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The Dangers of Too Much Lime

If a little is good, is more better?

by Neal Kinsey
Kinsey's Agricultural Services,
Charleston, Missouri

Perhaps the most frequently asked question by those using our soil fertility program is, "Can I put a higher rate of lime than you are recommending for this sample?" Generally, this has to do with getting the limestone spread, because the owner of the lime trucks says he either cannot or will not apply such a small amount.

Many times a farmer has been told,"You can't use too much lime." **That is not true.** From our experience in working with thousands of acres that have previously been over-limed, we know you can easily apply too much lime, not just on crops such as berries and potatoes, but on whatever crop you are intending to grow. And if this happens, it can be far more expensive than just the cost of the extra limestone that was not needed, and getting it spread.

It takes 3 years to show

What makes identifying the problem somewhat complex is the fact that it may take three full years to see the whole picture of total effects from any lime applied on a field. If too much is used, it is not normally noticeable in the first year. In fact, if any lime was really needed, improvements will be most evident in the first year. But by the third year, when problems are more likely to begin showing up, many growers have already forgotten the possible long-term effects of the limestone application, and tend to place the blame elsewhere (on weather, fertilizer, seed, and so on).

Lime applied in the proper amounts is a most excellent soil amendment, but like most good things can be overdone.

The adverse effects from overliming can show up in a number of ways. Principally we must deal with the damage caused from too much calcium and/or magnesium as well as the effects of increasing the soil pH.

Effect on pH

For example, adequate phosphate is a big concern for most farmers in terms of fertilizer. Just by increasing soil pH, phosphate may be released and increased in the soil. But if the pH goes unduly high, phosphates can also be tied up. Using more than enough lime can cause the pH to increase by so

See Liming Can Be Overdone, page 2

Farmland Quality Continues to Decline

Renewed Respect for Soil is Needed

by Paul W. Syltie, Ph.D.

One would think that after the billions of dollars spent on agricultural research the past 70 years or so, since the disastrous Dust Bowl days, our soil problems would be solved in America and elsewhere around the world. Such a conclusion would be far from the truth, however, as a recent survey of our world's soil resources reveals.

This peek at our valuable soils was made by the International Food Policy Research Institute. The study of satellite maps from countries around the world uncovered a plethora of problems on the land: chemical contamination, salinity from irrigation water, erosion, inadequate drainage, and other problems.[1]

The lead researcher of this study, Stanley Woods, stated, "The basic story is that agriculture is being pretty successful at keeping the world in food. It's been somewhat less successful in nurturing the natural resources that underpin that production capacity."[2] In other words, current agricultural methods are coaxing crop yields from many soils, but

In this field the compacted layers of soil have been exposed by a backhoe, and the soil carefully picked away to reveal every tire machine imprint.

See Two Billion Tons of Soil, page 3

Liming Can Be Overdone!

Continued from page 1

much that this happens. In addition, pH can tie up other elements as it increases, such as boron, iron, manganese, copper, and zinc.

Effect on trace elements

The higher the calcium level climbs from the use of calcium carbonate limestone or gypsum, or from the calcium makeup of dolomite lime, or any other significant calcium source, the more chance the trace elements, plus potassium and magnesium, have of being tied up in the soil - to the point that the crops can no longer take them up. Then plants suffer in terms of quality and yield. This is also a critical point to understand, if the levels of any of these elements, which can be tied up by too much calcium or too high a pH, are already borderline in the soil. In terms of availability for plant use, deficiencies can occur unless they are able to be determined beforehand by testing, and treated accordingly.

"Just by increasing soil pH, phosphate may be released and increased in the soil. But if the pH goes unduly high, phosphates can also be tied up."

Effect on water use

Use of calcium also increases the pore space in the soil. This is a desirable result until pore space reaches 50% of the total soil volume. But when too much calcium is applied by over-liming, so much pore space can result that the soil dries out much easier than before. So you can lose efficiency of water use, whether it's from rainfall or irrigation if you over-lime your soils.

