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Agricultural Edition

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The KEY to GOOD HEALTH

by Eric Eweson

[This eye-opening article is a special report by this noted Swedish biochemist as reported in The Plain Truth*, March, 1962, from a lecture delivered at Ambassador College, Pasadena, California.]*

I want to talk tonight as a biochemist about your health -- and how *fertile soil* affects it. Few people really know much about the very *ground* they walk on. If they did, millions of sick and crippled would be in radiant health today.

From soil we derive our food, our climate, and the pleasure of an attractive landscape. Soil has accumulated by the divers forces operating in nature. As every schoolboy should know, it consists of finely ground rock elements and decayed organic matter. FERTILE SOIL *accumulates very slowly, but it can be destroyed very rapidly*. Even under favorable conditions in our climate it would take three or four hundred years to accumulate an inch of it!

Why Soil Is Losing Its Fertility

It has been in the last fifty years — and, I would say, notably in the New World — that there has been greater demand on the land than the land can give without losing its natural fertility. This situation cannot be remedied by

Eric Eweson, inventor of the Eweson Digester and proponent of sane soil fertility management, is shown here with entertainer Eddie Albert at Ambassador College.

chemical — or commercial — fertilizers, as we call them, which are being used so extensively in modern times to increase the yield from the soil.

As you probably all know, the theory of chemical fertilizers was born of *war*. It was conceived in *Germany* during the latter part of the nineteenth century by a gentleman whose name was Baron Justus von Liebig. He developed his *theory* by analyzing organic matter and noticing the predominance of nitrogen, phosphorus, and potash. He then conceived the idea of adding those major elements to soil in the form of water-soluble chemicals to increase production.

The idea *seemed* to work like magic and was gradually adopted all over the world. But *one important fact was overlooked!*

Life Was Missing!

In more recent years we have discovered that even if we add to the soil these chemicals which are the ones used in the largest quantities by plant life, we still use up the *organic* living portion of the soil. And the greater the quantity of chemical fertilizer that we apply, the faster is the organic, living portion used up!

As the organic matter diminishes, we must *increase* the quantity of chemicals

See Loss of Organic Matter, page 2

The Mysterious World of Bacteria

By Paul W. Syltie, Ph.D.

bac•te•ri•a (bak ter'e a) **n. pl.**, microscopic, unicellular plant cells bounded by a membrane-wall complex and containing a variety of inclusions.

All around us lurk billions and trillions of microscopic bacterial cells that inhabit every nook and cranny imaginable on earth. They coat nearly every object in nature — trees, plants, rocks, and living creatures — and inhabit the waters of rivers, lakes, and oceans, besides proliferating in the soil, and even within the bodies of humans, animals, and insects. They are limited in number only by the suitability of the growth environment: temperature, pH, oxygen level, nutrient status, and light intensity.

The variety of bacteria is incredible. Millions of species probably exist. According to T.R. Gray[1], "It is probably true to say ... that almost any known bacterium and a good many more can be found in soil." The 13 groups of bacte-

Types of Bacteria Common to Soils

A. Phototrophic bacteria	H. Gram-negative chemolithotrophs
B. Gliding bacteria	I. Methane-producing bacteria
C. Budding/Appendaged bacteria	J. Gram-positive cocci
D. Gram-negative, aerobic rods and cocci	K. Endospore-forming bacteria
E. Gram-negative, facultative anaerobes	L. Gram-positive asporogenous rods
F. Gram-negative,anaerobic rods	M. Coryneform bacteria
G. Gram-negative cocci and coccobacilli	

See Bacteria Are Amazingly, page 6

Loss of Organic Matter=Soil Death

Continued from page 1

to obtain the same yields — not to mention the loss of *quality*. Gradually we will arrive at the point when there isn't enough of the humus fertility left in the soil to sustain a crop, NO MATTER HOW MUCH CHEMICAL FERTILIZER WE APPLY. In common terms, the soil is then said to have "died."

