The Vital Earth News

Agricultural Edition

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NAS Says "Chemicals Do Not Necessarily Increase Yields"

By Keith Schneider
Reprinted with permission from **The New York Times*****, September 8, 1989.***

The National Academy of Sciences (NAS) has found that farmers who apply few or no chemicals to crops are usually as productive as those who use pesticides and synthetic fertilizers .... In a long study, the Academy's Board on Agriculture said it was seeking to reverse Federal policies that for more than four decades have been focused on increasing the productivity of crop and livestock farms principally through heavy use of pesticides, drugs, and fertilizers.

The report's authors said Congress and the Department of Agriculture should change farm policies that have discouraged farmers, particularly those who grow crops subsidized by the Government, from trying natural techniques.

Subsidies and Overproduction

In the Federal corn program, for instance, farmers are paid a subsidy of roughly $1 for every bushel they can produce. The incentive is to produce the most bushels. Since the end of World War II, farmers have been taught by agricultural universities and the Department of Agriculture that the best way to increase output is to use ample amounts of chemical fertilizer and them protect the harvest with generous applications of pesticides.

Natural farming methods often incorporate crop rotations, manure and green manure crops for fertilizer, and strip cropping to control water erosion.

If farm subsidies were reduced, researchers say, it is likely that farmers would no longer produce surpluses marketable only to the Government, and might encourage farmers to try natural farming techniques. That would bring supply in line with demand, raising prices and making up for the subsidies. The effect on consumer food prices is not expected to be dramatic because grain is only a fraction of overall food costs ....

An Important Confirmation

The study by the nation's pre-eminent body of scientists is perhaps the most important confirmation of the success of agricultural practices that use biological interactions instead of chemicals. Such farming methods that play down chemicals have been invented and developed by farmers over the last two decades almost entirely outside of the Department of Agriculture,

See Chemicals Not a Boon, page 2

Do Microorganisms Make Rain?

By Kobus van Tonder
Reprinted with permission from **Landbou Weekblad** ***(South Africa), March 24, 2006.***

The most current scientific findings on how clouds and rain are formed differ dramatically from what one learned in school. The old view is that water has to evaporate, rise up and condensate to clouds, and then return to earth as rain drops.

Currently, scientists are saying that this process is not that simple. Colonies of microorganisms like bacteria and algae most probably play a bigger role in the formation of clouds and rain than was initially thought.

But can microbes really influence rainfall? Can they survive unfriendly conditions and travel vast distances in the atmosphere? Are there ecosystems in the sky of which we are not aware?

Imagine minute organisms that travel through the sky to make rain for their host plants and other living beings on earth.

This is exactly what researchers in America and Britain believe is true for

These* Pseudomonas syringae *cells look innocent enough, but may be implicated in the formation of raindrops all across the earth.

See Microbes May Help Form, page 6

Chemicals Not a Boon to Big Crops

Continued from page 1

agricultural universities, and other institutions in American farming.

Until very recently, farming methods shunning chemicals have been viewed by many farmers and farm policy leaders as unorthodox, and incapable of generating harvests that match those produced with chemicals ....

"Well-managed alternative farms use less synthetic chemical fertilizers, pesticides, and antibiotics without necessarily decreasing, and in some cases increasing, per-acre crop yields and the productivity of livestock systems," said the committee in the report *Alternative Agriculture*.

"Wider adoption of proven alternative systems would result in ever greater economic benefits to farmers and environmental gains for the nation," it said.

The Department of Agriculture, which was suspicious of natural farm practices during the 1980s, greeted the study enthusiastically, saying the "time was right" to consider changes in the direction of American agriculture.

Let's not forget these lessons taught by the National Research Council's study Alternative Agriculture *in 1989.*

"We are in a time when society is highly concerned about issues of food safety and water quality," said Dr. Charles E. Hess, the Assistant Secretary of Agriculture for Science and Education. "We have a ... goal of a highly efficient, internationally competitive and environmentally safe agriculture ...."