Consider all sources

Some growers might think that just as long as there is not too much limestone applied, there is no problem. High calcium limestone (calcium carbonate) and gypsum (calcium sulfate) are generally considered the most common sources of calcium. But the problem can be caused by other materials too. The list includes oyster shell, rock phosphate, kiln dust, marl rock (ground sea shells), sugar beet

See Use a Soil Test, page 7

Is Ag Biotechnology out of Control?

by Paul W. Syltie, Ph.D.

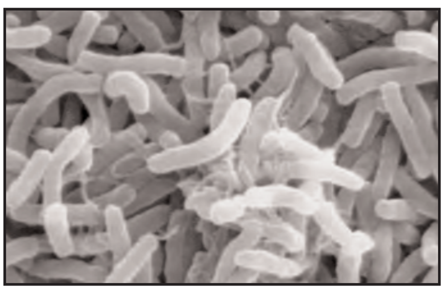
The year was 1992, and the site was western Oregon. A graduate student at the University of Oregon named Michael Holmes was looking for a topic for his Ph.D. thesis, and at the suggestion of his advisor, Elaine Ingham, he decided to investigate the effects of genetically engineered *Klebsiella planticola* (KP) on plants. This organism was a genetic variant of typical *Klebsiella* bacteria that inhabit the root zones of most plants around the world, but unlike the highly beneficial effects of the normal species these altered types produce considerable alcohol that can kill plants roots.

When KP was created by the Environmental Protection Agency (EPA) it was envisioned that the KP bacteria would convert plant residues into 17% alcohol and 83% mineral sludge, the sludge then being applied to the soil as a fertility amendment. Of course, the KP would be released during this process as well. There were no restrictions for the EPA to **not** dump these organisms onto the soil, so plans moved ahead with the project.

Just weeks before the altered KP microorganisms were to be dumped on the soil, the results of Michael Holmes' study came in. He had grown plants in three soil treatments:

(1) A sterile control
(2) Soil with normal KP
(3) Soil with genetically altered KP

The sterile control produced plants that were healthy and vigorous, while the normal KP soil improved growth somewhat. However, the soil with genetically engineered KP produced no plants! Alcohol produced by the bacteria had killed them. The soil had 17 parts per million of alcohol, 17 times the 1 part per million limit a plant can tolerate.



These bacteria look harmless, but when genetically altered they may produce very undesirable effects.

Dr. Ingham went on to inform the EPA about this test and succeeded in stopping this introduction of the bacteria to the soil. Had they been allowed to release them they could have potentially, over time, spread throughout the country and the world, wiping out all types of plants as it went. This bacteria is very tough, able to survive handily under adverse soil conditions despite being genetically altered. This is in contrast to nearly all other altered soil microbes, which are **less** able to survive in nature.

According to *Acres U.S.A.* (April, 2001), the EPA operates under the assumption that mutant bacteria are only as deadly as the parent, and pose no greater risk than the parent. Such an assumption is faulty, since many mutants of various bacteria, such as *Escherichia coli*, are known to be much more virulent than their parents. Once introduced into the environment it is impossible to get them back; thus, the need to prevent such a potential catastrophe of releasing potentially damaging organisms is obvious.

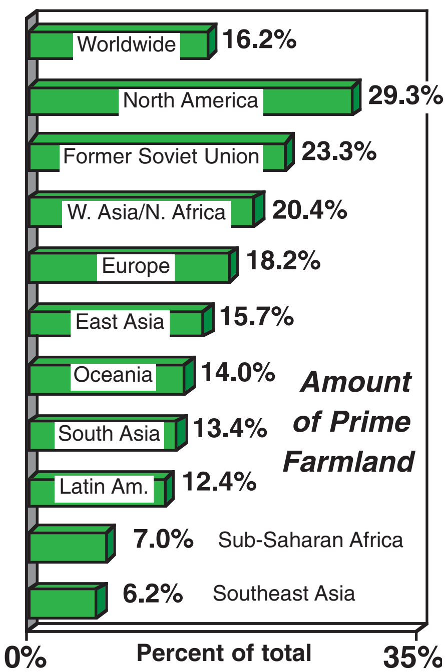
According to Dr. Ingham, "If we had not done that testing [of KP and engineered KP] the EPA would have allowed its field use in two weeks. We just happened to be working on that for academic interest. What would have happened if we had not done that work. What kind of unexpected effects are already out there? Hopefully nothing as devastating as this organism, but we don't know because they have not been tested." ■