The death of soil is a phenomenon that has occurred from early historical times. The earliest example is probably in China, some 1000 years before Christ. Such "soil death" was also a dominant factor in the decline of the Persian Empire after 500 B.C. It was previously the principal cause of the decline of the Babylonian Empire which flourished on the rich but thin soil in the valley of the Euphrates and Tigris Rivers. When the humus was used up, the topsoil could no longer resist erosion. It disappeared into the rivers. With the drastically reduced quantity and quality of food the civilization declined and finally disappeared. The same happened later in Greece, and again in the Roman Empire, which, at the time of the birth of Christ, had to go across the Mediterranean to obtain its grain.

All these developments, of course, took a long time. In Greece it probably took 300 to 400 years. In North Africa it took less, because by that time the Romans had introduced one-crop agriculture, growing the same crop year after year on the same land *without letting it rest.* The agricultural land was thus in the process of death for a much shorter time than, for instance, in China, Persia, and Greece.

Our Land Today

The problem has developed very similarly, but very much faster, in America! We have seen it in the Middle West where for many years we have had serious dust storms. Such dust storms are possible *only after the soil has lost its humus*, because it's the humus which holds the soil particles together in larger aggregates so that they don't blow away.

When the quantity of the humus is inadequate to hold the soil, what little is left of organic matter blows away, leaving nothing but the dead sand and rock. The land after that is completely useless for agricultural production, and the rehabilitation of it is no simple problem.

For example, the Sahara desert did not extend nearly so far north even 500 years ago as it does now. Today the Sahara in many places extends right to the Mediterranean. Whereas, in the times of the Romans, the coastline along the Mediterranean was very fertile, it is now fertile only in small isolated areas and then only with irrigation.

The moving up north of the desert has also changed the climate so that there is now hardly any precipitation. This was not the case when it was still fertile land that could cause the vapors from the Mediterranean to condense and bring some rain. Land in many *other* places has been affected similarly by drastic soil abuse.

In California you have large areas that were very fertile as late as 15 to 20 years ago, but which are now no longer productive in spite of adequate irrigation, much like in the Euphrates and Tigris valley.

This is, in few words, the sad state of the soil fertility in large parts of the world today. WE HAVE MUCH LESS ARABLE LAND TODAY THAN WE HAVE EVER BEFORE HAD IN HISTORICAL TIMES. And it now has to do for a much larger population!

Before we go further, let me explain what living soil is, and why good soil must have humus.

What Living Soil Is Like

Soil erosion has been a nemesis ever since mankind began to till the soil. Unfortunately the consequences of allowing rampant erosion to destroy the topsoil — any nation's most valuable resource — are devastating.

Decaying organic matter is called *humus*. The greatest proportion of fertile soil is rock material -- inorganic material -- so that only a very small proportion of fertile soil is humus. Even *very* fertile soil may well contain as little as 5% humus in the top six inches. The rest is inorganic mineral matter.

Many soils can be enormously productive if this humus is maintained in these proportions, and if this humus consists of *well-decomposed* organic matter. Unfortunately, the humus wears out — or is consumed — by cropping. If you *take from* the land more than you *put back*, what you remove is part of the quantity of *humus*.

New mineral nutrient matter is constantly being made available. In fertile soil it is manufactured, you might say, by means of microbial activities and the various effects of the weather. Rock is ground in many ways by nature and can then be decomposed by microbial activities. That is the reason why humus contains mineral nutrients of all kinds.

There is seldom any shortage of nutrient minerals in fertile soil because those minerals are constantly liberated by the soil microbes and incorporated in their cell tissues. In that form they are not water-soluble and thus *cannot* be leached out by the rain as is done with man-made chemical fertilizers.

But they can be utilized by the plants that are growing in the soil. This involves breakdown and using up of soil microorganisms and humus and is the reason why humus has to be renewed. If agriculture is not intensive — if, for instance, it is based upon letting the land rest once every three or four years in countries of temperate climate, then there is a very good chance that the soil can maintain fair productivity. That has been the case in some parts of the world, especially in the northern half of Europe. They still have some land with a fair amount of natural fertility. ☐

To be continued in the summer issue. Don't miss Dr. Eweson's conclusions regarding chemicals and composting!