The Board on Agriculture said natural farm practices are not a single method of farming, but rather a spectrum of farming techniques that have the common goals of reducing costs, preserving the environment, and protecting human health primarily by sharply lowering or eliminating toxic farm chemicals and animal drugs.

Among the practices cited as successful by the Report's authors are careful rotations of crops to battle weeds, diseases, and insects, and to provide nutrients naturally. Another is the production of a number of crops and livestock in combination. A diverse crop and livestock system, the Report said, enables farmers using natural methods to protect themselves from cyclical swings in price for any single crop.

Natural farming methods are usually more labor-intensive than chemical methods, but produce crops that yield as much and are nutritionally superior.

The Report said natural practices frequently demand greater management skills and take more work than chemical-based practices, and the Report's authors expressed some concern about the number of people with the skills and inclination to use the practices effectively.

In its study, which began in 1984, the Board on Agriculture closely examined 14 farms in Ohio, Iowa, Virginia, Pennsylvania, California, Florida, and Colorado which have developed successful natural production methods.

It is not known how many American farmers practice natural techniques, but it is thought that at least five percent of the nation's 2.1 million farmers have adopted such techniques. The numbers may be much greater.

A 720-acre dairy, cattle, and grain farm in Knox County, Ohio, managed by Rex and Glen Spray achieved yields of corn that were 32 percent higher and yields of soybeans 40 percent higher than the county average without using synthetic fertilizers and pesticides for more than 15 years, the study said. The Spray brothers controlled weeds by rotating corn, soybeans, small grains, and red clover in their fields and uprooting weeds mechanically. They use manure from their herds instead of synthetic fertilizers.

In Goochland County, Virginia, northwest of Richmond, Sandy and Rossie Fisher operate a 3,530-acre beef and grain farm profitably with sharply reduced use of chemicals, the study said. Synthetic fertilizers are used on the farm to start corn crops, but are not used with hay or soybean crops. The Fishers also discovered that by planting a legume in fields overridden with Johnsongrass, and then harvesting the field for forage for their 500 head of cattle, they could save thousands of dollars in herbicide costs.

In addition to the problems of overproduction, the environmental costs of using large amounts of chemicals have become more apparent in the 1980s, the study said. Weeds and insects develop genetic resistance to farm chemicals, often forcing farmers to use ever greater amounts to achieve the same effect. ❒

A Creed to Think About

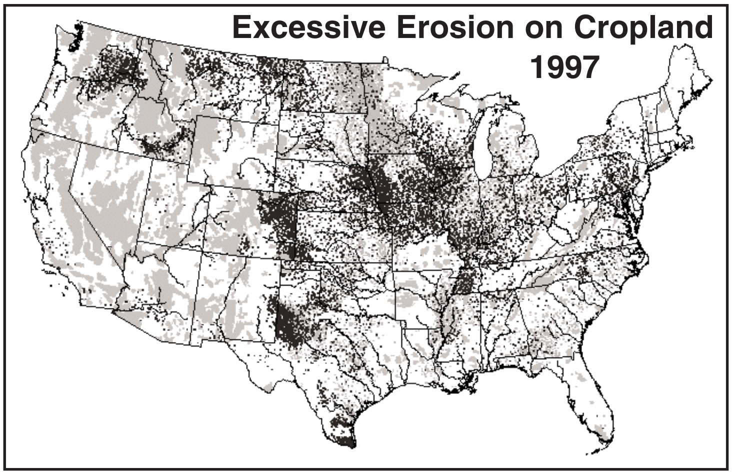
1. Good men are not cheap.
2. Capital can do nothing without brains to direct it.
3. No general can fight his battles alone. He must depend upon his lieutenants, and his success depends upon his ability to secure the right man for the right place.
4. There is no such thing as luck.
5. Most men talk too much. Much of my success has been due to keeping my mouth shut.
6. The young man who wants to marry happily should pick out a good mother and marry one of her daughters: any one will do.