Two Billion Tons of Soil Eroded Each Year!

Continued from page 1

at a price to the long-term viability of the soil that grows these crops.

It is estimated that about 16% of the world's farmland is free from major fertility problems . . . as long as the chemical imports to sustain commercial agriculture continue to be available, that is. North America has been granted the lion's share of such favorable land — 29% of its land has few limitations to optimum production — but parts of Asia have as little as 6% of the farmland free from serious constraints. Notice this graph that shows how prime farmland varies from place to place over the earth.[3]



Since the great awakening of America in the 1930's to the terrible toll soil erosion was taking upon the nation's soils, erosion by both water and wind has continued unabated. Hugh H. Bennett, the dynamic catalyst in the U.S. Department of Agriculture whose efforts led to the creation of the Soil Conservation Service, helped organize a nation-wide reconnaissance of the nation's soils the summer of 1934. Those findings revealed some startling statistics[4]:

- Fifty million acres of cropland had been rendered useless to further production.
- Another 150 million acres of arable land had declined so far that farming was difficult or unprofitable.
- Over another 680 million acres of all types of land, traces of water erosion were discernible.
- A large area of over 200 acres of the Great Plains, from Texas to North Dakota, was subject to wind erosion.

Annual losses of soil in the mid-1930's were at least 3 billion tons of solid matter washed from fields and pastures. The loss of plant food in this eroded soil amounted to 92,172,300 tons of nitrogen, phosphorus, potassium, calcium, and magnesium, which was 60 times the amount of plant food added in commercial fertilizers.[5] Unfortunately the fraction of the soil first lost to erosion is the low-density, nutrient-rich organic matter.

The erosion situation is little better today. A Worldwatch Institute report stated that in the U.S. in the early 1980's about 2 billion tons of soil a year were being lost, while the world total is around 26 billion tons! [6]

Salinization of lands from salty irrigation water continues at a high rate. About 4 million acres of farmland is lost to salt buildup every year, which is about 1% of irrigated land worldwide. Aluminum levels in many tropical soils are so high that toxicity to plants renders them highly marginal for cropping.[7]

Seldom mentioned in soil quality studies is the depletion of organic matter. Without adequate organic matter commercial N-P-K fertilizers are less effective, so in places such as Kenya, where poor farmers are forced to harvest corn stalks for animal feed and food rather than return it to the field, the organic matter has dropped greatly. Corn yields are only 15 to 25 bushels per acre, versus the U.S. average of about 150 bushels per acre.

Soil composition must also be calculated into the soil quality equation. Compact layers within the soil greatly restrict root growth, so much so that a root growing three inches per day in well-structured soil will slow to only 0.5 inch per day in oxygen depleted compacted soil.[8] Roots are then unable to extend and absorb needed nutrients for high yields, wasting fertilizer dollars. Moreover, rainfall is unable to permeate through the soil mass as quickly, increasing runoff and exacerbating nutrient loss from soil erosion. The use of farm chemicals – pesticides and fertilizers – accelerates compaction and soil quality loss by reducing organic matter and inhibiting the growth of soil microorganisms that produce the critical polysaccharides responsible for developing strong structure.

Soil water erosion does considerable damage each year to soils all over the earth, especially in row-crop plantings that are left unprotected such as in this field.

