawdust, pine needles and peat, to balance them with limestone materials unless an acid soil is desired.

Natural rock type fertilizers usually have a low level of available minerals. They are released by the activity of soil microorganisms and water. This will occur most rapidly during the warm growing season when an abundance of organic matter is present. Natural rock fertilizers can be applied any time, remembering it may take some time for them to become available, depending upon the condition of the soil They should be used moderately, especially the more soluble types as they can create an unbalanced condition if there is not adequate organic matter to buffer and balance them. Soil texture and types of plants will also affect the amounts needed. Most vegetable food crops require more minerals than the non-food type plants. The results will depend largely on the understanding experience and diligence of the husbandman.

Sources of Natural Fertilizers

There are numerous sources of organic fertilizers. Crop residues, green manure crops, livestock and poultry manures, composts, various mulching materials such as straw, spoiled hay and sawdust, peats, lignite, and other materials are available in most areas. Some organic products are available at local feed and seed stores, feed mills, cooperatives or perhaps even some grocery stores. Commercial products if used in excess, can result in a condition of imbalance by sudden release and subsequent lock ing up of certain elements. Use only as recommended or as a soil test would indicate. Organic matter and humus are helpful at all times to maintain soil life and balance.

When purchasing commercial "organic" fertilizer and soil conditioner products, check the quality. They should be decomposable to support and enhance soil microbial life. It should mulch to help balance and build your soil as a compost and not harm or poison it. The cost should be reasonable for your operation comparable to other materials.

The following is a list of several sources handling organic and natural rock fertilizers. You may write to them for information concerning their products if not available locally.

Natural Rock Fertilizers

Rhum Phosphate and
Chemical Co.
P.O. Box 361
Columbia, Tenn. 38401

Robin Jones Phosphate Co.
204 23rd Ave.
Nashville, Tenn. 37200

Fanning Soil Service
4951 S. Custer Road
Monroe, Michigan 48161

Organic Fertilizers

Farm Guard Products
701 Madison N.E.
Albuquerque, N. M. 87100

Bactelife International
Soil Conditioner Corp.
P.O. Box 212
Caldwell, Texas 77836

Southwest Wholesale Co.
P.O. Box 35052
Dallas 35, Texas 75200

Alginure Seaweed Products
P.O. Box 693
Sidney, B.C., CANADA

Blenders, Inc.
Lithonia, Georgia 30058

Diatomaceous Earth Sources

Perma-Guard
Box 6607
North 60th Ave.
Glendale, Ariz. 85301
(Insecticide and
mineral supplement.)

The information and guidelines given present only an outline for fertilizer application. If you desire further specific details please feel free to write.

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AGRICULTURE DEPARTMENT

SPRINGTIME IS GARDEN TIME

Delicious, nutritious - home grown vegetables - yours for the "growing." Let fresh, golden yellow, hot buttered roasting ears from your own garden tantalize and fulfill the desires of your delicate taste buds and those of your family. Crisp, fresh cut greens, firm juicy vine-ripened tomatoes - salad delight. Here are basic guidelines to help you "cultivate" a family food factory.

Successful gardening can be a very satisfying and rewarding experience for the whole family -- not only from the produce that is harvested, but also from the principles learned in applying basic laws of plants and soil. When applied properly, persistently, and effectively these principles will bring forth abundant, delicious benefits.

Gardening provides an exciting and "fruitful" family hobby. It presents an opportunity to strengthen family ties and for each member to enjoy the fruits of his labor. The germination and growth of a single seed portrays the wonder of Creation. Gardening is an engrossing pursuit, and you need not guess and depend on the proverbial "green thumb". Success comes from proper planning, timing, management, and following laws of Nature (Prov. 12:11).

Most people spend a large portion of their budget for food. Where available, many pay premiums for "home grown" vegetables. Why? Because of flavor and quality.

"Today, by train, truck, and plane we draw on the riches of half the world for food. This gain in variety has not been all gain, however, for in reaching afar we have lost freshness. We no longer have a ring of truck farmers around our major cities: today's lettuce, tomatoes, cabbage and celery must travel thousands of miles to market. Most important has been the loss in flavor" (Vegetables for Today's Gardens, Carleton, p. 2). A loss in flavor confirms a loss in nutrients.

Proper Planning

Fresh, tender, flavorful produce can be within close proximity of your back door if you take the time to plan a family garden. One of the first

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things to consider is the size garden needed for your family. Allow plenty of vegetables for daily use for canning, freezing and storing to fit your needs. Do not overplant items which the family will not eat or too much of any one at a time.

Select a well drained soil on a gentle slope if possible. A southern slope is warmer and will enable you to plant 2 to 3 weeks earlier and encourage faster growth. The site should not be close to trees. Tree roots reach out many feet in all directions and will rob moisture and soil nutrients from your garden.

Timing is very important for a successful garden. There is a time to plant, and a time to pluck. There is an early harvest and a later harvest exemplified by the feasts of Pentecost and Tabernacles (Ingathering). The early garden is generally more profitable.

Planting and harvest times vary considerably in different parts of the country. In many areas, especially southern states, a year-around garden is possible. Northerly areas, high or mountainous regions, etc. usually have later and shorter seasons. Easily acquired gardening pamphlets (USDA Bulletin #9 "Suburban and Farm Vegetable Gardens" is one) give guidelines as to which vegetables can withstand light freezing. If needed you can check with your local county agricultural extension agent for information concerning the last and first freezing trends for your area. A general guide for last frosts in the spring is to notice the little wild flowers when in full bloom in your area. If it froze after they are in full bloom they would not make seed and the species would die. Although the dates vary from year to year, these wild flowers do not blossom too early or too late. Many guidelines can be learned from these little "miracles" around us.

The basic factors that determine the proper times for planting and harvesting include: soil condition, temperature, fertility, available moisture, seed quality and variety, and amount of light. These factors control seed germination, plant growth, and maturation. Ground cover and good soil fertility will modify and lessen extremes of temperature and moisture.

Soil Preparation and Fertilization

Having selected the best possible location, it should not change from year to year. This practice allows the soil to be developed to a high state of fertility and productivity by the addition of organic matter, mineral fertilizers, mulching and cover-cropping. If enough land is available, garden crops may be alternated between two plots. Soil-improving crops (legumes, rye, beans, peas, etc.) may be grown in one of the plots for cultivating into the soil while the other is producing.

Fertile soil is living soil. An important factor to look for in soil is the amount of microbial life it will support. The pH range and amount of organic matter generally determine the amount of life your soil will support. The pH is merely the degree of acidity (0-7) or alaklinity (7-14). 7 is neutral. Plants and soil life produce best in a pH range

of 6.0 to 7.5. Good organic material will help bring your pH to 7. The key to fertility is soil balance. Proper soil balance simply means all soil nutrients are available in a usable form for the desired crop. Balance is achieved by restoration of organic matter, soil life, and needed minerals. A soil test can assist in determining basic needs.

Plenty of compost, manure and a good cover crop worked into the soil will help keep the nitrogen and humus content high. Humus is the substance which gives the soil its dark color. It is an indication of the soil's fertility. Manure used to be carefully preserved and composted when people understood its value. All too often, for many today, it is little more than a pollutant. Manure and compost feed bacteria and earthworms which reproduce to keep soil in a more healthy and productive state. In applying manure or compost, work it into the soil with a disc or roto-tiller. (If you desire, you may write for further information on "Soil Fertility".)

The lack of major elements may be determined generally by plant growth.

Hunger Signs in Plants

Not Enough Nitrogen:
1. A sickly yellowish-green color.
2. A distinctly slow and dwarfed growth.
3. Drying up or "firing" of leaves which starts at the bottom of the plant, proceeding upward. In plants like grains and grasses, the firing starts at the tip of the bottom leaves and goes down the center or along the midrib.