J. Ogden Armour, *Bits and Pieces*, August, 1973

Soil Erosion Still a Serious Problem

by Paul W. Syltie, Ph.D.

The preservation of our precious soil resources should always remain a prime issue for farmers across the nation. Yet, even today a goodly portion of U.S. farmland is experiencing severe to moderate erosion due to both wind and water, in excess of the natural rate of soil formation. As of 2004, the average rate of erosion across the country was 7 tons per acre. According to a 1995 study published in *Science* (Vol. 267), this loss of soil and water decreases productivity by about $27 billion per year.



Each dark dot represents 5,000 acres of highly erodible land, and each light dot represents 5,000 acres of less erodible land still losing soil above tolerable levels.

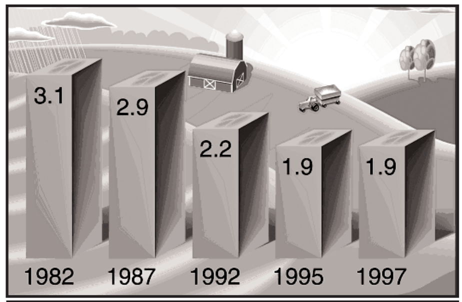
Soil eroded by water from farmland is usually enriched in nutrients compared to the average soil composition, having three times more nutrients and 1.5 to five times more organic matter. Of the estimated annual 20 million tons of synthetic fertilizers applied to farmland in recent years, about half is used by plants while the other half is lost to runoff, soil fixation, leaching, and the air. This runoff, unfortunately, pollutes streams and lakes, creating problems far beyond the fields of origin.

Soil erosion is truly a perennial problem, exacerbated by modern high-tech farming practices. Take, for instance, the case of adjacent farms — the Clausen and Lambert farms — in the rich wheat growing Palouse area of Washington state, not far from Spokane (*Journal of Commerce*, Dec., 1987). In the late 1940s and early 1950s, the Clausens, like most U.S. farmers, abandoned traditional farming methods in favor of intensive, high-technology agricultural methods that rely on synthetic fertilizers and pesticides.

On adjacent fields, the Lambert family decided to stick with the old ways. They rotated crops and renewed the fields every third year with a green manure crop of Austrian winterpeas. When plowed under, this pea crop adds nitrogen to the soil and organic matter to improve water percolation. The Lamberts also used no synthetic fertilizer and pesticides.

The differences today between the two farms are dramatic! The boundary between the two farms is not marked by a fence, and even though the fields were probably identical 40 years ago the Lambert soils are noticeably darker, not only because they have more organic matter but also because they hold more moisture. Soils on the Clausen side of the boundary are eroding four times faster than on the Lambert side; in another 50 years all of the topsoil will be lost.

Unwise land use appears to be the major culprit in losing soils: row crops like corn grown on sloping land, or tillage on land having any significant slope. American farmers, as well as farmers the world over, need to protect the soils they farm from erosion, for soil provides the chief renewable wealth for any nation on earth. Once gone, the forces of nature take decades to replace the soil that has been lost. ❒



Total Erosion on Cropland and CRP Acres
[Billions of tons of soil]

Silicon Gives Big Benefits to Crops

By Paul W. Syltie, Ph.D.

Few elements in the soil are appreciated less than silicon, but research is finding that its benefits in crop production can be quite astounding. The element comprises about 28% of typical soils, or about 560,000 pounds of silicon per acre-six inches depth. Only aluminum and iron come close at times to the level of silicon in soils.

Far from being inert, traces of silicon absorbed by the roots perform a number of functions within the plant:

1. Reduction of stresses due to frost, drought, high salts, or high heavy metal levels

2. Resistance to diseases such as blight in potatoes and wheat

3. Increase in protein content of wheat and other grains

14	28.086
Silicon	
1401	2355
Si	

Rice absorbs about twice as much silicon as nitrogen, according to Dirk Vanden Berghe of the University of Antwerp in Belgium (*The Furrow*, Dec., 2004). Other crops such as potatoes, onions, wheat, and barley also require high levels of the element, but all crops need some.