Technology Can Jeopardize Rural Lifestyle

by Dr. Val Farmer

Dr. Val Farmer is a clinical psychologist with MeritCare in Fargo, N.D. He specializes in rural mental health and family business consultation.

Rural life is celebrated for its hospitable people, neighbors that care, labor exchanges, participation in community activities, and family life. The bonds that tie rural people together are interwoven with the strands of church, school, community, and strong family values.

The hometown quality of rural life depends on one-to-one relationships of trust and dependency formed in many settings as people function in multiple roles. Historically, the automobile and the telephone played a role in changing rural communities and rural social patterns. These technological advances facilitated community contacts, but also provided an avenue for rural people to enlarge their scope of interactions across more distances.

As a result, the small towns gave ground to larger trade centers for community and business activity. Today, there are new and more modern technological and economic developments that pose even greater threats to this distinctive rural lifestyle and mutual interdependence. Rural values, community identity and participation are being supplanted by an electronic global village and perspectives from an entertainment oriented mass culture. Technologies such as television, computer use including the Internet, video games, DVD's, and videocassette offer a compelling range of passive entertainment in the home on demand.

The need for neighborly social visits is not as great when there is an electronic guest available at our fingertips. Even if all this programming were superlative, they still have a harmful effect. These choices displace and replace family and neighborly activities that shape the values and cement the bonds between people.

The programming itself, by and large, reflects a broad sampling of homogenous pop culture and a low common denominator of values appealing to a mass audience. Then there is the advertising, seductively packaged in upscale wants and high production values to entice us to be consumers of more and more "necessities."

Rural children are exposed to materialistic and hedonic values that suggest status and success usually not available in rural communities. The news programming also orients rural people to national and international issues and concerns, perhaps at the expense of decreasing interest in regional and local issues.

Community and family relationships in bygone eras were much closer, in most cases, than they are today because people depended on one another for survival. It is encumbent on us today to strengthen family ties.

With the economic pressure on families in agriculture, off-farm income is seen as a necessary step in maintaining a viable rural lifestyle. Many men and women who out of necessity seek off-farm employment, along with those women who enter the work force for reasons of fulfillment, are no longer available to serve the community. There is little time for visits with neighbors and to exchange labor to the extent they were formerly accustomed. Trying to farm, having a family and personal life, and working an off-farm job subtract from the time and energy people have for social contacts and community service.

Economic conditions in agriculture continue to reduce the number of small and medium range farms in rural communities. The countryside is emptying. The reduction in farms and farm families affects rural Main Street businesses and reduces the need for services. The operator who farms on a large scale has different concerns, needs, and values than the small operator. It is hard to work out truly reciprocal exchanges.

The large-scale operators solve their need for labor through capital investment and hiring farm workers. Large-scale operators operate more efficiently when they use their purchasing power to full advantage.

In many cases, this means by-passing the local community in favor of the best business deals. E-commerce skims off some of the bigger customers.

Community patterns and loyalties also are weakened by absentee owners and non-family corporations in agriculture. Their social and business commitments to the local community do not compare to local and family-oriented operations.

Telecommunications has led to centralization and consolidation of other business activity to larger trade centers. Local, entrepreneurial enterprises are forced to depend on marketing to ensure a customer base.

If rural communities are to retain their distinctiveness, cohesiveness and neighborliness, they need to promote rural values in the home and community.

