The Vital Earth News

Agricultural Edition

Volume XIV, Number 2 | Vital Earth Resources • Gladewater, Texas | Summer, 2008

Improve Nitrogen Efficiency

As Nitrogen Costs Soar There Is Much You Can Do.

By Paul W. Syltie, Ph.D.

We live in unprecedented times, with rapidly rising energy costs, erratic weather patterns, and volatile commodity prices as this generation has never seen before. The farmer is especially faced with fertilizer prices escalating at a phenomenal rate, egged on in particular by the cost of natural gas for nitrogen fertilizer synthesis.

Let me take a few moments and review some of the ways that you can economize on nitrogen use during these difficult times, and save as much as possible on this crucial crop input that in places has reached $0.90 per pound of actual nitrogen. A few changes in your farming program could mean thousands of dollars in savings for this year's season.

Remember: many soil fertility specialists (myself for one) do not agree on how much nitrogen fertilizer is needed to raise a crop. The topic is fraught with many uncertainties: how much rain will fall to potentially leach nitrogen or exclude air from the profile to encourage denitrification, how compact is the soil

Fertilizers, especially nitrogen, are becoming increasingly expensive and need to be used more efficiently.

to reduce microbial nitrogen synthesis and encourage denitrification, what will be the rate of nitrogen mineralization for the season — largely based upon temperature, rainfall, soil organic matter, and other items — and so on. Realize also that not all nitrogen sources are equal: nitrate-N does not give the same response in the plant as ammonium-N.

Choose the Correct Crop

High nitrogen using crops, such as corn, require about 240 lb/acre of nitrogen for 150 bu/acre; a 50 bu/acre wheat crop needs about 90 lb/acre of nitrogen, and bermudagrass about 300 lb/acre of nitrogen for an 8 ton/acre crop. On the other hand, legume crops like soybeans, while requiring about 250 lb/acre of nitrogen for a 50 bu/acre crop, obtain most of their needs from the air through symbiotic nitrogen fixation. This nitrogen is free, and if it can be captured for plant use by *Rhizobium* bacteria, and other nitrogen-fixing bacteria, algae, and fungi, it is the farmer's most cost effective way of saving fertilizer dollars.

The same can be said for beans, peas, alfalfa, clover, and all other legumes. Mixed grass-legume pastures and hay-

See Improve Soil Biology, page 2

Understanding the Phosphonates

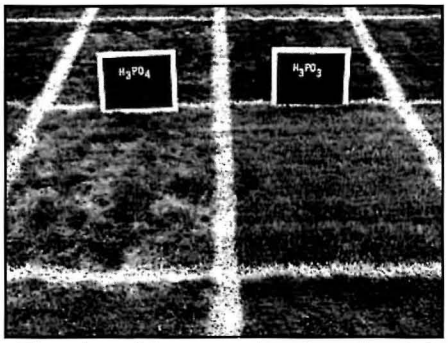
By Peter Landschoot, Ph.D., and Joshua Cook

[Abridged from the Dept. of Crop and Soil Sciences, The Pennsylvania State University]

In the broadest sense, the term phosphonate describes any compound containing a carbon to phosphorus bond. Some examples of phosphonate compounds include organophosphate insecticides, antiviral medicines, flame retardants, and some herbicides. Phosphonate compounds also occur naturally in some lower life forms, including protozoa, mollusks, coelenterates, and oomycete fungi

For this article, we use the term phosphonate to describe only those products made up of the salts and esters of phosphorous acid ($HPO(OH)_2$). Phosphorous acid is a solid substance that can be purchased through chemical supply companies. When mixed with water, it forms a strong acid called phosphonic acid. This acid is too strong to be used on plants and must be combined with other chemicals to raise the pH of the solution and decrease the potential for plant injury.