Formulations of silicon have traditionally been made using rock powder or foundry lime. The Japanese have used silicon as rock dust for centuries, but the silicon levels are very low. A new and stable formulation has recently been developed by Vanden Berghe, an orthosilicic acid which is relatively soluble. Most forms of silicon precipitate easily.

Look for future fertilizers to incorporate silicon as an ingredient. Besides silicon, several other elements will find their way into fertilizers as their benefits become better known. Look for nickel, germanium, and strontium, amongst others, to be proven plant boosters. ❒

15-Minute Soils Course

Lesson 23:

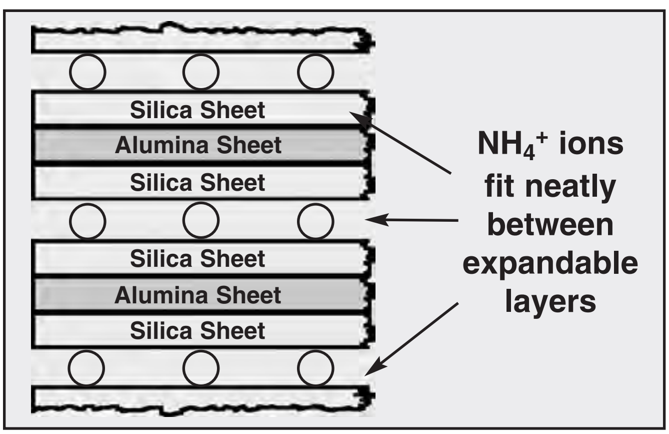
Nitrogen: How It Can Be Lost

Lesson 20 covered the elusive nature of nitrogen (N) in soils and how microorganisms play such a key role in its fixation (immobilization) and its release into plant-available forms (mineralization and nitrification). This lesson will emphasize the losses of N from soils.

Ammonium Fixation

Both organic (humus) and inorganic (clay) soil fractions can "fix" ammonia in forms and locations that are inaccessible to plant roots. Anhydrous ammonia (NH_3) can react with organic matter to form compounds that are resistant to breakdown — perhaps aromatics and quinones — but scientists are uncertain what they are.

Clay minerals of the 2:1 type of lattice (vermiculite, illite, and smectile) can "fix" NH_4^+ and K^+ between the expandable plates of the structure, so roots cannot easily extract them. These ions are just the right size to easily fit into cavities of the lattices. See the diagram below.

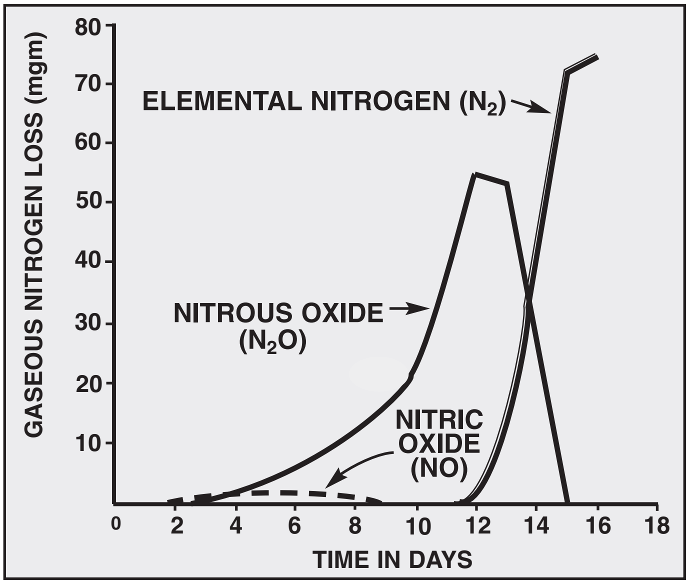


Gaseous Loss of N

Under conditions of low oxygen, such as in poorly drained and compact soils, considerable N can be lost to the air. Though not well understood, it is thought that this process of **denitrification** is caused by various microbes in three major steps ([O] = oxygen):

$$\text{Nitrate } (NO_3^-) \xrightarrow{-2[O]} \text{Nitrate } (NO_2^-) \xrightarrow{-2[O]} N_2O \xrightarrow{-[O]} N_2$$