Who – or what – is to blame for this serious decline in soil quality worldwide? Most forces are economy-driven since farmers generally have an instinctive motivation to care for the land. Chemicals and machines to replace

See Build Our Soils, page 7

Sheet erosion, as shown in the previous picture, can quickly graduate into gully erosion under the right conditions, leaving the land impossible to farm using conventional crops.

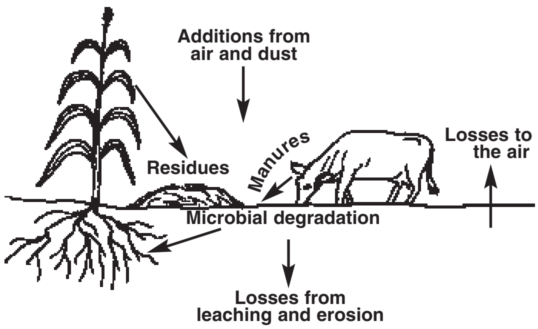
15-Minute Soils Course

Lesson 13:

Cycling of Nutrients

Natural laws teach us that nutrients taken from the soil must be recycled back to the soil on a regular basis for any cultural system to be

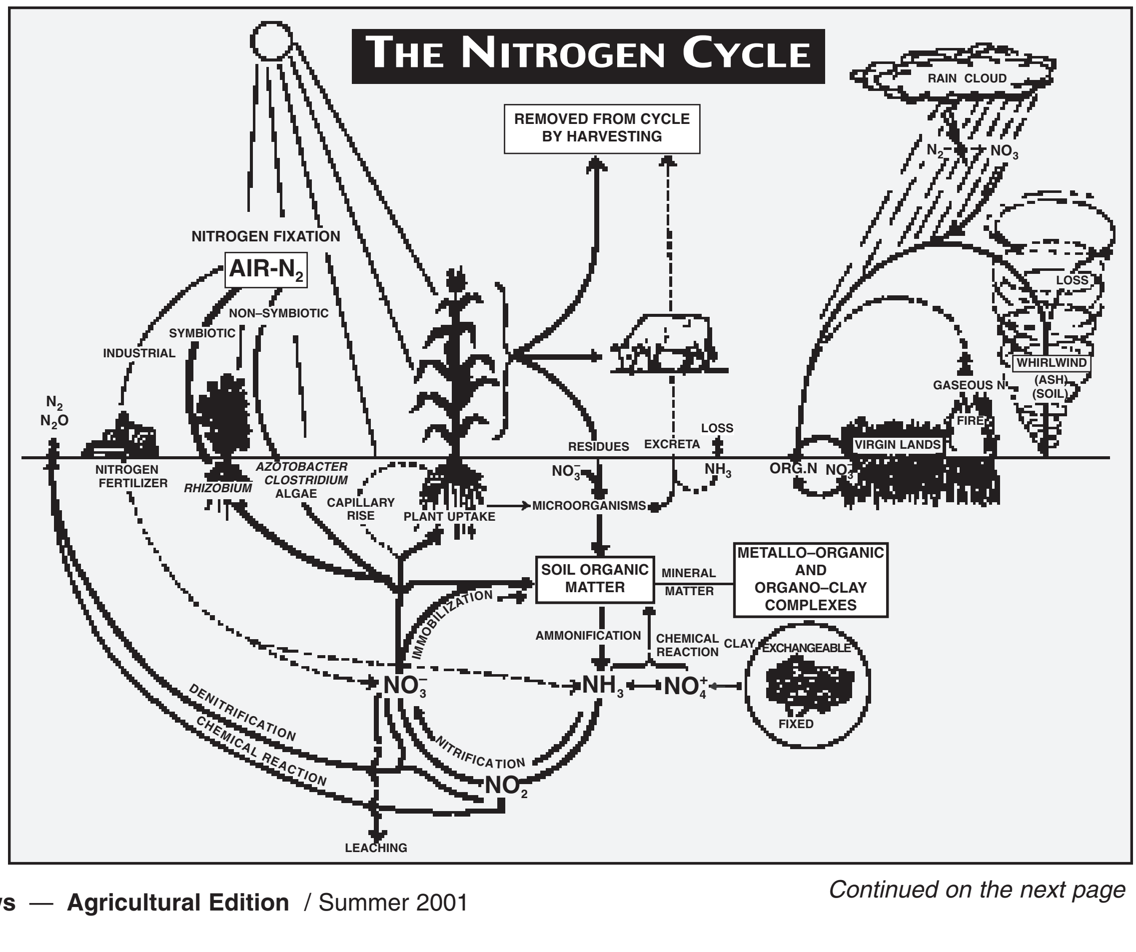
OVERALL SCHEME OF NUTRIENT CYCLING



permanent. This cycling requirement is true for all soil elements, including organic matter which contains not only all of the essential crop nutrients, but also so much life-essential carbon, nitrogen, sulfur, and many complexed elements like calcium, magnesium, zinc, copper, boron, and others.

Soil microorganisms play a paramount role in the nutrient cycling process. As plant residues are returned to the soil they are attacked by bacteria, fungi, mites, nematodes, springtails, insects, and a host of other