One means of reducing the acidity of phosphonic acid is to neutralize it with an alkali salt; typically potassium hydroxide (KOH). The resulting solution



The phosphite treated turf on the right was protected from fungal infections.

contains mono- and di-potassium salts of phosphorous acid (often referred to as potassium phosphite), and is the active

See Phosphites Have Fungicidal, page 3

Improve Soil Biology: Save Nitrogen

Continued from page 1

lands give excellent species combinations because the legume will supply the nitrogen for the grass, and normally eliminate the need for nitrogen fertilizer applications.

Improve Soil Biological Activity

Increasing the number and activity of soil microorganisms is an essential means of economizing on nitrogen use. By returning fresh crop residues, manure, or compost to the soil — most any organic material will do — the resident bacteria, fungi, actinomycetes, protozoa, mites, and other beneficial but unseen organisms will thrive, especially along root surfaces. There they feed upon the organic carbon compounds and convert nutrients into available forms, besides synthesizing antibiotics, vitamins, growth regulators, and other beneficial growth compounds.

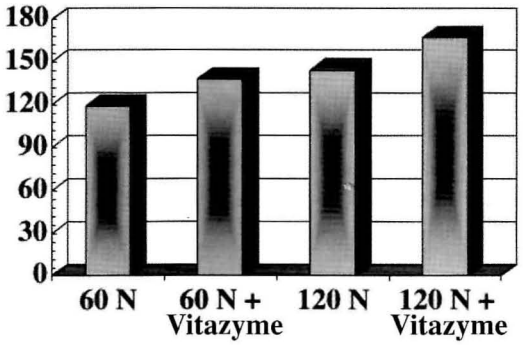
Increasing the number and activity of soil microorganisms is an essential means of economizing on nitrogen use.

Especially important are the symbiotic *Rhizobium* bacteria that fix atmospheric nitrogen, but other nitrogen fixing symbionts are common in soils as well: certain fungi, algae, and especially cyanobacteria. This last group fixes both carbon and nitrogen from the atmosphere, so is highly important in the soil's nutrient economy.

The farmer's goal should be to raise organic matter levels to improve overall soil physical, chemical, and microbiological properties. A virgin soil contains very little nitrate but high organic matter levels, so to emulate this natural system one ought to increase organic levels and allow the natural release levels of organisms to provide plants their needs on demand. When the microbes are generating and releasing nitrogen the fastest during warm and moist conditions, the plants are growing at their maximum rates as well. Plant uptake is proportional to microbial release.

Vitazyme for Nitrogen Economy

The summer 2007 edition of *The Vital earth News — Agricultural Edition* discussed an editorial written by Gordon Berg, editor of *Farm Chemicals* (October, 1983), who stated, "Fertilizer people are nuts if they don't capitalize on the new technology [using growth regulators]". While he was referring to using higher nitrogen rates coupled with growth regulators, recent research has proven that Vitazyme, produced by Vital Earth Resources, can greatly improve the efficiency of nitrogen use. The applications are highly cost-effective. Farmers who do not capitalize on this new technology are indeed foolishly repeating the old adage that "more is better" to get higher yields, but with this material "less is better!" Note the accompanying graph below from a 2007 corn study in southern Ontario.



A corn study in Canada, using 60 and 120 kg/ha nitrogen with and without Vitazyme, proved that 60 kg/ha with Vitazyme yielded nearly as much grain as the 120 kg/ha rate without it.

Accept Lower Yields?

Yes, that is what I said. Would you accept somewhat lower yields if your bottom line was greater? I think you

See Improve Nitrogen Use, page 7

Can the U.S. Be Self-Sufficient in Food?

Indeed it can: words from Kirkpatrick Sale

By Kirkpatrick Sale

[Excerpts from Human Scale, *Coward, McCann, and Geoghegan, New York, 1980, page 237]*

Most areas of the country were self-sufficient for the greater part of our history, indeed until quite recently. A citizens-action group called Vermont Tomorrow, for example, has shown that Vermont was self-sufficient at the turn of this century, producing its own fruit, vegetables, meat, grain, and dairy products, and by today's dietary standards supplied more than adequate amounts of everything except citrus fruits, though it had plenty of vitamin C from tomatoes and berries. Today, however, it is dependent on the large agribusiness networks for almost all its foodstuffs — even for milk — though dairy farming is the leading agricultural enterprise in the state....