Not Enough Phosphorus:
1. Purplish leaves, stems and branches.
2. Slow growth and maturity.
3. Small, slender stalk in grass; in small grains, lack of stooling.
4. Low yields.

Not Enough Potash:
1. Mottling, spotting, streaking or curling of leaves, starting on the lower levels.
2. Lower leaves scorched or burned on margins and tips. These dead areas may fall out, leaving ragged edges. In grains and grasses, firing starts at the tip of the leaf and proceeds down from the edge, usually leaving the midrib green.
3. Premature loss of leaves.
4. Plants falling down before mature due to poor root development.

Choose Good Seed

Another important item to consider initially is your choice of seed. Often good seed can be acquired from local gardeners or seed stores you know. Three major U.S. seed companies which carry good seed are Burgess, Burpee and Henry Field. Most companies advertize both hybrid and non-hybrid varieties and you will need to specify you want open pollinated

varieties when placing an order. Non-hybrid seeds produce a much higher quality product, both in flavor and nutritional value. Proper seed selection is of utmost importance to successful gardening.

When selecting your vegetables, carefully read the seed catalogue. The old name varieties for home gardens have more flavor than the commercial varieties which are bred for good looks, storage and shipping qualities. Flavor is a measure of quality and will bring rich dividends if considered in planning and selecting vegetables. A good booklet, "Care of the Home Garden" by the Joseph Harris Company, Rochester, N.Y., lists many proper varieties.

Cultivation, Planting and Care

A garden can and should be beautiful as well as useful. A variety of flowers can be planted for borders and interspersed in rows throughout the garden to add color and beauty. Some flowers such as marigolds, chrysanthemums, pyrethrums, and mums have helpful insect repellant characteristics.

When cultivating, strive to loosen and aerate the soil. A rake or garden harrow is fine to assist in preparing the seedbed for planting and sowing. Remember, your object is to loosen, not invert the topsoil, which in some cases may be quite shallow.

You may plant in any artistic form that meets your taste. However, if you desire nice straight rows, stretch a heavy cord or rope taut along the ground and walk on it. It leaves a good indentation in soft earth. The corner of a how or a pointed stake will make a suitable furrow for most seeds.

Start on one side of the garden, planting 30- to 45-day crops. When you harvest these crops, you could replant. Next to 30-day crops plant 45- to 75-day crops. Then plant your 75- to 100-day crops. This method of planting produces a continual vegetable harvest. If possible, plan your rows to run north and south for better utilization of sunlight by each plant. The previously mentioned USDA booklet #9 gives planting dates, depths, distances as well as many other specific helpful gardening details. (The "rule of thumb" is to cover three times the diameter of the seeds).

When planting certain seeds pollinated by wind, you may need to leave about 6-8 rows between types. This applies to garden seeds such as squash, cucumbers, pumpkins and watermelon. These should not be planted next to each other. These vegetables will cross-pollinate and produce inferior quality, flavor, and mingled seed. You can plant squash on one side or end and cucumbers on the other, but not together. Cantaloupe will not mix so it may be planted next to most any vegetable.

Take care in cultivating your garden properly. Do not hoe or cultivate too deep, too often or too close to the plants. Excessive cultivation does not conserve moisture.

After the plants are well established and you have cultivated a few times, it would be wise to mulch your garden. This will save labor and

conserve moisture. Earthworms have an ideal place to work under a mulch. This type cover helps maintain constant temperature and side moisture retention. Good mulch material is hay, straw, leaves, or any composted organic matter.

Keep weeds out of the garden. They rob your soil of moisture. A few inches of good mulch works well between rows to control weeds.

Keep a close check for insects in your garden. If you have properly selected seeds and have a rich fertile soil, the plants should be for the most part insect and disease resistant. In a garden that is properly fertilized, beneficial insects such as ladybugs, praying mantises, lacewing flies, and orange and black spotted beetles will take care of destructive insects that present themselves. However, to assist in insect control until proper soil and plant health is established, an inexpensive grade of wheat flour or diatomaceous earth dusted on plants when dew is on is helpful. If the insects have gotten out of control, add one part of Rotenone or Pyrethrum powder to ten parts of dust.

Do not water too much. Excessive watering retards root growth because the roots do not have to search for moisture. Also, the larger the root system, the more plant food becomes available to the plant and the better the production. Irrigation is a substitute when the blessing of rain is lacking. Many plants cannot take too much water, especially tomatoes. Too much moisture may contribute to unwanted fungus growth. One can easily tell when a plant needs water, not because the surface soil looks dry, but rather when plants begin to show a dark bluish green color or begin signs of wilting, or both. Much more good is derived from a real good gentle soaking (perhaps once a week in dry weather) rather than from daily wetting the ground. Also, it is best to not apply the water directly on plant foliage during the hottest part of the day. This can encourage "burning" rather than "cooling".

Harvest Time

When the time for ingathering has fully come -- here is what to do. Harvest your vegetables when they are ripe and contain the most nutritional value. At this stage they are tender and easy to cook and prepare. If they become overripe and too mature, they lose some of their nutritional value. Certain dried crops such as kidney, great northern, and navy beans must be mature when harvested. This also applies to pumpkin and some types of squash.

It is best to harvest only as much as can properly be taken care of (refrigerate, can or freeze) within three hours from harvesting. This will preserve the full tenderness, flavor and crispness. A home garden can often supply most of the vegetable needs of a family not only during the seasons it produces, but throughout the winter months if the produce is properly prepared and stored.

After harvest, if you desire to plant winter crops on part of the area, it is beneficial to mulch or use a cover crop on the rest. This gives the

earthworms and soil bacteria something to feed on and a chance to continue working before it gets too cold. This is part of a good program.

Remember to properly clean and store tools when your gardening season(s) are over. A light surface lubrication will prevent rust. Selecting an accessible dry location will help you locate them when needed and give them longer life.

Once you have made a garden plan -- stick to it. God's blessings require perseverance, hard work and diligence.

Successful gardening is rewarding and satisfying. How about it? Why not find out what a thrilling, educational experience and opportunity gardening can be for the whole family.

GDN

AMBASSADOR COLLEGE
BIG SANDY, TEXAS 75755

HERBERT W. ARMSTRONG, *Chairman*

AGRICULTURE DEPARTMENT

I N S E C T I C I D E S

Insecticides affect all life on earth. Back in the 1900's natural methods of controlling certain types of insects were used. This was primarily done with sulphate and pyrethrum (taken from the dried center of certain flowers, mainly chrysanthemums). Nicotine from tobacco and rotene (from a legume plant of East India) were also used. These were a mild form of insecticide, yet did a very good job. After World War II, man began to use synthetic insecticides which delivered a faster and more complete kill. In 1965 alone man used 900,000,000 pounds of these deadly synthetic (chemical) insecticides.

A form of arsenic was the first chemical insecticide. As insects became immuned and the kill lessened, more deadly poisons were introduced and became available on the open market. These fall into two main groups: 1) chlorinated hydrocarbons, of which DDT is one and 2) organic phosphorus. DDT was put on the market in the early 1940's. A German chemist developed it in 1939 and won a Nobel prize for this "great" achievement.

DDT has been used widely on every crop we grow. It is taken into the blood stream from the foods we eat, the liquids we drink and the air we breathe. This is done in most cases in quantities as small as 1/10 per million. This poison is stored up in the fatty tissue of the body and as it continues to build, causes a degenerative disease of the liver and other body organs. Tests show that men who work in DDT plants have accumulated as high as 648 parts per million. It is easy to understand why they are short-lived. DDT has infected our grain crops, hay crops, poultry and livestock feeds -- even the milk we drink daily.

INS

Then came chlordane, a little more deadly. In a 25-parts-per-million solution one drop on the skin will cause poisoning and sometimes immediate death. Heptachlor came next, soon followed by epoxide, which is four times stronger than chlordane.

Next came the hydrocarbons. They included deldrin, aldrin, and endrin. In solution they are 40 times more powerful than DDT. These are the insecticides that do such a fine job of killing birds, fish, and other wildlife.

