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Agricultural Edition

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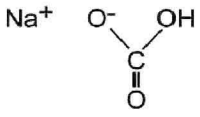
Baking Soda in Agriculture and Health

One Simple Compound Can Do So Much!

By Paul W. Syltie, Ph.D.

How excited should one get over the simple compound $NaHCO_3$? Based on research and practical experience ... very excited! This simple compound can do wonders in a wide variety of applications on the farm and in the home.

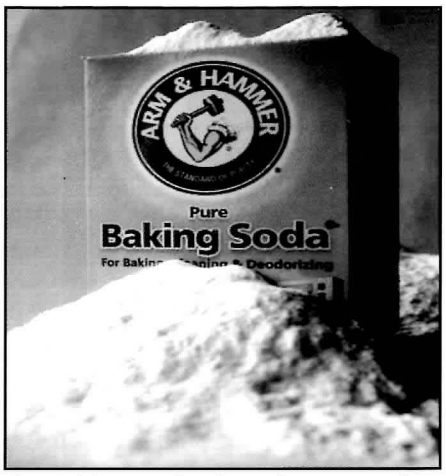


Notice on page 2 the common uses of baking soda as described by Church and Dwight, the manufacturers of the Arm and Hammer brand, and other sources.[1] One source lists 60 more uses for this simple compound.[2]

How Bicarbonate Works

Baking soda [sodium bicarbonate} is $NaHCO_3$, in chemical terms. This compound is found naturally as nahcolite in the Green River Formation, Piceance Basin of Colorado, and is mined by pumping heated water into the nahcolite beds, and recrystallizing the compound above-ground.[3]

Some reactions of baking soda are as follows:



Something as simple and commonplace as baking soda can do so much for the farm and the home, with little cost.

In water: $NaHCO_3 + H_2O \Rightarrow H_2CO_3 + NaOH$; $H_2CO_3 \Rightarrow H_2O + CO_2$ (a gas)
In an acid: $NaHCO_3 + HCl \Rightarrow NaCl + H_2CO_3$; $H_2CO_3 \Rightarrow H_2O + CO_2$ (a gas)

Notice that the end result of these reactions is carbonic acid (H_2CO_3), which breaks down to water and carbon dioxide (CO_2). In the process a hydroxyl ion (OH^-) is liberated, which raises the pH of the solution. Thus, the pH of any solution to which $NaHCO_3$ is added is increased. The same effect is achieved in the bodies of animals and people who ingest it, since the body is 70% water.

A Powerful Fungicide

As early as 1933, baking soda at one ounce per gallon is mentioned as a remedy to control powdery mildew on climbing roses. Thence began more widespread use of this compound, usually with a surfactant such as insecticidal soap, to control fungi on various crops.[4]

I personally worked with Dr. Ken Horst of Cornell University on some early work with bicarbonates on grapes. As a pioneer of using baking soda for leaf fungal control, he published articles which showed fungal control as good as, or better than, with conventional fungi-

See Oxygen in Baking Soda, page 2

The Benefits of Organic Food

A Growing Body of Scientific Evidence

By Andre Leu

President of the Organic Producers Association of Queensland, Australia; excerpted from *ACRES USA*, May, 2004.

Research published in a 2001 study showed that the current fruit and vegetables in the United States have about half the vitamin content of their counterparts in 1963. The study was based on a comparison of published USDA figures. A scientific study published in the *Journal of Applied Nutrition* in 1993 clearly showed that organic food is more nutritious than conventional food.

Organically and conventionally grown apples, potatoes, pears, wheat, and sweet corn were purchased over two years in the western suburbs of Chicago, and then analyzed for mineral content. The organically grown food was on average 63 percent higher in calcium, 73 percent higher in iron, 118 percent higher in magnesium, 178 percent higher in molybdenum, 91 percent higher in phosphorus, 125 percent higher in potassium, and 60 percent higher in zinc. In addition, The organic food was on average 29 percent lower in mercury than the conventionally raised food.

Naturally grown foods pay big benefits in terms of health, vitality, and flavor!

See Protein Synthesis Must, page 3

Oxygen in Baking Soda Does Much!