Self-sufficiency at an even smaller level is also feasible. Although the standard figure is that it takes an acre to feed four people, the Department of Agriculture has printed a study indicating that an acre of land can provide full garden crops for approximately 55 people, and the Institute for Local Self-Reliance in Washington estimates an acre could feed between 40 and 70 people, even more if certain intensive agricultural methods are followed.... That means that a community of 5,000 people would need only about 100 acres, or less than a sixth of a square mile, to grow its needed food.

Nor should cities be excluded from considerations of self-sufficiency. The experience of a dozen different organizations has proven that urban agriculture is not only possible but comparatively simple and successful, within certain obvious constraints. ❐

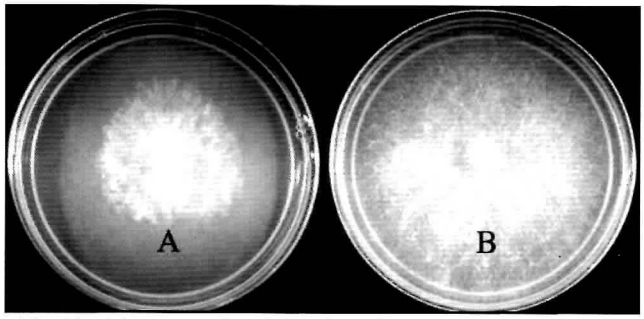
[What Sale did not mention in his book is that cities in China for many years had green belts surrounding their populace, producing most of the vegetables, fruits, and grains needed for teeming millions.]

Phosphites Have Fungicidal Properties

Continued from page 1

ingredient in Alude, Magellan, Vital, Vital Sign, Resyst, and other phosphonate fungicides. Potassium phosphite is also the main ingredient in several phosphite fertilizer products, including K-Phite (0-29-26), Ele-Max Foliar Phosphite (0-28-26), and Nutri Phite P + K (0-28-26).

Phosphonate fungicides and fertilizers should not be confused with phosphate-derived fertilizers such as ammonium phosphate and triple super phosphate. Even though phosphonate and phosphate compounds are very similar chemically, they differ significantly in how they act in plants and fungi.



The Pythium species inoculated onto each petri dish in corn meal media grew well with potassium phosphate (B), but not with potassium phosphite (A).

Phosphonate fungicides and fertilizers are absorbed by plants and incorporated into cells as phosphite ions ($H_2PO_3^-$). The fact that this ion has one less oxygen atom than phosphate means that it does not act in the same manner as phosphate in plants. Although the phosphite ion can be transported into plant cells, it does not appear to be involved in any phase of phosphorus metabolism (ATP production, photosynthesis, or respiration). Over time, phosphonate fertilizer can be converted by bacteria to phosphate in soil, where it can be taken up and metabolized by plants. This conversion can take several weeks and is not thought to be a very efficient means of phosphorus delivery to plants when compared with phosphate fertilizers. Phosphite ions have direct fungitoxic effects on certain plant pathogens, a benefit that is not found with phosphate.

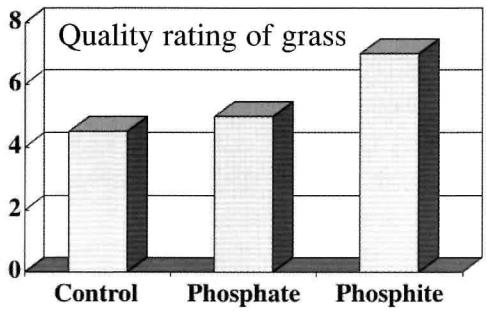
Fungicidal properties of phosphonates were discovered by scientists at Rhone-Poulenc Agrochemical Laboratories in France during the 1970s. These scientists were screening various chemicals for fungicidal properties when they discovered that phosphonate salts were effective in controlling diseases caused by a group of fungi known as the oomycetes (*Phytophthora, Plasmopara, Pythium*, and others). Soon after this discovery, fosetyl-Al was formulated under the trade name Aliette, and released for commercial use.