organisms that recycle the fresh plant tissue into humic substances. This humus contains complexes of various elements, either directly incorporated into the chemical structure (like N, S, and C) or bonded through complexing and chelating reactions. These complexes are created by microbes first devouring the organic carbonaceous residues, and then incorporating the components into their cellular protoplasm.

As microbes grow, other elements from the surrounding environment such as N, Mg, Ca, Zn, and B are taken up and incorporated into the cellular structure, and on death are left to comprise the resulting humic substances ... or they may be digested again by other microbes until a relatively stable humic substance remains. This residue, usually dark in color, serves as the reservoir of fertility for subsequent plant growth. When temperature and moisture conditions are optimum, roots penetrate the soil near these organic compounds, and the highly active microbial activity within this rhizospheric zone triggers the release of the many elements and compounds needed for plant growth.



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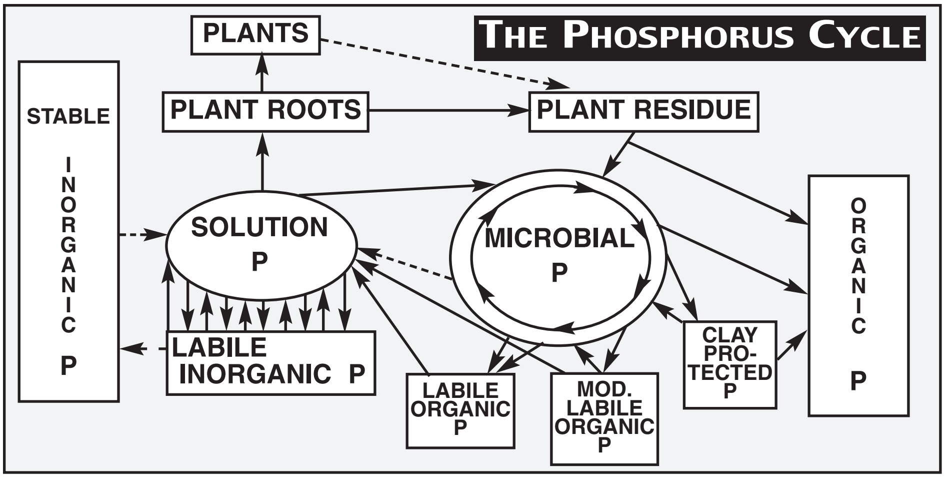
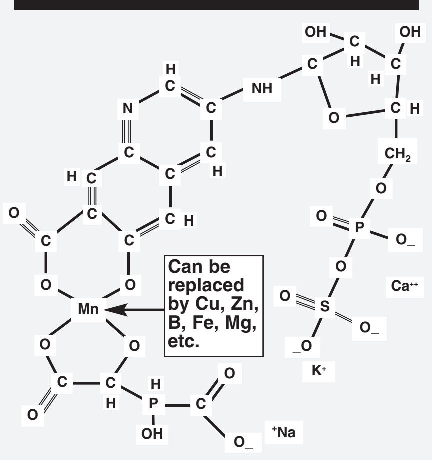
15-Minute Soils Course