The thions are being pushed as some of the best insecticides now available. Malathion and parathion are the most popular. One drop of parathion on the skin brings sudden death.

There is little wonder that our soil is dying, most of the bacterial life killed by poisons.

A visit with a bio-chemist who works for a large chemical company proved quite revealing. He mentioned that we had almost reached the limit concerning the effectiveness of poisons to kill insects. He said that over the years, the strength of the poisons has had to be increased to be effective. Each insecticide previously used would kill all but a few of the insects. Those not destroyed began to multiply at a much more rapid pace than before because there was no competition and more food. He went on to state there was only one stronger poison that could be used, and at only one-half part per million. If the solution were made any stronger, it would kill humans as quickly as insects. He did not specifically state so, but it is easy to conclude that if for no other reason, man would be completely destroyed from insecticide or insect infestation in the near future.

The insects are only trying to do the job for which they were created -- to destroy weak and sickly plants. Insecticides cause insects of necessity to mutate and become stronger in order to do their job. The death of the majority causes the mutant variety to prosper. The poisons from insecticides left in the soil destroy soil life. The weakened soil produces weak and sickly plants which invite more insects, more and stronger insecticides are applied, and the drastic cycle continues.

Many people go right on ignoring facts and closing their eyes to them. "Educated society" has no solution.

Answer Available

Healthy, living soil produces healthy plants with a built-in insect repellent. Certain sprays or dust may be used while the soil is being enriched. We have found powdered material (diatomaceous earth) to be effective as a dry dust or mixed with water as a spray. The item mentioned above is helpful. Much can also be accomplished by introducing a natural enemy of the insects that you are trying to eradicate. (Rachel Carson's book, Silent Spring, offers helpful guidelines.)

Diatomaceous earth is not poisonous in any way. In fact, we use it in our livestock and poultry mineral. Neither will insects killed by it harm birds when the insect is eaten. Well, if it is not harmful to warm-blooded animals, and it doesn't poison the insect, just how does it work?

To understand the lethal effect on insects, we must first know a little about the insect. Most insects' shelter consists of a hard shell. Around the joints and spiracles insects secrete a liquid. What the powdered material does is dehydrate the insect. It absorbs the moisture around the insect's joints, and demobilizes the insect. Being unable to move around to obtain food the insect dies. When powdered diatomaceous earth is put under a microscope it looks like tiny pieces of glass. With this quality it cuts and severs the insect's skeleton shell. Once the shell is broken, liquid leaks out. With loss of only 10% of its liquid, an insect will die. Therefore, the insect is killed in two ways without poisoning it.

Another advantage of harmless insecticides over chemical insecticides is that insects cannot build a resistance to it. You will not have to add a stronger dose each time.

Diatomaceous earth does kill almost any kind of insect. However, there are some it does not. Don't conclude that it is a solution to all problems. Don't deem it as a panacea.

Insects merely point to a soil problem. Once soil fertility is completely restored, insects will not be a problem.

Diatomaceous earth or similar materials work best when applied as a dust -- administered through an electro-static duster. "Perma-Guard" is the trade name of a diatomaceous earth product and may be obtainable in your area.

God promises He will rebuke the devourer if we have faith and obey His agricultural laws.

"And I will rebuke the devourer for your sakes, and he shall not destroy the fruits of your ground, neither shall your vine cast her fruit before the time in the field, saith the Lord of hosts" (Mal. 3:11).

We should with diligent earnestness claim that promise. If you still have bad insect problems after you feel you have obeyed in every whit, check again -- laws are still being broken, and this needs to be corrected.

INS

AMBASSADOR COLLEGE

BIG SANDY, TEXAS 75755

HERBERT W. ARMSTRONG, *Chairman*

AGRICULTURE DEPARTMENT

AN AEROBIC LAGOON FOR SUCCESSFUL WASTE DISPOSAL

D. L. Schurter
Ambassador College Agriculture Department
Big Sandy, Texas 75755

(NOTE: The following material on the Ambassador College lagoon system was presented at the 2nd International Poultry Liter and Waste Management Seminar at Texas A & M, College Station, Texas, in October 1968.)

Some weeks ago Dr. Howes visited the college campus where I work. In touring the grounds, we passed the college sanitation facility at which point the conversation switched to the lagoon, its function and success.

In beginning stages of planning the College, much discussion and study was directed in choosing a location. After somewhat lengthy deliberations, it was decided the location would be in a nicely wooded area of East Texas. This site had been used for a large annual Church Convention for several years. Some of the present installations could be altered and utilized by the College.

Sanitation facilities in use were septic tanks and drainage tile. The area was full of springs which caused the ground to be semi-saturated most of the time and limited the capacity and effectiveness of the present system. It was operational, but seemed likely to be inadequate.

Pressure to begin the College urged the decision to open with present facilities. It wasn't long before sanitation became a growing and "smelly" problem.

Several types of sanitation systems were considered. The College, like most others in beginning stages, had its growing pains. Economics was an important and needful consideration; however, not to sacrifice quality. An aerobic oxidation lagoon, it was thought, would best fit our needs. Lagoons were relatively new to this area. However, in Kansas, Pennsylvania and some other areas, the aerobic lagoon systems were quite popular. Reports showed them to be effective, efficient and economical to install and maintain. We decided to use this system.

The layout of our campus is of such a nature that we could take advantage of the natural terrain. Considering the slope of the landscape aided in selecting location for construction

LAG

of the lagoon. Natural drainage from all parts of the campus provided excellent fall for carrying waste materials to the lagoon. This eliminated the need for purchase of expensive and sometimes troublesome pumps.

The size of the lagoon would be determined, of course, by the amount of material to be handled. We needed capacity to handle approximately 250 people on campus over a 24-hour period and 400 students during the day for a period of 8 hours. Here is a quote used to guide in calculating the size of pond needed. "Aerobic ponds are designed to be aerobic throughout their depth, and unless they are mixed, they must be loaded at less than 20 lb. Biological Oxygen Demand (BOD) per day per acre to remain this way. When operated as unmixed ponds, they are valuable mainly as disinfection devices in which coliforms die away with the passage of time. Unmixed aerobic ponds may be constructed to have depths of 4 to 5 feet and to operate at detention periods in excess of 60 days."

Dimensions of the lagoon were determined based on the average daily volume. It was built to the following standards:

Volume: Not to exceed an average of 30,000 gallons per day (maximum of 60,000 gallons per day), average determined by measuring an average of the total daily waste discharges over a period of thirty (30) days.

Quality:

	NOT TO EXCEED		
Item:	Monthly Average	24 Hr. Daily Composite	Individual Sample
BOD	20 ppm	25 ppm	30 ppm
Suspended Solids	20 ppm	25 ppm	30 ppm

The above is a guideline that could be followed for any size operation. If the soil is sandy, a sealing type mud should be put in the bottom of the ponds. Barite, or driller's mud, worked into the bottom is good for this purpose.

Now that we had the pond, the next step was to charge it. Mr. Walter Klepfer, now a College employee, had been doing experimental work with soil bacteria privately for about 16 years. He observed, through experimenting with manure piles, compost piles, lignite deposits, etc., that certain types of the bacteria present caused a much faster rate of decomposition. This, of course, is common knowledge. However, he went on to select out those desirable types. His primary objective of developing this "culture" was to assist in farming operations.

He was later hired by the College to work in the Agriculture Department. The department began growing this bacteria in a large 5,000-gallon cement tank. To culture the bacteria successfully, it was necessary to feed it. This was accomplished by periodical applications of non-debittered brewer's yeast and sugar. The culture was used (and still is used) to spray on pastures and crop land. This helps restore soil micro-organisms that have been destroyed by improper farming methods. It proved quite helpful to speed the decomposition of chicken litter when applied directly to the floors of the houses, and to help speed up the making of compost.