Phosphonate fungicides possess significant symplastic ambimobility, or movement in both xylem and phloem. Translocation in phloem allows the fungicide to move from leaf tissues to the crowns and roots. Because of this unique property, phosphonates are viewed as excellent fungicides for controlling root rot diseases such as Pythium root rot and dysfunction caused by various *Pythium* species.

Mode of Action

The mode of action of phosphonate fungicides has long been a source of controversy and mystery. Some scientists believe that most of the fungicidal effects of these products are directly on the fungal pathogen; whereas others suspect that both a direct effect on the fungus and a stimulation of natural host defenses combine to prevent disease.

In a study using three *Phytophthora* spp., Australian scientists found that phosphonate fungicides interfere with phosphate metabolism by causing an accumulation of two compounds, polyphosphate and pyrophosphate, in fungal cells. Accumulation of these compounds is thought to divert ATP from other metabolic pathways, resulting in a decrease in fungal growth



When high temperatures and humidity reduced grass quality with the control and potassium phosphate treatment the potassium phosphate treated grass improved!

More recently, phosphonate fungicides were found to inhibit several key enzymes needed for growth and development in Phytophthora palmivora. These studies suggest that the mode of action is at least partially, if not mostly, direct inhibition of the fungus. Also, the mode of action of phosphonate fungicides appears broad enough so that the potential for rapid resistance development is not as strong as with some other systemic fungicides.

Research has also revealed that when certain species of *Phytophthora* infect certain plant species treated with phosphonate fungicides, fungus-inhibiting chemicals called phytoalexins are produced. Very little is known about activation of host defenses in phosphonate-treated plants, but many plant pathologists assume that this is possible, if not likely.

Fertility Effects

Findings that phosphonates do not affect phosphorus metabolism or yield appears convincing, but should be tempered by the fact that many of these products have demonstrated improved turf quality. Quality enhancement with potassium phosphite products is probably not due to nutritional effects, as our studies have shown no such improvement with equal amounts of potassium phosphate fertilizer. It remains to be seen what causes turf quality improvement, but one proposed cause may be the suppression of minor, plant debilitating pathogens, such as *Pythium* species. ❐

The Right Perspective

When Goliath came against the Israelites, the soldiers all thought, "He's so big we can never kill him!". David looked at the same giant and thought, "He's so big I can't miss!"

Russ Johnston, *Sales Upbeat*, June 27, 1991.

15-Minute Soils Course

Lesson 27:

That Indispensible Zinc (Zn)

This lesson we journey to another crucial element for plant growth: zinc. It uses are many by the plant, primarily as an enzymatic co-factor for several enzymes used in energy production, protein synthesis, and growth regulation. It is essential for the development of flower parts and grain and seed production, and a deficit will delay maturity.

30	65.39
Zinc	
419.6	907
Zn	

Because zinc is not mobile within the plant its deficiency appears mainly on new growth, and the plant requires a constant supply for optimal growth.

Zinc Deficiencies

Deficiency symptoms include short internodes, decreased leaf size, and delayed maturity. See the chart below for detailed symptoms.

Zinc deficiencies are most common on sandy soils low in organic matter, or on organic soils. Land leveling or shaping, and soil erosion which removes topsoil, may lead to zinc deficiencies, oftentimes in spotty and irregular areas of the field; the same is true for most micronutrients. Deficiencies also can occur in cool, wet weather when root growth and microbial release of zinc are reduced. Uptake of the element decreases as soil pH increases, and when soil phosphorus and iron levels are high.