- **Strong extended families, ethnic and religious communities need to proactively transmit values and history from one generation to the next.**
- **Communities and groups need to celebrate together.**
- **People need opportunities to come together, know one another, share their common understandings about life and cherish each other.**
- **Young and old need to get and stay involved in community service and leadership to preserve rural institutions and quality of life.**
- **Young people need to be exposed to local models of success and excellence.**
- **Local and regional economic development is needed to support lifestyles where there is enough time and leisure to promote personal interactions, neighborliness and pursuit of community goals.** ☐

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15-Minute Soils Course

Lesson 18:

Movement of Nutrients from the Soil Into the Roots

In lesson 15 we addressed the issue of how microbes make plant nutrients available. This lesson we will examine how the nutrients move from the soil into the roots.

The general process of soil to root movement is summarized in the following figure, which shows how nutrients move from the soil to the root surfaces. Then they are carried across root membranes and on into vessel elements within the root before being taken up by the xylem tissues into the stems and leaves.

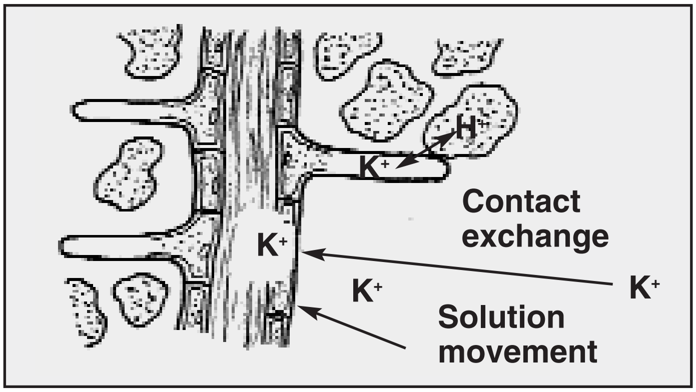
Nutrients may move into roots by ...

(1) *Root interception.* The root grows into the nutrient zone to take up nutrients by contact exchange (diagram to the right).

(2) *Mass flow.* Ions move with soil water (diagram to the right).

(3) *Diffusion.* Ions move toward the root as the soil takes up ions and establishes a concentration gradient.

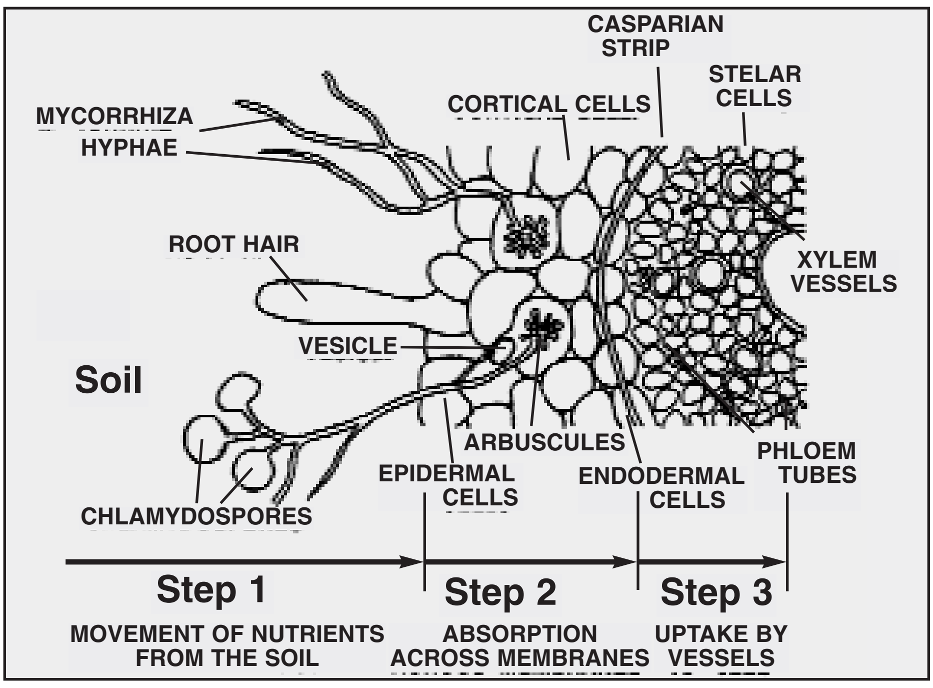
Notice that mycorrhizal fungi are in close contact with the root cortical cells, where a placenta-like exchange surface within the cell expedites the exchange of nutrients. The fungi feeds on plant energy and sends out hyphae throughout the soil mass to absorb nutrients, that in turn are funneled back into the roots and sent into the vascular stream. In this way the roots multiply their feeding volume by 10 to 100 times or more, and can pick up hard-to-get immobile nutrients like P, Zn, Cu, Fe, and others.