As stated by F.J. Stevenson in *Cycles of Soil* (Wiley-Interscience, New York, 1986), “An understanding of the various cycles and their interactions is essential for the intelligent use of soil as a medium for plant growth and for the rational use of natural and synthetic fertilizers.” These nutrient cycles are in every sense a “lifeline” for the operation of the ecosphere of planet earth. It is essential that nutrients be recycled from the crop residues, and that any shortfalls of nutrients be replaced by supplemental sources. These sources can be organic (manures, crop residues, compost, etc.) or mineral in nature (lime, commercial fertilizers). Organic fertilizers are preferred because they are much more “complete” than the usual commercial types; rather than containing only N, P, and K they contain the full spectrum of plant-essential elements, including the all-important carbon that is required to maintain good soil structure, and is necessary to feed soil microorganisms that perform a multitude of functions in soil fertility.

An Idealized Humic Molecule Containing Immobilized and Exchangeable Nutrient Elements



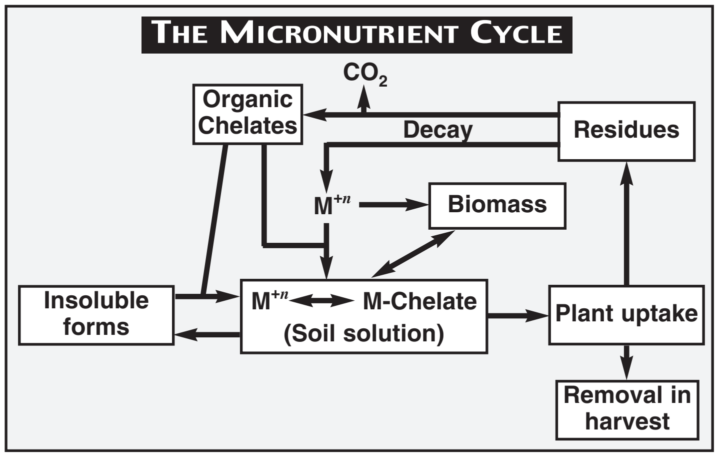
See How Much You Learned

1. Nutrient cycling is critical for the functioning of life on earth.
   T or F

2. ________ _______ play a critical role in the nutrient cycling process.

3. It is important to understand nutrient cycling to properly manage soils. T or F

4. Organic fertilizers are preferred to commercial fertilizers because they contain the ___________ array of plant nutrients..



5. The following elements are important to recycle in the soil:
   a. Nitrogen, b. Carbon, c. Zinc,
   d. Magnesium, e. All of the above

6. Which of these two groups of elements is retained in the soil primarily as chelated complexes?
   a. Mn, Zn, Cu, Mg, Fe
   b. N, P, K, Na, S