Cropping sequence will greatly affect zinc availability. Corn or soybeans following sugar beets will oftentimes be deficient in zinc. Crop responses to zinc fertilizer applications vary considerably, as shown in the table below.

Correcting Deficiencies

One should test the soil for zinc, along with other essential nutrients, and be sure that there are at least 10 lb/acre of available zinc; 20 lb/acre is even better. Soil applications before planting are usually preferable to correct deficiencies, but foliar applications are effective if made early enough, before deficiencies have manifested themselves for very long. Foliar treatments are usually standard with fruit and nut crops, and also with rice. For corn, a foliar spray of 1.0% $ZnSO_4$ is typical, or 0.25 to 0.5% of a chelated zinc source. For sensitive crops like beans, lower rates are applied. Soil applications usually range from one to 40 lb/acre of actual zinc for $ZnSO_4$, or 0.25 to 2.0 lb/acre for chelated zinc.

Crop Response to Zinc	
Alfalfa	Medium
Wheat	Low
Clover	Medium
Corn	High
Beans	High
Sugar beets	Medium
Grass	Medium
Citrus fruit	High

Sources of zinc include $ZnSO_4$, ZnO, Zn-Oxysulfates (mixtures of ZnO and $ZnSO_4$), Zn-EDTA, and organic materials. It is important that the water solubility of the material be high to obtain a good crop response. $ZnSO_4$ is 100% soluble, but some of the dark-colored granular materials, many

Common Deficiency Symptoms of Zinc

Legumes. Small bronze-colored spots on older leaves; as spots increase in size the leaves develop a mottled appearance

Fruit trees. Retarded terminal growth (rosetting); narrow leaves with yellow tissue between the veins

Corn. Yellow stripes on either side of the midrib, developing first on the lower, older leaves, which a bronze appearance

Sorghum. No visual symptoms may appear, but seed production is greatly reduced

15-Minute Soils Course

of them oxysulfates, have solubilities less than 50% and give poor zinc responses.

As with all of the soil elements, it is important to maintain high levels of microbial activity in the soil to make the nutrient available, since all of the elements go through a microbial conversion process to become available to the plant. The mycorrhizal fungi are especially important

Zinc deficiency in corn is characterized by light stripes in the upper leaves, and a light coloring in the newly expanding leaves.

Orange trees that are short on zinc show a marked chlorosis of the newly expanding leaves, with green midribs and veins

because their hyphae reach out from the root to seek out immobile elements — like zinc, copper, manganese, and phosphorus — and transport them back to the roots. Once again, the importance of biological approaches to solving soil fertility problems are seen as appropriate in today's modern agricultural systems.

On occasion zinc may be excessive, such as in this* cannabis *plant. Note how the newly expanding leaves are chlorotic and misshapen.

See How Much You Learned

It is important to use use a zinc fertilizer that is highly soluble in water. T or F

2. The following are zinc deficiency symptoms: a. Yellow stripes on corn leaves; b. Yellow leaves on oranges; c. Red leaves on soybeans

3, Especially important in the uptake of soil zinc are the _____ fungi.

4. Zinc is vital as an enzyme co-factor for processes of protein synthesis, growth regulation, and energy production. T or F

5. Zinc should be applied to a crop on the basis of _____ and accurate recommendations.

6. It is possible to get good responses to zinc if a deficiency is detected in the crop, and a foliar application is made soon after. T or F

7. Zinc deficiencies may be expected in the following situations: a. high pH soil; b. high available iron or phosphorus; c. corn following beets.

Answers: 1. T; 2. a. b; 3. mycorrhizal; 4. T; 5. soil testing; 6. T; 7. a, b, c.

Mineral Levels in Foods Have Plunged!

See how the nutritional values of foods have dropped in 51 years.