When an aerobic lagoon system was adopted for the College, Mr. Klepfer recommended the bacteria culture be used to charge it. The culture had worked well to dislodge wastes in his own, and neighbors', disposal systems. In fact, usage of this culture helped keep the College septic system functional until the lagoon was completed. The culture has worked satisfactorily in the lagoon.

The oxidation pond is rectangular in shape, approximately 40 x 70 feet; 2,800 square feet; and 16,800 cubic feet. It successfully handled 350 people the first year; approximately 500 the second year.

The plans of this sanitation system call for all material to pass through a chopper before it is deposited in the lagoon. For several months the lagoon operated successfully without installation of the chopper. The fall of the land was such that it caused the material to tumble to the point of breaking into fine particles. The bacteria had no problem in completing the job of decomposition. Later, however, we installed the chopper to conform to state recommendations. It has proven to be an additional aid to digestion.

As the College grew, so did the volume of material dumped daily into the lagoon. When the lagoon would become overloaded, we would broadcast yeast and sugar on it, which would speed up the multiplication of the little "dung-eaters." Within a 24-hour period the balance was usually recovered. The original lagoon was designed to handle the wastes from 550-650 people. It was handling more than its supposed capacity before expansion was necessary. Installation costs of this type lagoon system will vary some according to layout. Ours cost around $18,000.

Expansion was achieved by the installation of a second lagoon adjacent to the first. An overflow pipe from the first is connected to the second lagoon. As excess digested liquid accumulates in the second pond, it is pumped off to be used for fertilizer. Some is applied by tank trucks and some is pumped direct to the fields through an irrigation line.

This year's first cutting of hay at the College was produced from a field fertilized with the digested liquid, which was applied through an irrigation sprinkler. This particular field is divided by the College airstrip. No liquid was applied to one side, while readily applied to the other. The fertilized section outproduced the other 3:1. We had an abundance of rain, so increase in production from moisture received by application of the liquid would be small.

Many ask if anything other than bacteria can live in the lagoon. As an example of some of the "life" in our lagoon, we have bacteria and our largest digestor is "George," an alligator.

Much information is available on lagoons, both general and technical. Books are regularly being published on the subject. One of the outstanding books is Advances in Biological Waste Treatment, sponsored by the Manhattan College, New York, published in 1963 by the McMillan Company, New York. In the back of this book is a bibliography which gives many sources of helpful material.

Waste control is a national problem. The conclusion of a conference on biological waste treatment several years ago was that the solution of the waste problem was to utilize natural microbiological processes.

Senator Jennings Randolph of West Virginia was a speaker at the National Pollution Exposition and Conference held at the Astrohall in Houston, Texas in April of this year. He spoke to 2,000 conference delegates from all across the nation. Never before had such a broad-based conference on pollution control ever convened. He had this to say: "Only recently have we become acutely aware of the fact that we are exceeding nature's ability and capacity to reprocess the kinds and quantities of wastes which are being produced."

An assistant Surgeon General of the United States, Dr. Richard A. Prindle drove this point home: "The deterioration of our environment is a problem so vast and urgent that anxiety about it must not be confined to elected officials, professional health workers and conservationists. Every level and facet of citizenry is affected and must be concerned."

This includes everyone of us here, our families, our communities and the institutions we represent.

Natural microbiological processes alone will never solve the colossal waste disposal problem of this nation and the world. But--sample aerobic lagoons do comprise one important link in the chain of needed answers and solutions.

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AMBASSADOR COLLEGE
BIG SANDY, TEXAS 75755

HERBERT W. ARMSTRONG, *Chairman*

AGRICULTURE DEPARTMENT

KEYS TO PROPER SOIL MANAGEMENT

Agriculture is in a growing DILEMMA! Each year in spite of advances in technology the farmer's profit margin is LESS AND LESS. And, in many cases there is no profit at all. With new "improved" varieties of seeds, more potent herbicides and pesticides, new types of machinery and "more efficient" management practices the business of agriculture is coming to a standstill!

Each year, multitudes of farm families are forced to abandon their land and life's profession in despair and join the trek to town in search of economic success. This sad fact is revealing! Something grossly wrong is happening with the way agriculture is being carried out in our land!

To this personal tragedy must be added the trends in food production that portend a mammoth crisis for all of us -- unless these trends are reversed, and soon.

Warning us of the effects of soil mismanagement, at a recent meeting of the American Association for the Advancement of Science, Barry Commoner, a noted ecologist, pointed out that when the United States was settled, the soil system was in a natural and fertile condition. But the organic store of nutrients began to be depleted as the quality and the yields of crops declined year by year. Farmers moved westward, skimming the most available nutrients from the soil, resettling each time, land productivity fell. Finally reaching the west coast they could go no farther. As the nation's population increased, agriculture responded to the demands by robbing the soil as more and more of the nutrients were removed by wrong farming practices.

The farmer applied chemical fertilizers, hoping he would somehow restore soil fertility. Today this has led to such a wide practice that now farmers find themselves almost <u>completely</u> <u>dependent</u> on these fertilizers for their livelihood.

> . . . fertilizer is being substituted more and more for land and other capital. The acreage of crops harvested has decreased but the percentage fertilized has increased. (<u>Farm and Ranch Bulletin</u>, Federal Reserve Bank of Dallas, April 1968)

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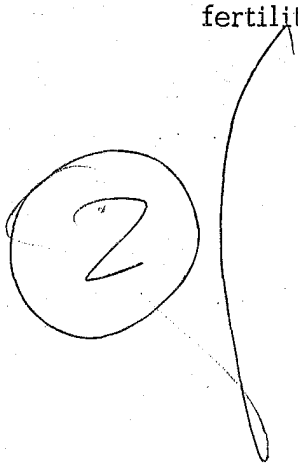
Yet, in spite of all the additional fertilizer that is being used, soil fertility has actually decreased -- and continues decreasing.



> Evidences of declining soil fertility are seen in the greater number of deficiency diseases among our farm animals. Veterinarians are constantly faced with increasing cases of strange animal ailments for which no specific body weakness or visible physiological cause can be found. Eye ailments, a tendency to blindness, bad gaits, rounded back lines, inferior condition, poor feeding progress, and even debility and death can be traced to deficiencies in animals' nutrition. ("Sick Soils Have Effect on Animals," by Dr. William A. Albrecht)

The Cause of Chaos -- and the Cure

There is a cause for these alarming trends, a reason agriculture is in trouble. That cause is a monumental failure to seek out, examine and apply the principles that govern soil fertility and economic crop production.

You need to know the fundamental laws -- the basic physical principles -- that govern success or failure in farming -- which in turn will govern the continued existence of human life with plenty.

But what are these principles? What are they concerned with? Where can you read about them?

Natural laws, revealed from creation, instruct man in dressing and keeping the earth so it will produce abundant, healthfully nutritious, life sustaining crops. These laws will naturally attempt to destroy sick, diseased and inferior plants and animals. But, unfortunately, most of the effort in commercial agriculture has been directed toward trying to find a way around nature's laws. It seeks to suspend the natural penalty of breaking these laws, instead of seeking out ways to farm in harmony with them. Certain industries dealing with farming have sought more profit for themselves by ignoring natural farming principles.

The laws of agriculture were set in motion by God at creation, but mankind has lost much of the true understanding of these laws. These laws have to do with such things as the soil life cycle and maintaining a balanced, living soil. Crop rotation and diversified farming are also a part of the cycle.

The key to understanding these laws is to first understand what the soil really is and how it works. The common view is that the soil is nothing

but a dead substance in which plants are held up while receiving various applications of chemical plant foods which cause them to grow. But this is not true. Soil is a living, active thing.

A healthy soil is very much "alive" and dynamic, teeming with bacteria, actinomycetes, fungi, molds, yeasts, protozoa, algae, worms, insects, and other minute organisms which live mostly in the top few inches of the soil. This soil life must be maintained in balance in order to grow health-giving, nutritious crops. It is essential to understand this soil life cycle in order to understand the physical principles that control it. (For a more complete explanation of this soil life cycle write for our article on "Soil Principles.")