Up to 90% of P uptake occurs through mycorrhizae symbiosis, because the hyphae grow beyond the zone of root nutrient depletion to pull in immobile elements.

A truer picture of the uptake mechanism must take into account the activity of microbes along the root surfaces. These fungi, bacteria, algae, protozoa, and other microorganisms cluster by the billions on the root surfaces, feeding on energy-rich compounds excreted from the root. Substances in the exudate include those in the table on the right, as well as many others.

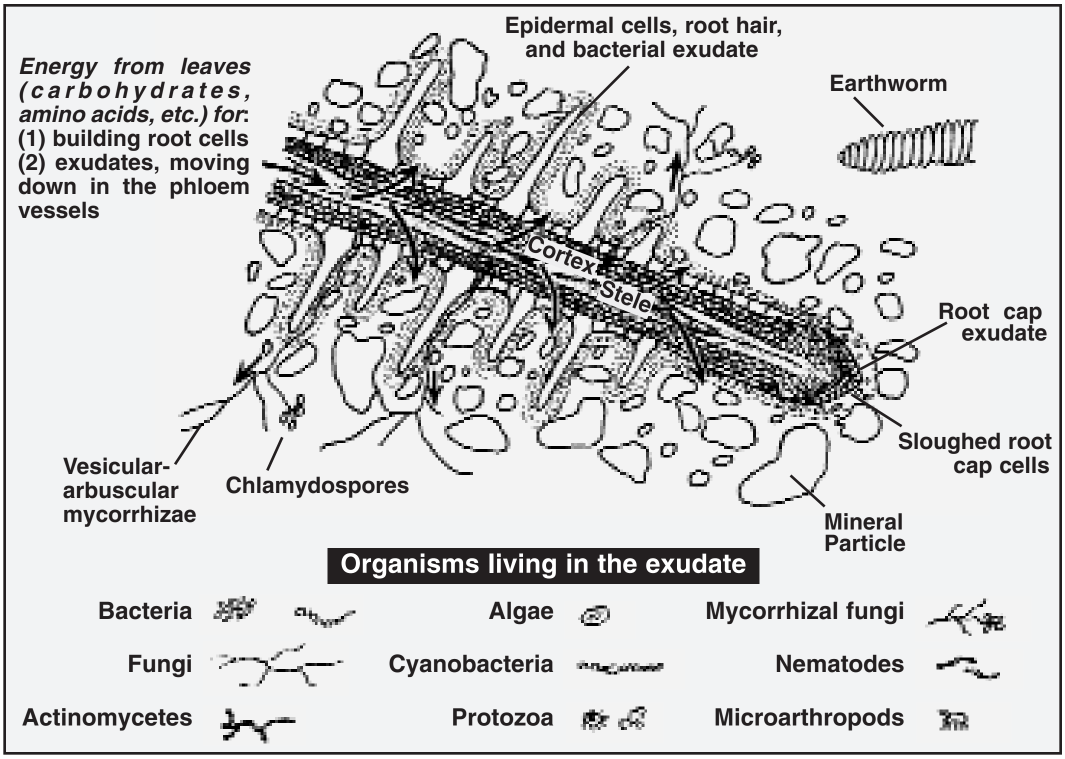
As described in Lesson 15, the soil microbes make nutrients available for plant uptake. The feeding process of these tiny microbes is summarized in the diagram on the next page. Once the microbes utilize the nutrients and make them avail-



Continued on the next page

15-Minute Soils Course

able, they are absorbed into the roots and sent up to the leaves. One can thus see the great value in assisting soil microbes to multiply by utilizing regenerative cropping practices such as returning organic residues to the soil, minimizing or eliminating tillage, reducing the application of toxic agrichemicals, and applying fertilizers that are compatible with maximum microorganism activity ... especially the fungal types.