By R.A. McCance and E.M. Widdowson

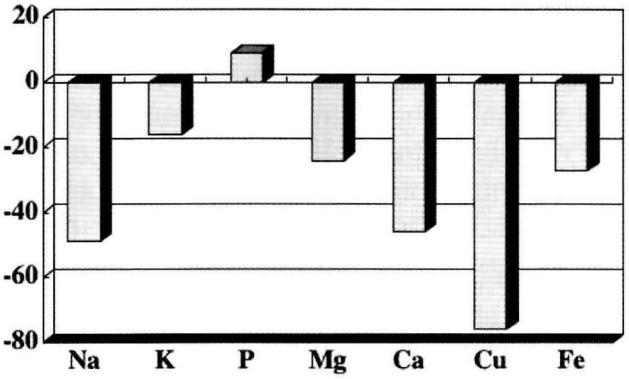
[From www.mineralresourcesint.co.uk]

The information in this article is extracted from "A Study on the Mineral Depletion of the Foods Available to Us As a Nation Over the Period 1940 to 1991". The data used as the basis for this study were published under the auspices of the Medical Research Council and later the Ministry of Agriculture, Fisheries, and Foods and the Royal Society of Chemistry.

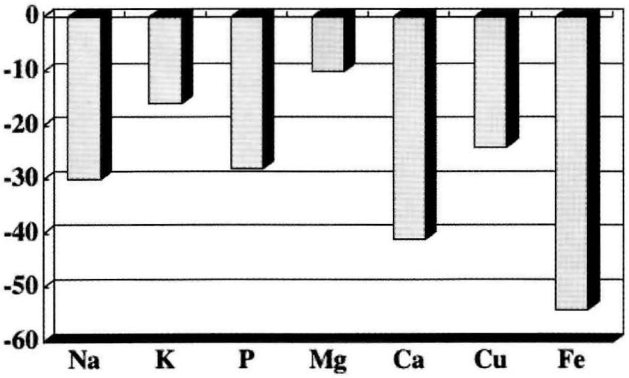
In 1927 a study at King's College University of London of the chemical composition of foods was initiated by Dr. McCance to assist with diabetic dietary guidance. The study evolved and was then broadened to determine all of the important organic and mineral constituents of foods. It was financed by the Medical Research Council and eventually published in 1940. Over the next 51 years subsequent editions reflected changing national dietary habits and food laws as well as advances in analytical procedures. The most recent edition, published in 1991, has comprehensively analyzed 14 different categories of foods and beverages.

In order to provide some insight into any variation in the quality of the foods available to us as a nation between 1940 and 1991, it was possible to compare and contrast the mineral content of 27 varieties of vegetable products, 17 varieties of fruit products, 10 cuts of meat, and some milk and cheese products. The results demonstrate that there has been a significant loss of minerals and trace elements in these foods over that period of time. It is suggested that the results of this study cannot be taken in isolation from recent dietary, environmental, and disease trends. These trends are briefly mentioned, and suggestions are made as to how the deterioration in the micronutrient quality of our food intake may be arrested and reversed. ❐

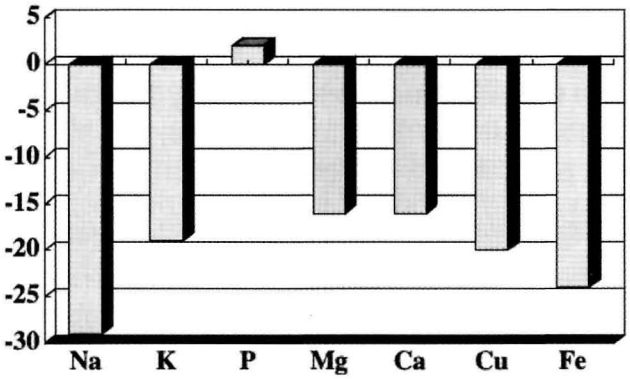
Average % Change in Minerals, Vegetables — 1940 to 1991 —