7. Soil ________ ________ provides the chief reservoir of nutrients for plant growth in most mineral soils.

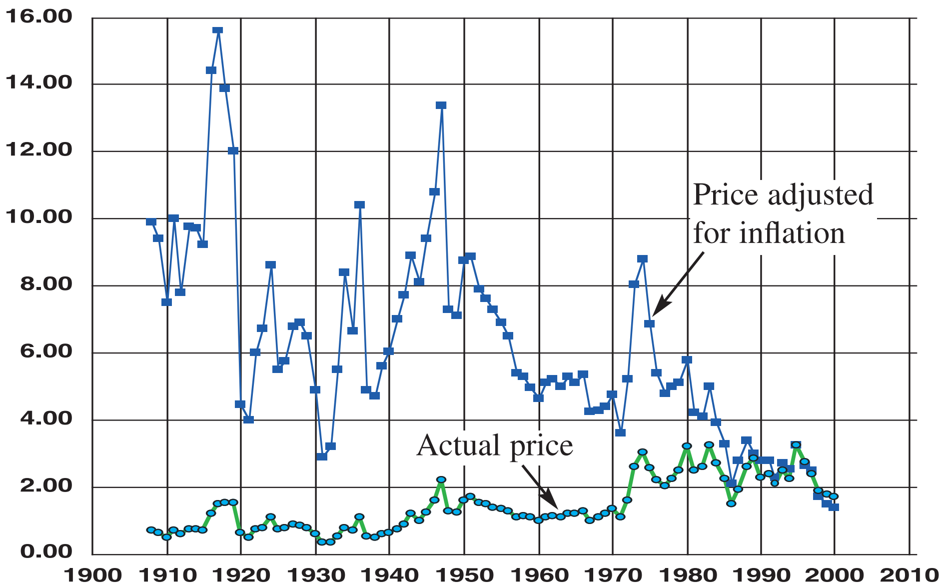
1. T; 2. soil microorganisms; 3. T; 4. complete or full; 5. e; 6. a; 7. organic matter.

Corn Prices in the U.S. Are At Historic Lows

Notice the graph on the right, which charts the price of corn in terms of constant 1995 dollars, (adjusted for inflation, and also in terms of actual price paid each year in dollars).

Throughout the past century, with notable exceptions, the price of corn in real terms has dropped progressively, especially since 1974. Notable exceptions to the average trend were low prices in the early 1920's and early 1930's, and very high prices in 1916 to 1919, 1936, and from1945 to 1947.

Logic tells us that there will be a jump in corn prices within the next two years if historic trends are to be repeated. Farmers hope there will be a major breakthrough in prices, or even more farm foreclosures will be imminent. ■



Genetically Modified Soybeans — Harmful to Plant and Animal Health

Much has been said recently about genetically modified crops, especially corn and soybeans. Producers of these seeds stand to reap major profits in not only seed sales, but also herbicide sales for glyphosate-tolerant types.

Not all soybean varieties are created equal, and tampering with the genome directly has caused many problems.

However, more and more problems are beginning to surface with the use of these seeds, two of which were mentioned in the April, 2001, issue of *Acres U.S.A.* In a four-year study at the University of Missouri (UM) it was discovered that several species of non-beneficial fungi multiplied in the soil and roots of soybeans in response to glyphosate (Roundup) application. These species did not normally inhabit the root zones to any extent, and were tied to various fungal root diseases.

According to Dr. Pat Donald, UM plant pathologist, and Dr. Robert Kramer, MS soil scientist, "Experiments conducted in 1997 to 2000 at two Missouri locations revealed that Roundup Ready soybeans receiving glyphosate at recommended rates had a significantly higher incidence of fusarium on roots within one week of application compared with soybeans that did not receive glyphosate."

Near Nokomis, Illinois, a farmer had a 50-acre soybean field near a pond that was planted to conventional beans and to Roundup Ready beans. Geese that lived in the pond would graze on the soybeans, but would leave the Roundup Ready soybeans untouched while grazing the conventional beans to the ground. These geese knew which variety was nutritionally superior, and would not touch the inferior Roundup Ready variety. This observation shows that at least some genetically altered seeds produce plants having a poor nutritional value. The implications of these observations for human health and nutrition are clear. ■

You Can Change . . . for the Better!

"The bee for a millennium has fluttered its wings in the same mating pattern; the social ant also follows its set instinctual patterns. Moths fly to the light, even if it destroys them. We humans, too, have special patterns, but we are different, for we — uniquely — can change our patterns. Human culture is a two-way business: it creates us, but we create it. We react to the culture, the culture reacts to us. What is immensely powerful also has tremendous potential for change. The cultural influence can be positive or negative. We have the flexibility to choose; we are endowed with the ability to change our behavior patterns if we wish."

Robert F. Allen, *Lifegain*, Appleton-Century-Crofts, New York, 1981.