Amino acids (asparagine, methionine, adenine, serine, aspartate, valine, glutamate, leucine, lysine, tryptophan, tyrosine, glutamine, phenylalanine, histidine, arginine, alanine, glycine, proline)

Vitamins	**Indole**	**Tartaric acid**
Sugars	**Salicylic acid**	**Oxalic acid**
Tannins	**Purines**	**Malic acid**
Alkaloids	**Pyrimidines**	**Citric acid**
Phosphatides	**Nucleic acids**	**Scopoletin**

See How Much You Learned

1. Mycorrhizae are very important for root absorption of nutrients. T or F

3. By which of the following methods do roots absorb nutrients?
a. Diffusion
b. Root interception
c. Mass flow
d. all of these

4. Bacteria, algae, protozoa, and other organisms by the billions feed on the rich exudates at the root surface. T or F

5. Which of these compounds are commonly found in root exudate?
a. Amino acids
b. Sugars
c. Vitamins
d. Carbon black

6.The mycorrhizae can multiply the plant feeding volume of the soil by _______ times or more.

7. It is highly important to encourage soil microbial activity to realize the best possible uptake of soil nutrients by plant roots. T or F

8. *Super bonus project*. Draw a picture of the root, as shown above, along with the stele, cortex, and root hairs, plus the zone of root exudation and arrows showing the pathway of energy-rich compounds out into the soil.

Answers: 1. T; 2. d; 3. immobile; 4. T; 5. a,b,c; 6. 10 to 100; 7. T.

Why was the mushroom always invited to his friends' parties? Because he was such a "fun-guy".

Bacteria Are Amazingly Complex

Continued from page 1

ria he lists include those in the table on page 1, and can number over a billion for a single gram of soil or compost.

The idea that bacteria are simple and archaic is a false presumption. Even though they are prokaryotic (without a defined nuclear membrane), lack typical organelles like mitochondria, and have no cytoskeleton to give structure, they have remarkable properties such as "fluctuating components." The DNA occupies an area of the cell called a "nucleoid", and plasmids — circular or linear strands of DNA — occur in the cell cytoplasm. The DNA and other cell components can move around inside the cell as needed, like rearranging the bed, stove, sink, couch, and toilet.[2]

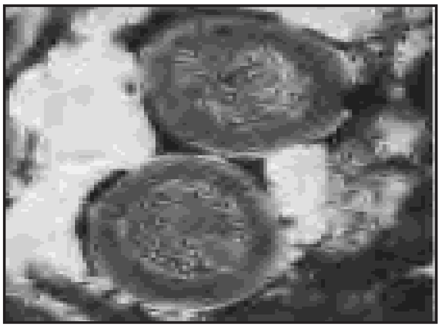
Adjusting to the Environment

Bacteria can sense their environment, and respond quickly to very small amounts of external stimuli such as light intensity and chemicals. Molecules bind to sensory receptors of cell membranes and will cause the cells to move toward nutrients and away from toxins.

Moreover, they can sense their numbers. When enough bacteria accumulate in a community, they change their behavior such as in the light organ of the squid *Euprymna scolopes.* A bacterium (*Vibrio fischeri*) lives freely in ocean water, but when it collects in sufficient numbers in the squid's light organ the community of bacteria begin to shine.