Average % Change in Minerals, Meats — 1940 to 1991 —



Average % Change in Minerals, Fruits — 1940 to 1991 —



Na = sodium
K = potassium
P = phosphorus
Mg = magnesium
Ca = calcium
Cu = copper
Fe = iron

SOME FACTS ABOUT CORN

Scientists believe people living in central Mexico. developed corn from a wild grass called teosinte. Teosinte looked very different from our corn today. The kernels were small and were not placed close together like kernels on the husked ear of modern corn. Almost a ton of corn is produced in North America to provide for each citizen of the continent. Its uses are many and incredibly diverse: fabrics used to make your clothing are strengthened by cornstarch. The chickens that laid the eggs often consumed for breakfast were fed corn, as were many of the cows whose various products pervade our society. Many soft drinks and myriads of other artificially sweetened products are laced with generous dollops of corn syrup. The textbooks you study from and the books you check out of the library are bound with cornstarch. The ink used to print them contains corn oil. Ethanol, touted by many as a key component in the battle to reduce greenhouse gas emissions, is made from corn. Corn is also used in such products as glue, shoe polish, aspirin, ink, marshmallows, ice cream, and cosmetics. Some industrial uses of corn include improving household detergents, making "packing peanuts", printer's ink, and "Hydrosorb" (a super-absorbent cornstarch). A bushel of corn fed to different species of food animals produces 5.6 pounds of retail beef, 13 pounds of retail pork, 19.6 pounds of chicken, or 28 pounds of catfish.

www.schnr-specimen-shells.com

***Bits and Pieces*, May 2, 1991.**

Know Your Soybean Growth Stages

By Purdue University IPM Experts

Vegetative and Reproductive Stages

The V stages following VC are numbered according to the uppermost fully developed leaf node. Start with the unifoliolate leaf node when counting the number of fully developed leaf nodes. A leaf node is fully developed when the leaf above it has leaflets which are fully unrolled.

Vegetative Stages

VE Emergence

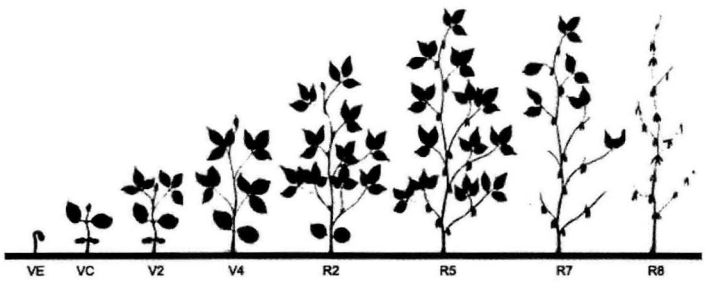
VC Cotyledon

V1 Unifoliolate and first trifoliate leaves are fully developed

V2 Unifoliolate and first two trifoliate leaves are fully developed

V3 Unifoliolate and first three trifoliate leaves are fully developed

V(n) Unifoliolate and (n) trifoliate leaves are fully developed



Reproductive Stages

R1 Open flower at any node on the stem

R2 Open flower at one of the two uppermost nodes on the main stem with a fully developed leaf

R3 Pod is 3/16 inch long at one of the four uppermost nodes on the main stem with a fully developed leaf

R4 Pod is 3/4 inch long at one of the four uppermost nodes on the main stem with a fully developed leaf

R5 Seed is 1/8 inch long in the pod at one of the four uppermost nodes on the main stem with a fully developed leaf

R6 Pod containing a green seed that fills the pod cavity at one of the four uppermost nodes on the main stem with a fully developed leaf ❐

Improve Nitrogen Use

Continued from page 2

would, as would any astute farmer. The most efficient use of plant nutrients is made at moderate application levels of fertilizers; at higher rates the return per additional unit of nitrogen decreases, and with the price of this input skyrocketing it would behoove you to consider accepting somewhat less than optimal yields. Then again, why accept yields less than optimal when studies with Vitazyme have shown that only 50% of optimal nitrogen with this material produced yields superior to the 100% nitrogen rate without it.