But how are these laws or principles broken? Simply by doing anything that kills soil life. Most all highly soluble chemical applications will kill soil life. Improper tillage can destroy this life. Lack of proper crop rotation is also detrimental. These are areas in which man has gone far astray. He has lost the understanding that soil is a dynamic living substance and hence does not understand how chemicals, tillage and crop rotation affect the soil. But these laws are living laws that work, whether they are understood or not. To kill the life in the soil is to destroy the capacity of the soil to produce quality food.

A big key in maintaining this soil life cycle which is often overlooked today is to have a diversified operation. By that we mean having cattle, chickens, etc., as well as grain and hay. If you feed your own balanced, nutritious grain to your animals, <u>they</u> will supply you balanced, nutritious food to eat and also fertilize your land. This will maintain your health and outlook, and thus your capacity to work and live.

Diversification plays a big part in keeping the cycle of minerals and micro-organisms alive. Healthy soil means good produce which means productive animals which means adequate manure which can be put back on the soil to maintain its health.

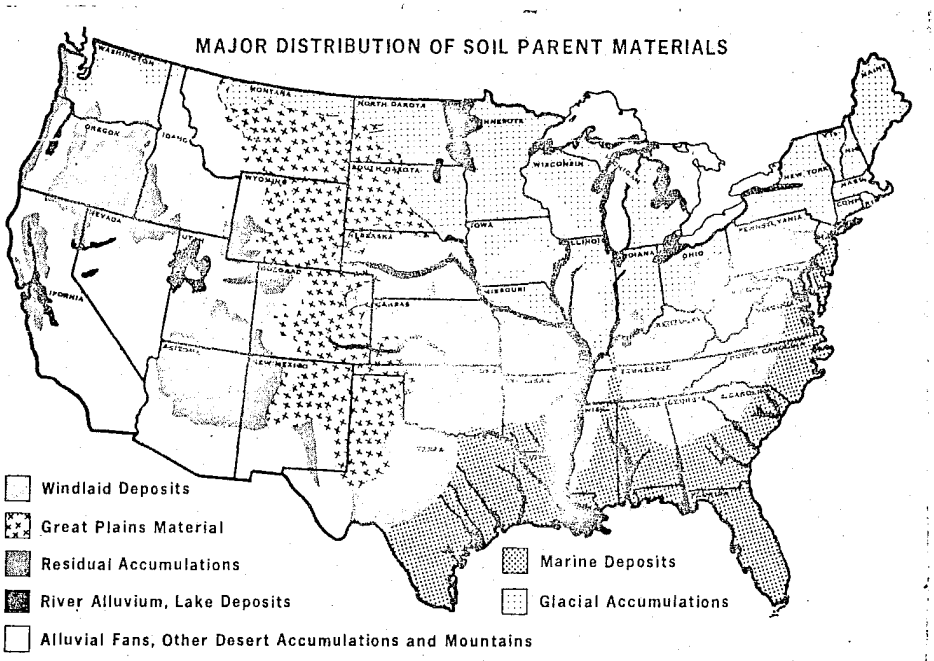
Another aspect of diversification concerns crop rotation and relying on a number of crops instead of relying completely on one crop for an income. Different crops take different minerals from the soil. Monoculture can rapidly deplete a soil of the particular element one crop uses. By rotating crops, minerals will be balanced and maintained since certain crops will replace minerals used by others.

Here are some common problems which can be answered by farming in harmony with these fundamental and basic laws.

Soil Fertility

Fertile soil is simply soil capable of growing and sustaining abundant, healthy plant growth. It supports a variety of soil microorganisms which help make elements available to the growing plant.

The materials from which soils were originally formed and the manner in which they were formed will determine inherent fertility. Certain soils are better suited to certain crops, depending of course upon the topography, drainage, and the soil forming factors. Your county agent will have information for your area. The 1957 yearbook on "Soils" is also an excellent reference manual. You should determine physical soil type for a proper fertilization program.



Soil follows a biotic life cycle and fertilizers applied need to be balanced, containing major, minor and trace minerals. Why? So soil microorganisms and plants can get a balanced diet. Only those natural fertilizers which aid the soil life cycle should be used. "All the phases of the life cycle are closely connected. All are integral to nature's activity. All are equally important. None can be omitted. Soil fertility must be the basis of any permanent system of agriculture." (An Agriculture Testament, p. 22)

How can we attain true soil fertility? Soil cannot be made healthy and fertile merely by the addition of chemical fertilizers. There are,

however, natural rock fertilizers that can play a part in bringing back true fertility by adding missing trace minerals and other needs.

Immediately when people hear about natural fertilization they think that it is either completely impractical or only practical on a small scale. In the long run, however, it is the only practical method of farming. Increasing problems of insects and disease in animals and humans present evidence that natural fertility must be restored.

The United States produces a larger amount of food than other nations. It is largely the result of greater acreage and more machinery -- not better quality produce or better care of soil fertility. Our yield per acre for most crops, including wheat, is low in comparison to many other nations. This fact is very seldom mentioned because it is a disgrace to our agricultural methods.

Farm Manure

Part of a natural fertilization program should, if possible include farm manure. The value of manure will depend on the source. Because of modern antibiotics, insecticides, herbicides and artificial fertilizers, much of the manure produced today will not even decompose properly. However, one should never underestimate the values of "good" farm manures.

The value of manure will vary depending on the kind of feed used. The following table gives average values of manures from various animals.

YEARLY EXCRETION PER 1000 LBS. LIVESTOCK (FECES)

Animal	*Nitrogen*	*Phosphate*	*Potash*
Horse (1)	*69*	*35*	*47*
Cow (1)	*66*	*35*	*23*
Steer (1)	*68*	*51*	*16*
Hog	*112*	*97*	*61*
Sheep (2)	*56*	*32*	*23*
Chicken	*90*	*83*	*37*

(1) 50 per cent is usually dropped on pastures and uncultivated fields.

(2) 80 to 90 per cent is usually dropped on pasture.

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The figures in the table above could be doubled for the amount of nitrogen and tripled in the amount of potash when all liquid manure is saved from cattle and sheep. The nitrogen would be increased by one-half again and the potash by two-thirds again. Urine contains practically no phosphate. About 50 percent of the nitrogen and phosphorus and 90 percent of the potassium in manure are soluble in water and subject to leaching. In figuring the amount of plant food returned to the soil through manure, loss by leaching should be figured. The table following shows the losses when manure is handled in different ways.

LOSSES FROM MANURE

	Nitrogen Per Cent.	Phosphate Per Cent	Potash Per Cent
Leaching from piles	15-30	10-40	20-60
Heating in piles	15-35	None	None
Drying after spreading	15-35	None	None
Freezing after spreading	5-20	None	None

UNIV. OF ILL. & USDA

When one considers the fact that the majority of nutrients a plant contains is manufactured from the air, light and water in connection with the life in the soil, these losses are placed in a more balanced perspective. In nitrogen especially the atmosphere is a major source of supply.

Minerals and Soil Life

Deficiencies of major minerals can be corrected over a period of time by the careful application of mineral powders. These are much less costly than manufactured fertilizers, and do not produce the undesirable side effects.

In the past few years trace minerals have come into the limelight. A side effect of today's agricultural practices is trace mineral deficiency. These deficiencies are especially prevalent in humid regions (where nutrients have been leached or cropped out) in thin or sandy soils, or in older well-weathered types of soils. Symptoms of these shortages are especially noted in intensive cropping areas where production has dropped off. Legumes readily show a lack of trace elements. For example, alfalfa is particularly susceptible to a boron deficiency.