Continued from page 1

cide for cucurbits, roses, and grapes. Various bicarbonate products are now available as a result of Dr. Horst's work, including First Step (Helena Chemical), Kaligreen (Monterey Chemical), and Remedy (Boride). Most use 1 to 2% sodium, potassium, or ammonia bicarbonate plus about 1% surfactant.[5]

Common Uses of Baking Soda

- **Cleaner for kitchen and bathroom surfaces**
- **Deodorizer for refrigerators, carpets, beds, upholstery, and pets**
- **Ingredient for baking, such as bread and omelets**
- **pH maintainer for pools**
- **Fire extinguisher for the home**
- **Sink deodorizer**
- **Clothes washing cleaner and deodorizer**
- **Ice remover for sidewalks**

The Health Area

Of considerable interest during the past decades has been the use of baking soda for treating animals and people. It is well established that bloating in livestock can oftentimes be remedied; some cattle raisers put baking soda on a regular basis into their rations.[6] Similarly, excess acidity in the stomach of people can be relieved with bicarbonate.[7] There is a small amount of bicarbonate produced in the stomach, but more in the liver where it travels down the bile duct to neutralize acidic stomach contents moving into the ilium.

Even as bicarbonate suppresses fungi and other pathogenic organisms on leaf surfaces by raising the pH, so are fungi suppressed in the body by a higher pH through the moderate consumption of baking soda. This fact has dramatic ramifications on the overall health status of people. Many health experts admit that an abnormally low pH within the body is a precursor of disease, so efforts to raise the pH above 7.0 (neutral) by eating raw fruits and vegetables ("alkalizers") bear considerable benefits in reducing illness.

These benefits may be due in large part to the oxygen that comprises hydroxyl groups ($-OH^-$), which become more and more abundant in the cells and circulatory solutions of the body as the pH rises. Many disease organisms, including the fungi and viruses implicated in cancer, cannot survive high oxygen levels,[8] so by raising the body's pH

Powdery mildew of grapes can be effectively controlled with regular sprays of baking soda and a surfactant.

using various means to normal levels, these pathogens are unable to thrive and disease disappears. Dr. Simoncini in Italy treats cancer as a fungal disease, and achieves excellent success using sodium bicarbonate.[9] Others have found success in curing stage four prostate cancer, the stage at which conventional medicine can do little or nothing to help.

One bicarbonate treatment utilizes maple syrup, and though sugars tend to exacerbate cancer, the cancerous cells are killed before any growth stimulation occurs. Using this treatment one survivor said, "Those other doctors told me I was a goner and had less than six months to live, but the doc put me on

Many health experts admit that an abnormally low pH within the body is a precursor of disease, so efforts to raise the pH above 7.0 (neutral) by eating raw fruits and vegetables ("alkalizers") bear considerable benefits in reducing illness.

his mixture and in a couple of months the cancer was gone. It did not even show up on X-rays".[10]

Another cancer victim, having "incurable" bone cancer, consumed baking soda along with molasses for eleven days before receiving a bone scan at the hospital. His saliva and urine pH reached 8.5, and though some nausea and diarrhea were experienced the cancer was gone.[11]

Other documented health benefits of baking soda include the following:

- Aid in overcoming chronic kidney disease
- Prevention of kidney disease and renal failure, and kidney stones
- Reversal of halitosis (bad breath)
- Boosting of athletic performance
- Cleaning and whitening of teeth, and healing of gums
- Help in preventing blisters from burns
- Softening of skin, and removal of excess oil
- Helping to calm an acidic stomach
- Relief of toothache pain

This article is not intended to prescribe a healing regime for those with illnesses — that responsibility belongs to a qualified physician — but one should check out alternative health authorities concerning the uses of baking soda to heal and prevent disease.

Moreover, farmers ought to recognize the great potential of utilizing baking soda based fungicides on their crops to replace the toxic chemicals they are now using. Fungicides comprise a highly carcinogenic group of chemicals that ought to be avoided as much as possible.

Sometimes the best remedies for our problems are right in front of us if we would but look and see. Let's explore sodium bicarbonate more closely and evaluate how this simple and cheap compound can benefit us in everyday life, on the farm and at home.