Build Our Soils, Protect Our Future

Continued from page 3

expensive labor on huge tracts cannot make up for the benefits of careful soil husbandry of the small husbandman, who is not pressed to remove fodder from his fields to feed stock and heat homes instead of return it to the soil. The pressure on farmers to survive economically drives so much of the destruction of our lands. These facts place much of the blame on governments and grain markets that keep food prices low and farm input costs (seed, fertilizer, machinery, fuel, etc.) high . . . alongside high land prices and taxes.

With the prospect of the world's population increasing by 1.5 billion by 2020[9], it is clear that farmers must switch their methods towards soil improvement or risk the alternative of food shortfalls and starvation. Will political and business leaders the world over wake up to the imperative need to bolster the quality of the soils that feed the very life-blood of every nation, and ease the plight of the farmer . . . and will farmers heed the common-sense call to preserve and build their soils rather than prefer short-term profits? The correct choice is clear. The gravity of the choice is profound in its consequences, to the point that the very foundations of today's civilization are at stake.

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9. Same as 1. ■

Use a Soil Test, Not pH, for Lime Needs

Continued from page 2

processing lime, and stack dust from scrubbers of utilities or industrial facilities burning high sulfur coal. All of these, as well as poultry manure, especially from laying hen operations (where calcium is supplemented to strengthen the egg shells) can be a significant source of additional calcium. Also, certain types of wood ashes that are applied at high tonnage rates, and some sources of irrigation water, can contribute substantially to the levels of calcium in the soil. Don't be fooled, too much calcium can cost you money in terms of lower crop yields. On the other hand, even on crops such as berries or potatoes, so called "low pH crops", too little calcium, or too low a pH, can cost you just as much or more, if not corrected.

Use a soil test

The best way to determine what is actually needed or not needed in terms of liming is to use a detailed soil analysis. The soil analysis should include measurement of calcium and magnesium and the percentage saturation of each in the soil. (As we explain in *Hands On Agronomy*, growers cannot determine whether lime is required simply by measuring the pH of the soil.) The soil testing methods used by Kinsey Agricultural Services always include checking for both calcium and magnesium levels to determine if there is too little, too much, or if the proper amount is already there. Chapters 2 through 4 of *Hand On Agronomy* help explain this in greater detail. An overall picture of what over-liming actually does to a soil can be seen by taking a soil sample prior to the use of the lime and following up each year for the next three years.

So when someone asks, "Why can't we just go and apply 2000 lbs anywhere that you call for less than that?" the answer is: if you can never apply too much limestone, that would be fine. But too much limestone can be a problem for the soil and for the crops to be grown there, because it ties up other nutrients also needed for the growing crop. So it is far better not to use too much lime. The correct amount of lime makes a real difference in how your crops are going to respond, whatever the crop you may choose to grow. ■

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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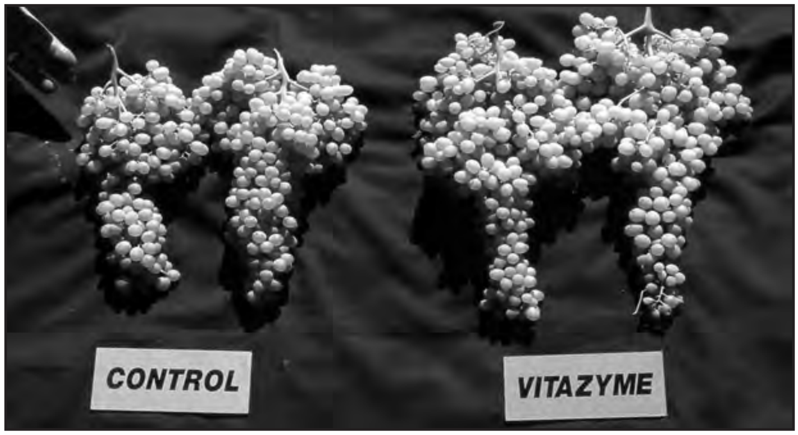

Grapes for raisins in this California study responded especially well to 13 oz/acre of Vitazyme applied twice.

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