Nitrous oxide (N_2O) is the gas most commonly lost under field conditions, but in some situations gaseous nitrogen (N_2) is formed. One experiment gave the result shown below.



Urea fertilizer can also help nitrite break down to gaseous nitrogen (N_2). Certain other salts, sulfur compounds, and carbohydrates can also bring about this loss, mainly in slightly acidic conditions. This type of loss is chemical and does not require microorganism intervention. Urea itself can be lost (5 to 20%) as NH_3

$$\text{Nitrite } (NO_2^-) + \text{Urea } (CO[NH_2]) \longrightarrow CO_2 + \text{Water} + N_2$$

if not tilled in soon after spreading.

Even when conditions for soil absorption of anhydrous ammonia are good, losses as N gases can be large. Large quantities of nitrite are thought to build up as soil organisms are killed, and rather than being converted to plant-usable nitrate the N is lost as N gases.

Losses of added and native N as gases is

Continued on the next page

15-Minute Soils Course

often at least 10 to 15% of the total, but can easily reach 40% under poor drainage, heavy N applications, and poor incorporation. In some cases in sandy soils in warmer climates, virtually no NO_3^- may remain two weeks after addition.

Leaching and Erosion Losses of N

Only the nitrate (NO_3^-) ion is normally mobile in soils. It can easily be carried by percolating water into the subsoil, out of reach of roots, eventually polluting groundwater, streams, and lakes. Heavy applications of ammonium nitrate, or high rates if nitrification in climates having heavy rainfall — especially with sandy soils — will lead to large leaching losses of N. Soil erosion also removes the richest N-fraction of soil.

Temporary Losses of N by Carbon

When the soil contains a high level of carbonaceous material containing relatively little N — a high carbon-nitrogen ratio — the microbes breaking down the residues will grab the limited N supply and deprive roots of enough for effective growth. This deficiency will continue until the raw organics are broken down to humic substances and micobes die to release excess N.

What the Farmer Can Do

To limit losses of N in soils a number of approaches can be used.

1. Strive for soil conditions that supply N at the rate plants need it. Then there will be sufficient N for optimum plant growth and no excess for denitrification and leaching. Such a condition is achieved through adding N in organic form (manures, compost, etc.), and allowing microbes to degrade the material and release N.

2. Limit amounts of fertilizer N application at any one time, especially anhydrous ammonia, so gaseous losses will be minimized.

3. Build a highly porous, high organic matter soil to discourage denitrification and erosion.

4. Limit tillage and return residues so organic stores will be built and erosion will be reduced.

Remember: the soil and its microbe population are not "dumb", but will deal with the excesses and deficiencies of all elements effectively if given the opportunity. They will denitrify excesses or fix N from the air if given the tools. This "intelligence" resides amongst a wide array of beneficial soil organisms — from bacteria to fungi to earthworms and mites — all of which are the farmer's greatest assets.

Soil erosion removes the very best of the soil first, especially organic matter, which contains the greatest amount of soil nitrogen,

See How Much You Learned

1. Soil nitrogen (N) can be lost through...
   a. leaching b. denitrification
   c. clay fixation d. all three of these

2. Ammonium and potassium ions can neatly fit into the interlayers of some clays. T or F

3. The gaseous loss of N in soils is called ________________________.

4. The loss of N from fertilizer additions is not a serious problem. T or F

5. A typical loss of fertilizer N from farmland might be about ___________ %.

6. It is important to build a high level of organic matter in the soil, and build good structure, to limit N losses. T or F

7. What does it mean that soils have "intelligence" in regard to N levels?

____

Answers: 1. d. 2. T. 3. denitrification. 4. F. 5. 10 to 15%. 6. T. 7. The soil will get rid of excessive N levels and build up ("fix") N if levels are too low, given the proper tools.