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Pesticides Inhibit Beneficial Compounds

Continued from page 1

A peer-reviewed scientific article published in the February 2003 *Journal of Agricultural and Food Chemistry* stated that organically grown corn, strawberries, and marion berries have significantly higher levels of cancer-fighting antioxidants than conventionally grown foods. Some of these compounds, such as flavonoids, are phenolic compounds that have potent antioxidant activities. Many are produced by plants in response to environmental stresses, such as insects or competing plants. They are protective compounds that act as a plant's natural defense and also have protective properties in human and animal health.

Pesticides may help protect a crop from disease, but will reduce food quality.

The research suggested that pesticides and herbicides disrupt the production of these protective compounds. Good soil nutrition appears to increase the levels of these natural compounds that have anticancer, immune-boosting, and anti-aging properties.

Two comprehensive studies have been published that compared the differences between organic and conventional foods. Both studies came up with similar conclusions that there is overwhelming evidence that organic food is more nutritious than conventional food.

One of the authors stated, "On average our research found higher vitamin C, higher mineral levels, and higher phytonutrients —plant compounds which can be effective against cancer. There's also less water in organic vegetables, so pound-for-pound you get more carrot for your carrot."

It is no coincidence that consumer demand for food supplements has grown as the amount of minerals and vitamins has declined in conventionally farmed food. Many people cannot get the necessary quantity and quality of nutrition from food grown with synthetic chemicals.

Pathogens

In the recent past there have been a number of media stories claiming that, because organic foods are grown with manure, they contain higher levels of dangerous pathogens. On investigation, all of these stories were proved to be false, and most of the media presenters apologized publicly for promoting inaccurate and misleading stories.

In fact, a UN Food and Agriculture Organization report concluded that the superior management practices of organic agriculture reduce E. coli and mycotoxin infections in food: "It can be concluded that organic farming potentially reduces the risk of E. coli infection.... Two studies reported by Woess found that aflatoxin M1 levels in organic milk were lower than in conventional milk.... As organically raised livestock are fed greater proportions of hay, grass, and silage, there is reduced opportunity for mycotoxin-contaminated feed to lead to mycotoxin-contaminated milk."

Food Additives and Chemicals

The use of antibiotics, antimicrobials, and hormones or other growth promoters is prohibited in organic production. Where animals are treated with veterinary chemicals, they are not allowed to be sold as organic. Similarly, the use of synthetic chemicals as preservatives, colorings, antioxidants, etc., is prohibited in the processing of organic foods. There is an increasing body of concern about these synthetic compounds in the diets of humans and animals used for human food.

Many studies show that most conventionally farmed foods have pesticide and other chemical residues. Repeated tests show that many of these foods can carry a cocktail of synthetic poisons. A growing body of scientific evidence is showing that repeated exposures to cocktails of small amounts of synthetic chemicals produce a range of adverse health effects. A recently published study shows that as little as one-tenth of a part per billion of one commonly used herbicide can damage reproductive systems. In addition, many scientists believe these exposures of minute quantities of agricultural chemicals are very significant for children.

Peer-reviewed, published research has demonstrated that many of these types of chemicals are known to disrupt the hormone, nervous, and immune systems. The escalating increase of certain types of cancers such as lymphoma, leukemia, breast, uterine, and prostate cancers are linked to agricultural and other synthetic chemicals. Similarly, a good body of scientific research also links these chemicals to dramatic increases in autoimmune diseases such as asthma and chronic fatigue syndrome, and non-Hodgkin's lymphoma has gone from being one of the rarest to one of the fastest growing cancers among people exposed to agricultural chemicals.

A detailed scientific analysis of organic fruits and vegetables published in the peer-reviewed journal *Food Additives and Contaminants* showed that organic foods have significantly less pesticide residues than conventionally grown foods.

The nitrate content of organically grown crops is usually significantly lower than that of conventionally grown products. The governments of Germany and France have encouraged conversion to organic farming in certain areas in a bid to improve water quality, particularly in relation to its nitrate content. [High nitrate can cause Blue Baby syndrome, tiredness, and a general feeling of being unwell.]