Often trace elements do not have known values because "science" is just beginning to learn about them. Increasing micronutrient deficiencies and problems emphasize the need for a balanced natural fertilizer which contains trace elements. They play a big part in making other elements available. They increase humus and soil tilth and encourage bacteria and higher soil life. This is a complex subject and anyone who desires will be able to find good books on natural farming. If interested, write for our booklist giving sources of information.

Only recently has man begun to realize how dependent quality crops are on the bacterial population of the soil. Without soil bacterial activity it would be useless to dung crops, to try to improve land by tilling a legume cover crop into the soil, or to attempt to fertilize soil. There is no dispute over the prominent role soil bacteria play in soil fertility. If you desire to know the major types of bacteria in the soil and their relationship to compost and healthy soil you may write for additional information on microorganisms and compost.

Correct Cultivation

Part of a good fertilization program includes returning of crop residues. Stubble mulching, "trash" farming, cover cropping are all a part of the "law of return." To make effective use of crop residues, you should not till too deeply, burn straw, or continually bale everything off without replacement. Burning or deep plowing of a crop residue is burning or burying money. Yet this is commonly done. Then costly nutrients are purchased to replace those burned off. Too often these are in man-made or artificial, highly soluble chemical form which will leach out with the first rain and then leave a harmful chemical residue in the soil.

When you disobey the law of return and rob from soil humus -- you are destroying soil life, texture, and moisture reservoir. Correct cultivation will leave crop residue on the land, thus improving tilth and texture. It will also allow for easier tillage, conserve moisture and improve fertility. Nature's most prolific and industrious workers -- soil microbes -- live off the trash and crop residue in the top three to four inches of the soil. Preserve, keep and cultivate this valuable life.

How to Plow

A common practice is improper cultivation through deep plowing. Some arguments have been stirred up by E. Faulkner's book, Plowman's Folly. To many his concept of minimum tillage is quite new. Proper tillage aids the top four or five inches of topsoil. Deep plowing (6-12 inches) destroys the top layer of soil life and brings up soil with less life. Where one has 1-4 feet of rich topsoil the harmful effect of deep plowing is lessened.

A farmer can maintain the organic humus -- maintain the top few inches of soil in a proper texture -- by cultivating with the harrow, disc, or similar tools. Of course it may be necessary to plow heavy grass, sods, thick weed growth, or to break a hard surface crust. Some of this might work with a sub-soiler. Where a disc or similar type implement will not work, shallow plowing may be done. Deep plowing damages the soil life structure and it should be wisely limited. Only recently have men felt that they needed to plow deep. For millennia, soil tilth was such that surface cultivating was adequate. The proper handling of a plow is an art and in order to apply it one must understand the importance of life in the soil and how to conserve it.

Moisture conservation is another reason deep moldboarding should not be done. Soil without organic matter cannot absorb water. In contrast organic material will hold up to ten times its dry weight. Why? It is very simple. Internally "organic matter" is chiefly open space. Minerals on the other hand are dense, largely solid crystal. The matter rather than the minerals should be on the surface to hold moisture.

Most farmers know that plowing will check weed growth for quite some period. Now why is this? There are two reasons: One is that you have cut off another water source. Before plowing there was an unbroken capillary track from the water table to the surface. After plowing, these finer capillary tracks are destroyed. This along with the organic matter deposited at the plowsole cuts off sub-soil moisture. The second reason is that the soil has lost its firmness. After spending hours of laborious, rubber-tire wearing, gas-consuming time to loosen the ground, you have to turn right around and establish that former state of firmness before anything will grow vigorously on it again. Seem rather ridiculous? It is. Oftentimes plowing is simply unnecessary.

Cultivated soil should have a loose texture, be properly aerated and allow plenty of oxygen, water and light to enter in. It does not form a hardpan and in most instances its crumbly surface will look as if harrowed rather than plowed even if shallow plowed.

What About Weeds?

Weeds are called an enemy of the farmer. They are something which he fights with sweat and valor. They steal moisture, nourishment and growth from the crops planted. They are a plant growing in the wrong place! Often they are a result of monoculture. Cultivation rather than weedicide is the solution. Herbicides merely kill the soil life and result in hardened lifeless soil.

If weeds are destroyed and properly tilled in, they aid the crop as food for microorganisms and are returned as manure. By being worked into the soil, they add to the organic matter of the soil, its tilth, fertility and moisture retention. A good source to study which shows the practical value of weeds, in bringing back fertility by drawing on the deep minerals in the soil, is Weeds -- Guardians of the Soil by J. Cocannouer. Once fertility is restored to soil, the weed problem will often disappear. Harmful weeds have a tendency to avoid a properly balanced fertile soil.

Balanced Diversification

Where soil is specialized for a certain industry or crop, soil life tends to die. It will literally die because it lacks a balanced diet for its microorganisms. The only function of such soil is to hold up the plant. Specialized farming can be judged by its fruits. Are today's increasing pests and diseases and more chemical sprays the solution? No. A better way is to be balanced and diversified by growing several types of grasses for grazing pastures, by rotating corn, wheat and other grains year by year with legumes, by raising livestock and spreading the manure, etc. Only through balanced diversification in farming can one wisely use the land and produce healthy crops from soil.

"If we study the prairie and the ocean we find that similar principles are followed. On lakes, rivers and the sea mixed farming is again the rule. Great variety of plants and animals are found living together. Nowhere does one find monoculture." (An Agriculture Testament, p. 271) The example of nature shows we should be diversified in crop production.

There are many benefits of diversified farming. Not only does fertilization occur in the return of various nutrients from different root levels, but also there is encouragement of beneficial insects and discouragement of harmful insects and disease. Cover and crop rotation allows a buildup of natural soil and insect life. This is the only sensible control measure for harmful insects and disease. Soil fertility produces healthy crops that naturally resist insects. So-called "harmful" insects merely do the job for which they were created -- to destroy weak and sickly plants.

A good source to study about beneficial insects such as ladybugs, lacewing flies, praying mantises, etc., is the book by Beatrice Trum Hunter, Gardening Without Poisons, published by the Houghton Mifflin Company, Boston. It covers many practical solutions for the insect problem and shows how one can grow crops and gardens without the use of toxic chemical sprays.

HOW TO CHANGE FROM CHEMICAL TO NATURAL METHODS

Basic knowledge must be learned and the importance of proper education cannot be over-emphasized. The structure of natural agricultural laws shows farmers are expected to be diligent in studying their occupation. They must be well educated -- not just hard workers. Once a person understands the basic laws involved, and that they will work, the question is where to begin in applying the knowledge. How should one change from chemical to natural farming? Is there an economical way to change in today's society with the high taxes, high interest rates and the high cost of machinery? Natural laws are not followed in most present methods of agricultural practices. This society has no desire to obey the laws of God. Yet these laws are the controlling force. They bring the results. Obedience is the key. What do you need to know and how can you start in a practical way to correct the situation on your land?

Economic Considerations

The way other people look at farming today is -- "Does it pay?" Someone with the courage to change from chemical to natural farming will be continually observed by people who have not tried natural farming.

When you have not tried, applied and seen the profitability of simply following right principles it is difficult to invest and believe in them. It is easy to follow instructions carefully printed on a costly sack of toxic

pesticide; 2,4-D or DDT for example. It is more difficult in natural farming where you must follow unwritten instructions, where more knowledge is needed and where greater obedience to law is demanded. Yet in spite of this difficulty, natural methods are expected to be profitable automatically and immediately.

A Note of Caution

If you lack information or experience in the natural and true ways of farming you should not just jump into the venture. Success is based on knowledge, a proper foundation and understanding of the laws involved as well as faith and courage. Because of today's tight economic pressures, especially on the farmer, perhaps you should not make too bold a start without first having developed a sure market and planning overall economic success.