Microbes May Help Form Clouds

Continued from page 1

the past twenty years. To test this hypothesis, a study is being conducted at the University of London-East in England. The results of this study can change the whole concept of how rain and clouds are formed.

Plant-bound organisms undertake journeys into the sky for their own survival, according to these scientists. If a host plant does not get enough water and dies, the survival of the micro-organisms is also at-risk. Because of this threat, they learned to make ice and to ride on the wind and dust particles to undertake a journey to make rain. In this manner, they protect their own lives and help all other living things to survive.

Scientists see the mutual relationships between plant, microorganisms, atmosphere, clouds, rain and the eventual return of the microorganisms to earth as a kind of biological cycle.

This idea was so outrageous that it remained on the fringe of scientific inquiry for many years. But recently, scientists started to study this theory in earnest because more information about the rain cycle and the necessary equipment are available. This field of study is viewed as one of the most understudied areas in biology on earth.

Consequently, the researchers at the University of London-East started a 18-month-long research project two years ago to investigate the ecology of the atmosphere. The results will be available shortly. Dr. Bruce Moffett is the leader of a team that consists mainly of microbiologists. The specific assignment is to determine if microorganisms are actively involved in cloud formation and rainfall.

According to Moffett, it is already known that bacteria, fungi, algae and other microorganisms can survive in unfriendly conditions in the atmosphere, even if they glide on clouds over vast distances. Evidence exists that microorganisms stay in these conditions for a long time. The possibility that they multiply in this environment is very likely. What scientists still have to determine is how many of which microorganisms are involved.

The "high" life of microorganisms in the clouds is still shrouded in mystery, and many questions remain unanswered. Scientists are trying to establish to what extent the metabolism of certain microbes influences rainfall patterns. To date, they suspect that micro-organisms have a substantial influence.

Microorganisms do not only stay in the clouds, but also help with cloud formation. For this purpose, some microorganisms developed the ability to make ice crystals. Ice crystals form the foundation of clouds. In addition, most of the gasses in the atmosphere have been produced by microbes since the beginning of time, says Moffett.

The most important piece of equipment that the scientists use is described by Dr. Moffett as a revolutionary "cyclonic cloud catcher". One expects this to be a sophisticated apparatus. Not so. It is a type of vacuum cleaner that sucks in clouds to serve as specimens for further analysis.

Rain-forming clouds usually have microorganisms from plants and soils as nuclei to condense raindrops.

Bacteria and other organisms find their way into the atmosphere through wind currents, especially in storm systems.

The equipment is connected to an airplane or is carried to high ground where clouds touch the earth. The specimens are subsequently analyzed according to specific methods to identify the different micro-organisms in the clouds.

Moffett believes that this area of study, which has been neglected for so long, can have various practical advantages for humans. New species of bacteria, which survive in such adverse conditions, can be of particular value for medical research and biotechnology. It is possible that some organisms have natural protection against harmful ultraviolet rays that can be useful for human use. It is not unreasonable to expect that some micro-organisms have processes to neutralize greenhouse gasses.

According to Moffett, their research can provide information about distribution by wind of animal diseases like mouth-and-foot disease, and natural phenomena like "red tide". Another possible application is the development of a more organic procedure to "milk" clouds in cities of harmful chemicals through microbial action in trying to relieve droughts.

It is well known that different types of bacteria have the ability to form ice crystals. *Pseudomonas syringae* is the most able in this regard. This bacterium grows freely on plant material and helps with the decomposition process. A single gram of plant material contains about a million bacteria and can form, theoretically speaking, a million ice crystals.