"... as little as one-tenth of a part per billion of one commonly used herbicide can damage reproductive systems.... Exposures of minute quantities of agricultural chemicals are very significant for children."

Conclusion

The FAO states the case very succinctly: "It has been demonstrated that organically produced foods have lower levels of pesticide and veterinary drug residues and, in many cases, lower nitrate contents. Animal feeding practices followed in organic livestock production also lead to a reduction in contamination of food products of animal origin."

The facts show that organic food has significant health benefits because it has negligible chemical residues and pathogens and higher nutritional values when compared to conventionally farmed food. ❐

15-Minute Soils Course

Lesson 31:

Magnesium (Mg): The Element of Life

Closely related to calcium on the Period Table of the Elements, magnesium is an essential plant element that comprises from 0.12 to 1.50% of soils across the globe. In highly weathered soils that percentage may average 0.3%, giving 6,000 lb per acre-furrow slice, but in most arid region soils the content may average twice as much.

12	24.305
Magnesium	
648.8	1090
Mg	

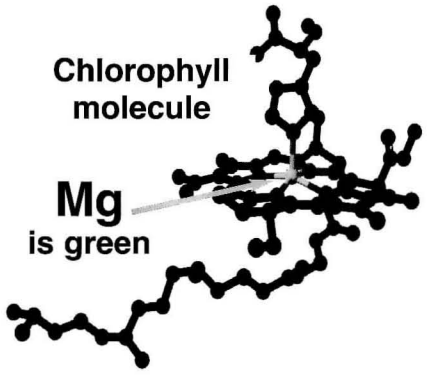
Plants contain approximately the same general levels of Mg as the soil, as can be seen from the table below. The element is taken up by the roots at exchange sites through contact exchange, or by the transport of mycorrhizal fungi, since Mg is a rather immobile element. Other ions present at high levels can greatly depress its uptake, such as potassium (K^+), ammonium (NH_4^+), calcium (Ca^{+2}), manganese (Mn^{+2}), and even hydrogen (H^+) at low pH. The acute disease of cattle called *hypomagnesemia* is caused by cattle grazing on forage recently fertilized with potassium, resulting in a low level of Mg in the vegetation.

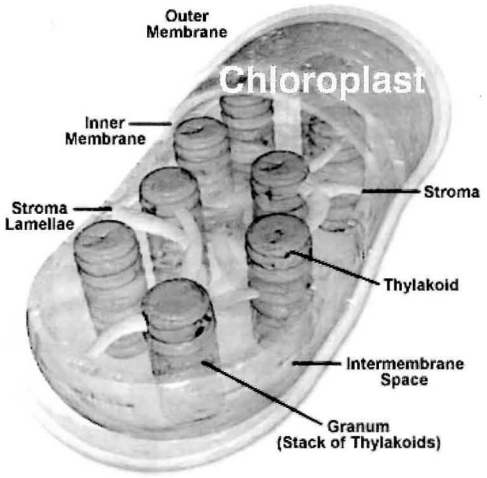
Plant	Mg content, % Nebraska	Mg content, % Georgia
Wheat, boot stage	**0.12 - 0.80**	**0.15 - 0.50**
Corn, ear leaf	**0.15 - 0.30**	**0.13 - 0.30**
Alfalfa, top 6 inches	**0.30 - 1.00**	**0.25 - 1.00**
Soybeans, mature trifol.	**0.30 - 1.00**	**0.25 - 0.80**

What Magnesium Does

Magnesium has a small ionic radius and a very high hydration energy (1,908 jouls/mole), meaning that it will hold water tightly, more so than calcium. Thus, when the magnesium saturation of the exchange sites of the soil exceeds about 18% there is a tendency of the soil to become compacted due to a reduction in pore size. Calcium, with a lower hydration energy, tends to flocculate soils and increase pore size.