Methods of Restoration

The four simple, basic, practical methods which we have used on the Ambassador College Farm reap abundant, rich benefits. (1) Correct the soil pH. A near balanced pH will unlock and make available a storehouse of minerals and elements already in the soil. This can be done by applying the recommended natural rock fertilizers. (2) Add a buffering marine-type marl, rock mineral, or material from natural organic lignite deposits or any material high in humates to rapidly create soil humus. (3) Grow a crop to add plant residue to keep the soil cycle going. Add as much organic matter as possible and keep a cover crop on the soil. Actively grow a cover crop and with proper tillage practices, use the field as a compost pile. (4) Add soil bacteria to (a) help break down trash into useable humus (b) overcome harmful chemical residues from previous wrong practices and (c) encourage higher soil life such as earthworms which will help create additional newly balanced soil.

The above four points are just part of an overall plan followed by the Ambassador College Agriculture Department as a practical program in changing from chemical to natural farming. To help get started you need to run a soil test to evaluate the amount of material needed to correct the soil pH, as well as to show which type of fertilizers are needed.

In making a change in agriculture, take it easy and do not jump into the program overnight or try to make the entire change on a whole farm in one day. Wise counsel and careful planning all the way is necessary for converting or changing even part of the acreage and it does take time. An initial step of course is to stop using harmful and poisonous chemicals.

Remember the natural steps listed are simple practical methods of enhancing and increasing soil microorganism and soil life. They need to be adapted to local, individual circumstances to help establish and keep the soil cycle going. A soil test will help indicate what corrective measures should be taken. You must, however, make your own decision. Repeated tests (once per season or crop) will help give continual guidelines on establishing truly productive methods of farming.

You should remember too, it is better to use no soil building supplements than to make a wrong application. This would only throw the soil into a greater unbalanced condition. Soil tests are only general guidelines and should not be viewed as the answer to every problem. However, they can help you avoid applying the wrong material which might throw the soil into a more unbalanced condition.

Finally, no matter how profitable or practical any steps or methods of production or management are, they won't solve the agricultural problems overnight for just any individual. God looks at the heart and the attitude of willingness and the initial step by the individual in the right direction.

God will give rain in due season, the land will yield its abundant increase and the trees of the field will yield their fruit to those who obey Him. God promises to rebuke the devourer and help overcome all the problems in farming if <u>man</u> will just learn to obey and understand the basic lessons he needs to learn.

The world can't solve the entire agricultural problem by its methods. Farmers today, however, can and need to learn the right principles and become educated in the right methods for success. Preparation for a future solution to the world's agricultural problems and for yours individually can begin now.

For the ultimate solution of the overall agricultural problems and for our society as a whole review the available fully-illustrated booklet, "The Wonderful World Tomorrow -- What It Will Be Like."

In only a few short years, society will once again -- as it should -- be geared to an agricultural society. People will be receiving fantastic blessings because they'll be obeying God's laws. Why not get a head start and begin receiving these fantastic blessings NOW! In Malachi 3:10-12 God promises to bless those who willingly obey His laws -- not just normal prosperity but blessings so there is not room enough to receive them, and He does not limit it to the future. You can, at least, begin <u>learning</u> proper soil management and agricultural principles now! In the World Tomorrow you'll be able to help teach others to return to the wonderful agrarian life -- the most satisfying and rewarding occupation of the future.

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AMBASSADOR COLLEGE
BIG SANDY, TEXAS 75755

HERBERT W. ARMSTRONG, *Chairman*

AGRICULTURE DEPARTMENT

PRINCIPLES OF POULTRY PRODUCTION

Today poultry farming has gone berserk. Actually some poultry farms are not even classified as farms, but appropriately named factories. Why? Because they treat the chicken as a machine and not an animal. The chicken is debeaked, decombed, dewinged, and declawed. It is shot full of vaccines, antibiotics, hormones, and other medicated food additives. It is put in a cage with water and feed passing by. It never experiences the taste of green grass or a fat juicy bug or worm. Is this the only way you can raise broilers or produce eggs profitably? Is there a simple, natural way for poultry production?

Modern production is oriented towards high production under unnatural conditions and depends upon the technological developments in medicine and nutrition for their success. The establishment of a poultry program should begin with an understanding of the natural laws involved. Basically they pertain to the selection and breeding of the birds, nutrition, sanitation and management practices.

The basis of the poultry flock should be the selection of the natural variety or varieties in the pure lines of birds best adapted to your area and suited to your purpose. It is rather difficult to find pure lines, so once a flock is established it would be desirable to raise your own replacements by selecting the best hens for brooding purposes and continually culling the poor producers and those lacking hardiness and resistance. Unfortunately crossbreeding programs are being used to gain hybrid "vigor" in place of selecting and mating for quality, resistance and production in the pure lines. (See Lev. 19:19.)

In mating birds of the light or egg breeds, such as Leghorns, generally one male is used for fifteen to twenty hens. In the general purpose breeds, such as White Rocks, one male with ten to fifteen hens is a better ratio. We are presently running one rooster for every ten hens in our layer flocks.

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New stock to be added to the poultry flock should be isolated from the flock for about two weeks to make sure they do not have any disease or show the symptoms of disease infection.

Once you have obtained your chickens, how should you take care of them? First they must be fed. The best poultry rations can be the simplest if the feeds are grown "organically" on a fertile soil and if the birds are provided with tender green pasture or fresh greens daily along with adequate sunshine. Sunshine provides vitamin D. Green forage is high in the essential vitamins, minerals and high quality proteins required by poultry. In addition the bugs, insects and worms which chickens find provide protein and other "unknown factors" in the diet. A good pasture program will greatly reduce feed cost and help to maintain a healthy flock. Pastures should be rotated and tilled occasionally to prevent buildup of parasite and disease problems.

Pasture alone will not provide sufficient energy (calories) and protein needs for optimum growth and production. The simplest manner of supplying the extra energy and protein is to provide "free choice" grain (whole grains are more palatable than finely ground ones) and protein supplement. This will allow the birds to balance their own ration. Grit should be made available if birds are not on pasture. Laying hens generally need extra calcium which can be provided by high calcium limestone or oyster shells.

When good quality organically grown feeds and forage are not available it will be necessary to provide special supplements of animal proteins, vitamins, and minerals in order to prevent poor growth and production and disease problems. While striving for a simple and balanced feeding program, one may find it necessary to compensate for present deficiencies by adding some supplements to the basic ration. We formulate our rations by:

1. Determining the availability and cost of feeds in our area.
2. Following guidelines in Morrison's Feeds and Feeding.
3. Actual experience with our flocks.

One should be able to grow a portion of his own feeds. When feeds must be purchased we suggest you use feeds not contaminated with antibiotics, hormones or other medications and use the natural supplements when they are needed.

Fresh clean water should be available at all times. If a flock shows signs of illness, we have found it helpful to add a small amount of vinegar (1 oz. per gal. of water) as a purifier in the water and as an aid in digestion.

Another very important point of care is sanitation. The poultry house should be cleaned preferably once a month or more often if needed. At each cleaning the building can be disinfected with a washing of hot lye water or another method is whitewashing several times a year. This will not only free the house of lice, mites, and disease germs, but gives the building a clean, fresh fragrance. After cleaning, the house should be bedded down with clean, dry bedding such as straw, sawdust, or corn cobs--whatever is available in your area. A good deep litter is very essential. Ground corn cobs are excellent absorbing litter. The feet and claws of poultry are made for scratching and their beaks for pecking. Throwing "scratch" grain on top of the bedding daily provides the need for scratching and pecking--giving the poultry much needed exercise to help maintain healthy bodies.

Problems with external parasites such as flies, lice, mites, ticks, fleas, bed bugs, chiggers, etc., can be overcome by good sanitation and dusting procedures. Lime sulfur or cresol spray can be used in houses and on roosts. Dusting with woodashes, diatomaceous earth or finely powdered sulfur directly on the birds, in the nests or in a scratch box will protect the birds.