This ability of *Pseudomonas syringae* is so well known that it is added to the water of snow-making machines at skiing resorts. In the atmosphere this bacterium makes clouds.

According to research, the ability of micro-organisms to make ice is nothing new. Microorganisms have been doing this on mother earth for a long time with the aim of breaking down plant material that can serve as food for them. This process implicates micro-organisms in the formation of frost and the damage that often results.

If Moffett and his team obtain positive results, it will provide new proof for the controversial "Gaia-hypothesis", which indicates that the climate on earth and the constitution of the atmosphere are governed by biological processes. ❒

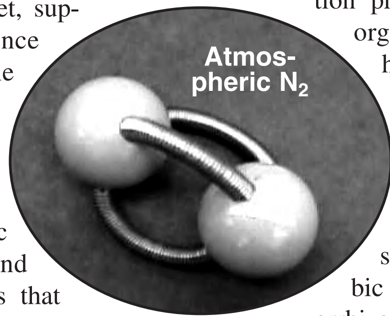
Soil Scientists Still Fail to Pin Down N

By Paul W. Syltie, Ph.D.

One might think that in today's enlightened scientific world there would be few questions left to answer regarding soil fertility. The truth of the matter is that soil fertility is just as complex and mysterious as ever ... maybe even more so today because we know more questions to ask. Let's look at just a few of these mysteries concerning N.

1. Not all N can be accounted for in many, if not most, fertility experiments. For example, in a sweet potato study at the International Institute for Tropical Agriculture in Ibadan, Nigeria, it was found that unfertilized plots produced yields of sweet potatoes as great as did heavily fertilized plots; the amount of N taken up by the plants in unfertilized plots could not be attributed to indigenous or residual soil N levels. The source of N remained unexplained, although it was suspected that dinitrogen-fixing bacteria and mycorrhizae might be responsible.

2. Low-energy biological transmutations do indeed occur, although the possibility is usually denied by scientists of all disciplines. Yet, supporting evidence exists in the work of Dr. Kervran and others. Isn't it interesting that N has atomic numbers and atomic weights that are exactly half of silicon? We know so little about the function of silicon in plants, but if the powers of frequency within the cells and chloroplasts of leaves are able to split silicon to form two atoms of nitrogen, cannot we account for some of the unaccounted-for N increases in plants? Research yet needs to be done to verify this possibility using radioactive isotopes of silicon.



3. Many species of organisms are capable of fixing atmospheric dinitrogen into plant-usable forms. The cells most commonly live in association with plant roots, and receive root exudate energy from the plant while performing the fixation process. Some of these N-fixing organisms, such as cyanobacteria, however, live on leaf surfaces or even within the air spaces inside leaves. N-fixing potential has been found in symbiotic nodulating bacteria (*Rhizobium*, *Frankia*, etc.), free-living photosynthetic bacteria, facultative aerobic and anaerobic bacteria, some mycorrhizae, lichens, liverworts, mosses, and water ferns. Biologists have largely underestimated the potential of microbes to fix N. See Lesson 20 in the Winter, 2005, issue of *The Vital Earth News—Ag Edition* for more details. ❐

"Cultivators of the earth are the most valuable citizens. They are the most vigorous, the most independent, the most virtuous, and they are tied to their country and wedded to it's liberty and interests by the most lasting bands"

Thomas Jefferson

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.

Vitazyme for the third year has improved apple yields and quality in New York orchard trials.

Increases for Empire apples in 2005 were 7.4% for yield, 5.5% for fruit size, 1.5% for Brix, and 1.9% for fruit pressure. Monetary return was improved by $594 per acre!

Applications of Vitazyme at 16 oz/acre at pink, petal fall, first cover, and 30 days before harvest have resulted in excellent apple responses in New York for several varieties.

Vital Earth/Carl Pool logo and return address