◆ **Chlorophyll and protein synthesis.** Chlorophyll has as its nucleus a magnesium ion, coordinated within a porphyrin ring (see the diagram on the right). This complex molecule that makes all life possible on earth, due to its ability to direct sunlight energy into chemical bonds within the chloroplast, begins as an iron-coordinated heme molecule, identical to the hemoglobin of blood. Enzymes containing Mg catalyze the replacement of the Fe with Mg. Magnesium is also necessary for the enzymatic breakdown of chlorophyll. Besides, Mg is a bridge to aggregate subunits of ribosomes during protein synthesis; too little Mg causes protein synthesis to stop. It is also required for the enzymes producing RNA (ribonucleic acid) in the nuclei of cells. In leaf cells, 25% or more of the Mg is concentrated in chloroplasts, the center of chlorophyll and photosynthesis.





◆ **Enzyme activation and phosphoryla-**

15-Minute Soils Course

tion. Many enzymes and enzyme reactions require Mg, or are strongly enhanced by this element. Examples include the transfer of phosphate or carboxyl groups, as well as energy reactions involving ATP and the synthesis of starch.

◆ **Carbohydrate partitioning.** A deficiency of Mg tends to reduce the transport of starch and sugars to roots, and leads to their accumulation in the leaves.

Magnesium Deficiency

Chlorosis of fully expanded leaves is the usual deficiency symptom of Mg. In these leaves the synthesis of protein is depressed and the proportion of nonprotein nitrogen is increased. Photosynthesis rates drop, and carbohydrates accumulate. Yet, if the Mg deficiency is only slight it is oftentimes reversed as the plant matures, and yields may not be depressed if the Mg level was high enough during grain or fruit formation.

Magnesium fertilizers include those in the box below. If the percent base saturation of the soil is below 12% Mg, then dolomitic limestone application is a typical and fairly inexpensive way to increase this deficit. Applications may vary from a ton/acre or less for sandy, low cation exchange capacity (CEC) soils, to 2 or 3 tons per/acre for high CEC soils, those containing more clay and organic matter. If a deficiency of Mg is noted in the growing plant, a spray of up to about 4 pounds/acre of Epsom salt is effective, oftentimes along with some nitrogen and Vitazyme biostimulant.

Magnesium Fertilizer	Mg, %
Epsom salt ($MgSO_4 \cdot 7H_2O$)	9.6
Kieserite ($MgSO_4 \cdot H_20$)	18.3
Potassium Mg-sulfate	11.1
Magnesia (MgO)	55.0
Dolomite [$Mg,Ca(CO_3)_2$]	12-15

To maintain adequate uptake of all nutrients from soils, a highly active rhizosphere is the best insurance. The regular return of crop residues and manures – both plant and animal – is best. Natural ecosystems abound with animals such as bison, deer, and antelope, which return their manure to the soil. We would do well to emulate these natural systems as closely as possible within our own management systems for optimum plant nutrition. ❐

See What You Learned

1. Magnesium is especially noted for its importance in _____ in plants.
2. Chlorosis of leaves is a typical symptom of magnesium deficiency: T or F
3. Typical Mg fertilizers include a. dolomitic lime, b. Epsom salt, c. potassium Mg-sulfate.
4. Magnesium can cause compaction with a high base saturation due to its high _____.
5. Chlorophyll and protein synthesis in plants require Mg. T or F
6. The chemical structure of chlorophyll is nearly identical to that of _____ in blood.
7. *Hypomagnesemia* is an acute disease in livestock caused by grazing on forages recently fertilized with high rates of calcium. T or F.

Answers: photosynthesis; 2. T; 3. a, b, c; 4. hydration energy; 5. T; 6. hemoglobin 7. F.

Maximizing Phosphorus Efficiency

By Paul W. Syltie, Ph.D.

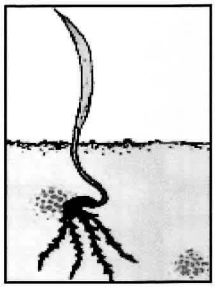
In an age of high and erratic phosphorus fertilizer prices, it pays to make the maximum use of one's fertilizer dollars. Besides, maintaining adequate soil phosphorus levels for plants continues to be a major problem for farmers, especially with the advent of modern cultural methods that have minimized the activity soil biota, especially mycorrhizal fungi.