Biofilms

One form of community of bacteria is a "biofilm". The cells organize on a surface to include channels for food, water, and waste, and secrete a sticky polysaccharide-protein that covers the community with a shiny film. Some of these films are beneficial, as in nitrogen fixing plants, but others can be harmful and coat natural and artificial heart valves, urinary tracts, contact lenses, and air conditioners.[3] These biofilms can also become resistant to antibiotic and host antibodies. When isolated cells of *Myxobacteria* meet, they align themselves side by side and perform "ritual motions".[4] Movements within colonies of *Myxobacteria* are highly coordinated. As Shapiro says, "Trails of extracellular slime are secreted and serve as highways for the directed movement of thousands of cells, rhythmic waves pulse through the entire populating streams of bacteria .... As simple as a single bacterium may seem, bacterial colonies are pretty complex."[5]



Pictured here is one of the thousands of bacterial species that are found in the rhizosphere (root zone) of plants.

Breakdown of Radioactive Elements

One bacterium, *Deinococcus radiodurans*, is so tough it can survive the heat and radiation of an atomic explosion! Genes from another bacterium have been inserted into *D. radiodurans* to form a "superbug" that actually breaks down radioactive mercury compounds found at nuclear weapons production sites. While not neutralizing the radioactivity, it thrives amidst the radiation, tolerating 1.5 million rads of gamma radiation, or 3000 times the lethal dose for humans.[6]

"Thinking" Bacteria?

If bacterial colonies are able to react in different ways to dozens of different stimuli, then the cells require sensory equipment, internal clocks, memory, and decision-making capacity. All of these qualities are posessed by humans, so in one sense bacteria "think" as do people, albeit on a simpler level. The reductionist views of preprogrammed bacterial cells fall short of reality, so innovative are these microscopic, ubiquitous cells.[7] Recent studies on bacterial mechanisms show that they may be using a system similar to that used in cell phone communication. Just as cell phones use amplifiers and repeaters to carry words and insure they arrive at a distant location, so bacteria use clusters of receptors to make sense of information they get.[8]

Beneficial to Soils and Crops

Many well-known bacterial effects occur in soil, including those listed in the table below. In addition, bacterial coatings of plant leaves with compost tea, a fairly recent innovation, is quite effective at arresting and preventing leaf fungal diseases. A leaf coated with friendly bacteria has little room for pathogens to take hold. *Bacillus thuringiensis* has been used for years to kill insect larvae on crops like corn and cabbage.

Bacteria are indeed ubiquitous and most essential to life on earth. Besides breaking down and recycling dead plant and animal life, they enable plants to gain access to all of the essential nutrients. Some species under the right conditions — such as in a weakened plant — can cause harm, but usually these tiny cells are helpful to mankind and all life on earth. They have helped break down mineral and organic matter over the aeons to form the soils upon which we depend. Without bacteria, civilization could not exist on earth. ☐

Soil Benefits of Bacterial Species

- ◆***Symbiotic nitrogen fixation*** (Rhizobium)
- ◆***Nonsymbiotic nitrogen fixation*** (as Azotobacter, Azospirillum)
- ◆***Rhizosphere nutrient release*** (phosphate dissolvers, acid producers, and conversion of all elements of available forms)
- ◆***Rhizosphere growth regulator and antibiotic producers***
- ◆***Antagonists of root diseases, nematodes, and plant pests***
- ◆***Creation of soil polysaccharides for building soil structure***
- ◆***Turnover of plant and animal residues; creation of humus***
- ◆***Formation of soils***

Bibliography

1. Gray, T. 1990. Soil bacteria, p. 15-13. In *Soil Biology Guide* (ed. by D. Dindol). Wiley Interscience, New York.

2, 3. Asimov, J. 1999. Structure of simple bacteria deceptively complex. *Milwaukee Journal Sentinel*, Dec. 6.

4, 5. Shapiro, J. 1988. Bacteria as multicellular organisms. *Scientific American* 258:32.