Part of sanitation is providing adequate ventilation and area. The floor space that should be provided per bird will depend on such factors as type of floor, size of bird, temperature and ventilation. Crowded conditions cause birds to develop habits such as picking, feather eating, and cannibalism which are apt to result in poor growth, poor feed conversion and poor laying, as well as possible disease outbreaks. General recommendations vary from one square foot per bird for broilers to four square feet for the larger general purpose type hens. For ample roost space, allow eight inches for each bird. Laying hens need about one nest to every four birds or community-type nests can be used if preferred. If hens lay eggs on the floor or in feeders, it may be that there is too much light in the nest. Make the nest as enclosed and dark as possible.

Several poultry farmers try to increase egg production by leaving lights on all night. This is a means of "forcing" the chicken. If God had intended poultry to see at night, He would

have created them with cat eyes. Poultry's digestive tract usually completes its duty before the night is over, giving the system a time to rest. By leaving the lights on, the chicken will eat all night and its body will wear out in less than half the time it should.

Management is an overall key to successful poultry production. Planning the whole program with the right goals in mind is the first step. Secondly, common sense, securing the right knowledge and experience will prepare a manager to achieve the planned goals. It is not possible to give all the particulars needed for a successful poultry program in a letter. Much useful information can be obtained through your County Extension Agent, books and USDA publications, and experienced farmers.

A final point of success has to do with following the basic principles in selection, nutrition and management. Hard work and being a conscientious husbandman are essential aspects of a good manager. God promises to help those who will do things His way.

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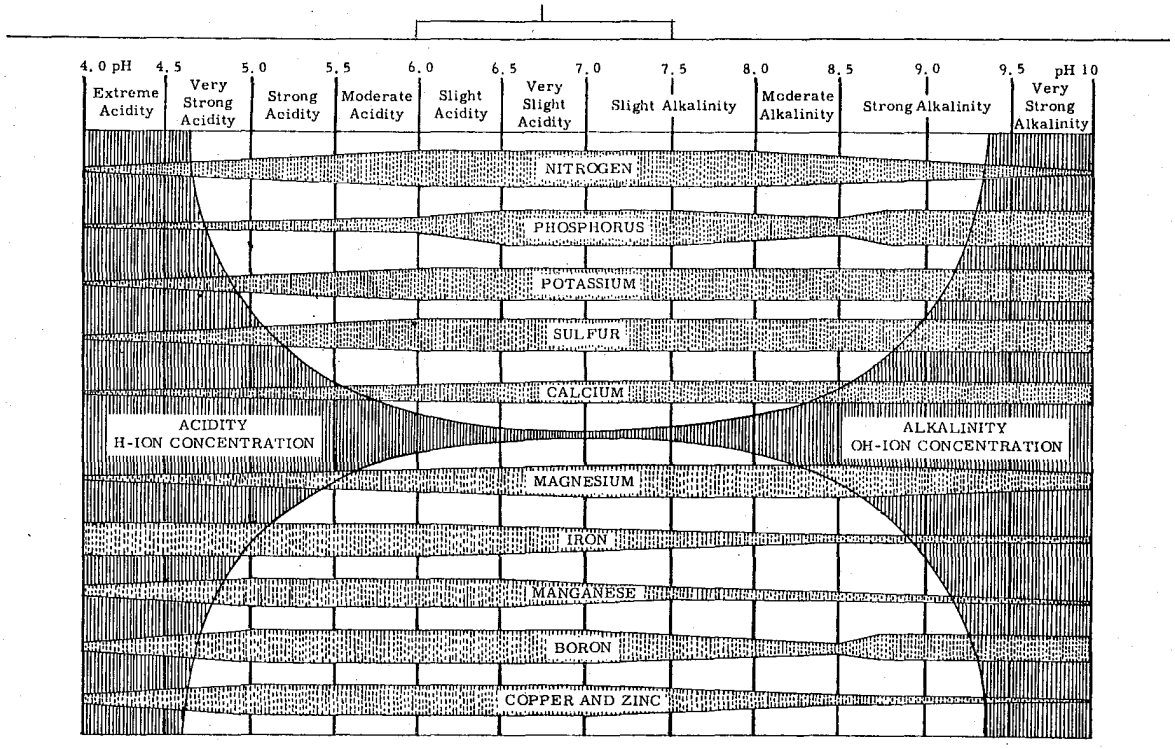
SOIL TEST RESULTS AND FACTORS AFFECTING CROP PRODUCTION

To heal sick soil and bring it back into profitable production of high quality, health-sustaining crops, it is necessary to stop using the farming practices which have caused the trouble. Farming must be in accord with the laws God set in motion. Good crop production is no accident. It is the result of selecting and planting pure seed in fertile soil with the benefit of good growing conditions.

Fertile soil is a combination of minerals from pulverized rock, water, air, decaying plants, animal remains, and living organisms. A balance of these factors is necessary. A soil test helps indicate the relative balance of some of these factors. Tolerance to acid or alkaline soils can be increased by the addition of organic matter. Organic matter tends to stabilize the soil pH when acid or alkaline materials are added. Plant remains and humus increase the buffer capacity of the soil (although some organic materials are highly acid). The chart demonstrates the pH range where maximum availability of soil nutrients occurs resulting in optimum plant growth.

Effect of Soil Reaction on Availability of Mineral Elements

Where most plants grow best



Close examination of the chart above reveals the importance of a buffer action created by a soil rich in humus. An alkaline soil yields

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maximum availability of phosphorus, potassium, sulphur, calcium and magnesium whereas an acid soil yields maximum availability of iron, manganese, boron, copper and zinc -- a different group of elements. The desired soil condition is one that expands the range of soil nutrients to include both those of an alkaline and acid soil. Humus, acting as a buffer, expands the pH range on both sides of the neutral zone (pH 7) - resulting in utilization of all nutrients by plants.

To restore soil balance and maintain a proper pH level, restore the organic matter and soil life. This will unlock minerals that are in the soil. If minerals are deficient, rock materials can be added. Please direct any further questions on crop and soil test results to the Agriculture Department, Ambassador College, Big Sandy, Texas 75755.

PROCEDURE FOR TAKING SOIL SAMPLES

Soil tests can be only as accurate as the samples on which they are made. Proper collection of soil samples is extremely important. Chemical tests of poorly taken samples may actually be misleading.

Step 1. Take one soil sample from each uniform area of 10 to 40 acres in a field. In areas such as East Texas, one sample should represent only 8 to 12 acres; whereas, in areas such as the Coast Prairie, where some soils are more uniform, one sample can represent up to 40 acres. The sample should be taken from over all the area. This can be done by taking a small amount

INFORMATION ON SOIL SAMPLES

Mailing Address:

Name _____

Street or R.F.D. _____

City, County _____

State, Zip _____

To aid in interpreting the soil test and making recommendations, fill in the following information sheet, and submit with your soil samples. Each soil sample should be marked with your name and sample number which should correspond with the information furnished on this sheet. See mailing instructions on preceding page under step 3.

SAMPLE NO.	DRAINAGE	PLANTS TO BE GROWN NEXT	PREVIOUS HISTORY							
	Good, fair or poor		Plants previously grown	Growth (good or poor)	Fertilizer used per season				Lime or Slag	
					Mixed grade (8-8-8,etc.)	Pounds per 100 sq. ft.	Extra Nitrogen (kind)	Pounds per 100 sq. ft.	When applied (Mo. Year)	Pounds per 100 sq. ft.

Include in previous history any information that will help describe the soil or plant conditions where troubles occurs.

Amount of payment attached
for all samples in this shipment: $ _____

SOIL TEST REPORT

Mailing Address

Name_____ Date_____
Street or R.F.D._____ Tested by_____
City, State_____

Your Soil Test Results and Classification						
Sample No.	Soil pH	Organic Matter	Nitrogen	Phosphorus	Potassium	Other

Suggested Fertilization and Management			
Sample No.	Crop	Requirements pH, Nutrients	Remarks Recommendations

Comments: _____

S.T.I.