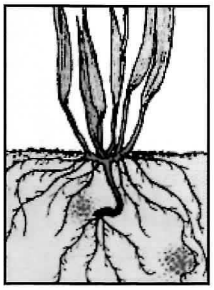
In natural ecosystems, these mutualistic fungi scavenge the soil volume well beyond the root and bring in up to 80% or more of the phosphorus the plant requires. Note the figure below: the roots are yellow, while the vast network of white appendages are the hyphae of the mycorrhizae. This network expands into the soil around the roots, absorbing phosphorus and other immobile nutrients, and then transporting them to the root where they are exchanged into the root cortex cells for plant use.

Research has shown conclusively that in acid soils any applied phosphorus — be it orthophosphate or polyphosphate — will quickly convert to the immobile and very insoluble forms of iron and aluminum phosphates. Similarly, at high pH, when calcium is readily available, very insoluble calcium phosphates are quickly formed. Much less than 1% of the total phosphorus in the soil will be available at any time.

When organic matter is low, and mycorrhizal fungi are inhibited, there are a number of management practices that will aid in the utilization of soil phosphorus.

1. Band the fertilizer. This advice is good for most fertilizer elements, but especially for phosphorus. The band is applied at planting near but not on the seeds, and at a rate that is not too high to injure seedlings as they germinate. For instance, in eastern Washington a 7-inch band spacing for wheat will exhibit reduced germination with 892 lb/acre or higher of 0-46-0 (triple superphosphate). By banding, the roots will be in the vicinity of the nutrients and take them up more efficiently than if they were broadcast (see above).





2. Use polymer coated phosphorus sources. These are more costly than conventional uncoated phosphorus fertilizers, but will release the element slowly, at a rate more adjusted to plant needs. Then less of the element will become fixed by iron, aluminum, or calcium. However, it is possible that early in the season, when temperatures are cool, the release will be too slow for plant needs, so a mixture of coated and uncoated phosphorus sources may be preferable.

3. Apply some nitrogen fertilizer, such as urea, with the phosphorus in a band. The extra nitrogen will help the plant utilize the phosphorus, partly by increasing the pH in the vicinity of the granules due to urea hydrolysis.

4. Use a medium sized fertilizer particle of about 0.025 mg if the choice is available. At high application rates the particle size becomes less important..

Even during the best scenario, only 20 to 30% of the applied phosphorus may be utilized by the crop due to rapid fixation of the applied fertilizer. To improve utilization efficiency, it is critical to maintain a vigorous growth of soil fungi (especially mycorrhizae), bacteria (which includes phosphate-dissolving types), actinomycetes, protozoa, earthworms, and other species. This microbial enhancement can be achieved through a judicious return of crop residues, the addition of manures, compost, and other organic materials, and the use of metabolic stimulating products such as fish, Vitazyme, or humates. ❐

Storms Becoming More Intense?

By Paul W. Syltie, Ph.D.

There is increasing evidence that the weather is turning wilder as the years pass. While we can be assured that the climate will always be changing, concrete research reveals that in Iowa, based in 113 years of records, while in the 1890s there were an average of 60 days of precipitation per year, now the average is 120 days. Such a dramatic increase has made tillage, planting, and harvesting operations more difficult. In recent years, planting of some fields in the Midwest has been impossible.

The frequency of heavy rainfall events has also increased across the country. In the Midwest, based on data from 3,445 weather stations, in the past 60 years serious downpours have become 24% more frequent; in New England, 60%!

In the Great Plains, the frequency of hail storms has been increasing for some time. According to National Weather Service estimates, 100-year floods in Iowa are occurring every 20 years instead, such as the serious flooding in eastern Iowa during 2008.

While flood frequency is increasing in some areas and decreasing in others, it is generally increasing, up to 30%. The reasons for such increases may be tied to solar output, but the complexity of the atmosphere will likely make it impossible to understand all of the reasons. One thing is certain: we need to hang on for the ride! ❐

[Based on The Furrow, *February, 2010.]*

Glyphosate Resistance Found in Kochia

[Excerpted from a Kansas State University article, March 1, 2010]

Kansas State University scientists have completed long-term evaluations of a limited number of independent kochia (*Kochia scoparia*) populations on privately-owned land in western Kansas that are now confirmed to be glyphosate-resistant. These populations have undergone both greenhouse and field testing by K-State and Monsanto personnel.