I am impressed by a Colorado dryland wheat farmer who is making good money by keeping his input costs low. He uses a low rate of N-P-K+micronutrients plus Vitazyme, and produces acceptable though not high yields. He continues to purchase land while his neighbors, following the agribusiness model, are selling out.

It is possible to produce excellent yields with low overhead and minimal nitrogen fertilizer inputs. This "new way" requires good management, but the methods are not beyond the capabilities of most farmers. Your land and your bank account will appreciate the changes you make in limiting nitrogen fertilizer costs, and especially by making more efficient use of what you apply. ❐

Let's Help One Another

Edmund Hillary and his native guide Tenzing were descending Mount Everest after their historic climb. Suddenly Hillary lost his footing, but Tenzing held the line taut and kept them both from falling by digging his axe into the ice. Later, Tenzing refused any special credit for saving Hillary's life; he considered it a routine part of the job. As he put it, "Mountain climbers always help each other."

Should the rest of us be any different? *Bits and Pieces,* No. 5, 1971

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.

***Yes!* Send me a subscription to *The Vital Earth News* and/or product information!**

- ❑ *The Vital Earth News Agricultural Edition* (two issues per year)
- ❑ Carl Pool water soluble fertilizers
- ❑ Potting soils, mulches, and compost
- ❑ Vitazyme, Aqua-Min, and Odor-X
- ❑ I am a ( ) farmer or grower, ( ) retailer, ( ) other interested party.

Name _____

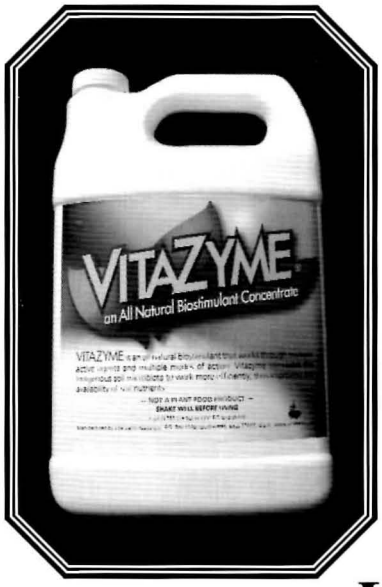
Address _____

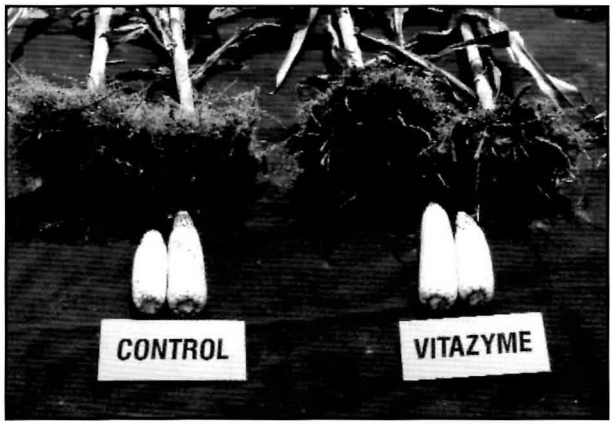
City/State/Zip _____

Telephone and/or fax (optional) _____

Mail to: **Vital Earth Resources, P.O. Box 1148, Gladewater, Texas 75647**

Vitazyme continues to prove it can improve nitrogen utilization in an age of soaring fertilizer costs. In Ontario, Canada, 50% of the recommended nitrogen along with Vitazyme produced a yield nearly as great as the 100% nitrogen rate without Vitazyme. Use Vitazyme to boost nitrogen efficiency!





At 60 kg/ha of nitrogen, Vitazyme produced significantly more grain than did the control.

Vital Earth Resources™

Carl Pool®

P.O. Box 1148 • Gladewater, Texas 75647