6. Verrengia, J. 2000. A rad bacteria. *Milwaukee Journal Sentinel*, Jan. 17.

7. Morowitz, H. 1981. Do bacteria think? *Psychology Today* 15:10.

8. Kiessling, L., and Gestwicki, J. 2002. Bacteria mimic cell phone system to communicate. *Nature*, Jan. 3.

GM Crops Increasing Pesticide Use

The planting of 550 million acres of genetically engineered corn, soybeans, and cotton since 1996 has increased pesticide use in the United States by about 50 million pounds, according to "Impacts of Genetically Engineered Crops on Pesticide Use in the United States: The First Eight Years," a report released in November by the Northwest Science and Environmental Policy Center. The report finds that substantial increases in herbicide use on herbicide-tolerant crops, especially soybeans, accounted for an increase in pesticide use on GM acres compared to acres planted with conventional plant varieties. Many farmers have had to spray incrementally more herbicides on GM acres to keep up with tougher-to-control weed species, coupled with the emergence of genetic resistance in certain weed populations.

The report concludes that the other major category of GM crops, corn and cotton engineered to produce the natural insecticide *Bacillus thuringiensis* in their cells, continues to reduce insecticide use by 2 million to 2.5 million pounds annually. The increase in herbicide use on HT crop acres, however, far exceeds the modest reductions in insecticide use on acres planted with Bt crops, especially since 2001. The report is available at www.biotech-info.net/technicalpaper6.html. ○

This report is from Acres U.S.A.*, January, 2004. Order* Acres U.S.A. *at www.acresusa.com.*

Life Lessons From Geese

Fact One: As each goose flaps its wings, it creates an "uplift" for the birds that follow. By flying in a "V" formation the whole flock adds 71% greater flying range than if each bird flew alone.

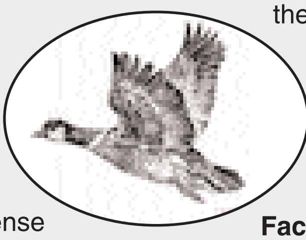
Lesson One: *Cooperation*. People who share a common direction and sense of community can get where they are going quicker and easier because they are traveling on the thrust of each other.

Fact Two: When a goose falls out of formation, it suddenly feels the drag and resistance of flying alone. It quickly moves back into formation to take advantage of the lifting power of the bird immediately in front of it.

Lesson Two: *Unity*. If we have as much sense as a goose, we stay in formation with those headed where we want to go. We are willing to accept their help and give our help to others.

Fact Three: When the lead bird tires, it rotates back into formation to take advantage of the lifting power of the bird immediately in front of it.

Lesson Three: *Leadership*. It pays to take turns doing the hard tasks and sharing leadership. As with the geese, people are interdependent on each others' skills, capabilities, and unique arrangements of gifts, talents, or resources.



Fact Four: The geese flying in formation honk to encourage those up front to keep up their speed.

Lesson Four: *Encouragement*. We need to make sure our honking is encouraging. In groups where there is encouragement, the production is much greater. The power of encouragement, to stand by one's heart or core values and to encourage the heart and core values of others, is the quality of honking we seek.

Fact Five: When a goose gets sick, wounded, or shot down, two geese drop out of formation and follow it down to help and protect it. They stay with it until it dies or is able to fly again. Then, they launch out with another formation or catch up with the flock.

Lesson Five: *Family*. If we have as much sense as the geese, we will stand by each other in difficult times as well as when we're strong.

Statement of Purpose

Vital Earth Resources is a for-profit private corporation dedicated to the development, production, and sale of top-quality, ecologically sound horticultural and agricultural products. *The Vital Earth News* is a periodic publication of Vital Earth Resources to inform customers and other interested parties about our products and programs, and to educate our readership on critical issues facing growers today and in the future. If you would like to receive future issues of this newsletter or product information, simply fill out the form on the right and mail it to us.

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Vitazyme **increases the yield of rice, sometimes dramatically. In replicated tests in Cuba, yield increases were 57% with two applicationsof Vitazyme with normal fertilization. Even when nitrogen was reduced by 25% on the Vitazyme plots compared to the control, Vitazyme still increased yields by 25%, producing 15.7 more bushels per acre.**

This rice field comparison near Rector, Arkansas, shows the stimulation of early rooting and growth that is the typical response to Vitazyme.

Vital Earth/Carl Pool logo and return address