Kochia, also called fireweed, is a drought-tolerant weed commonly found in cropland, rangeland, pasture, and non-agricultural sites in arid and semi-arid regions of the western United States and Canada. Kochia is highly adaptable and grows on many soils including saline and alkaline soils.

Phil Stahlman, who is a weed scientist with K-State Research and Extension, has listed as many as five glyphosate-resistant kochia populations in western Kansas on the International Survey of Herbicide Resistant Weeds website (www.weedscience.org) following lengthy evaluations of greenhouse and field studies. He, along with K-State scientists Kassim Al-Khatib, Curtis Thompson, and other colleagues, including Monsanto scientists, have investigated the sites independently, focusing on the variability of the resistance and difficulties in proving heritability — a trait required for confirmation of resistance.

Kochia resistance to glyphosate is another example of how nature informs us we have taken a wrong turn,

"This complicates and may increase control costs for those growers who may have a resistance problem, but there are other herbicides that can be used to control kochia," said Stahlman, who is based at K-State's Agricultural Research Center at Hays, Kansas....

Stahlman said there is evidence that a glyphosate-resistant kochia population from Thomas County does not grow as well as a known susceptible population. Thompson, however, reported a glyphosate-resistant kochia population from Stevens County is more aggressive than a nearby susceptible population....❐

How to Reach Your Goal

In 1976, Patrick Quesnel rowed a 22-foot dory 2,000 miles across the Pacific from Hawaii to the coast of Washington. Four things helped him do it:

1. Health. **Quesnel ate right, got plenty of sleep, and worked out regularly. He got his body into proper shape for the ordeal.**

2. Preparation. **He planned the voyage in detail, obtained an excellent boat, sturdy ashwood oars, a waterproof radio, plenty of canned food, and reading matter. He forgot nothing.**

3. A definite routine. **Quesnel rowed for 50 minutes of every hour, 8 to 10 hours a day. He read for 10 minutes of each rowing hour, disciplining himself to stop in the midst of a sentence rather than break his routine.**

4. Faith. **Quesnel was confident he would reach his goal, and did not become discouraged when his efforts seemed inadequate. When he was dashed about for a week by stormy seas and could no nothing but shiver under the dory's tarp, he did not lose hope. He just waited until the seas calmed, and then went back to rowing.**

***On the Upbeat*, August, 1978.**

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 or Email it to us.

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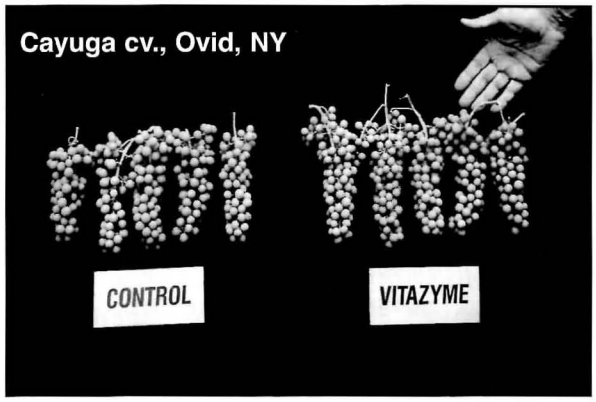
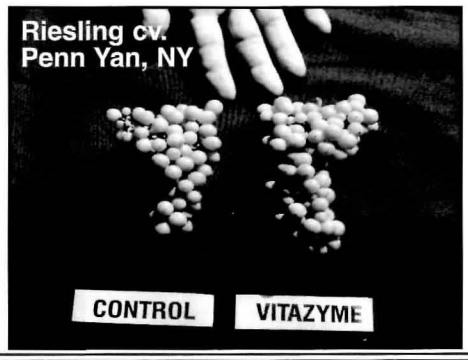
Vitazyme in New York during 2009 produced grapes of excellent size and quality in a series of studies in the Finger Lake region. Berries per cluster, cluster weight, and brix were uniformly increased for three vineyards. See results in *Vitazyme 2008 Field Trial Results*!





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