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Designing the Agriculture of Tomorrow

Using Nature's Principles to Optimize Health

By Paul W. Syltie, Ph.D.

We live in a world of opposing world views. Some believe the world we now live in is the best of all worlds—or at least it should not and cannot be changed—while others believe there must surely be something better. Those who believe in a better world have widely differing views of what that renewed world might to be like.

While I do not propose to be the final judge of these differing proposals put forward by ecologists, politicians, historians, businessmen, farmers, or anyone else, I will put forth a few facts that not too many of us will disagree with as a starting point in evaluating what sort of a world would be best for us all.

1. The soil forms the basis for life of all living beings on the face of the earth.

2. Health, defined as "the state of being free from illness or injury, and a person's mental and physical condition," is the most priceless possession we have.

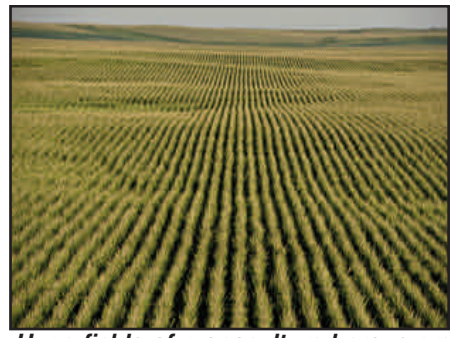
3. There is an intimate and direct connection between the health or condition of the soil, of the plants that grow on it, and of the health of the people and animals that consume those plants.

4. Most people, if given the choice, would rather possess a piece of land and be self-sufficient than exist in a city.

5. The beauty of our surroundings is highly important to our well-being.

We are formed from the elements of the earth through the food we eat, the water we drink, and the air we breathe. Does it not make sense, then, that we ought to first look at the soil beneath our feet, and the crops that grow from that soil, to investigate which system of agriculture in this world best complements maximum health of the people living on that earth?

The answer is an obvious "yes!" When such agreement is asserted, then one is immediately thrust towards the question of what governs the best manner to grow those food crops, and what types of crops should be grown. Here are those two terms that we see so often: genetics and environment, the qualities that make all of us what we are as individuals, the same two quali-



Huge fields of monocultured crops are the rule in modern American.

Mixed small-scale vegetable, grain, and fruit culture is an option. Which environment is your preference?

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Biostimulants Go Mainstream

After Decades of Scorn, Acceptance is Here

Substances called biostimulants have a colored history that can be traced back to ancient times. In the past few centuries, farmers in the Alps would mix clayey soil in a barrel of water and stir it, singing into it an ascending scale during rotation to the right, and a descending scale while rotating the liquid to the left. This water would then be sprinkled across the field with a stout leaf applicator for improved crop performance. According to the farmers, this concoction truly did work.[1]

Nowadays, science nearly always leads the way toward new innovations in agricultural production, researching a new technology and either recommending its use or abandonment. Such has not been the case, however, with biostimulants. In fact, the reverse has been true: farmers have increasingly been using them in spite of a lack of academic encouragement, and now science has begun to research them for efficacy, though sometimes grudgingly so.

Biostimulants can greatly improve crop growth, as in this corn trial. Vitazyme was applied in-furrow (left).

This progression of events is quite unique within our system. Why are these materials finally being accepted by many scientists after decades of rejection by mainstream agricultural research? The answer is simple: because they work, or at least some of them do. They cannot all be put into one basket because they are

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The Laws of Nature Hold Sway

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ties that make up every living being here on earth.

A close inspection of the natural world uncovers some most fascinating principles—laws, if I may call them that—that operate within every properly functioning ecosystem. It is the degree of conformity to these laws that determine the health and vitality of the ecosystem, be it a forest or a prairie environment.

The revered agriculturalist from England, Sir Albert Howard, who lived and worked during the mid-20th Century, was a generalist who shunned conventional agricultural research methods in favor of practical on-farm testing. His research, conducted mainly in India over a 25-year period, led to the writing of *An Agricultural Testament*[1] and *The Soil and Health*[2], in which he showed how the use or organic manures enrich the soil and the health of the people who lived from its produce. He is considered to be the father of the modern organic method.

His ideas were distilled into seven laws which all natural ecosystems follow, and which are shown in the box to the right. Notice that all of these laws emphasize the recycling of both mineral and organic matter back to the soil to maintain excellent soil fertility, soil-water relationships, strong structure, a vibrant soil organism population, and protection from erosion. On top of that is superimposed a mixed culture of perennial crops, from trees to shrubs and grasses, both monocots and dicots, plus animals to complement adapted plant species.

The Laws of Nature

1 **Mixed farming is the rule..** Plants are always found with many species of plants and animals living together. There is never an attempt at monoculture.

2 **The soil is always protected from the action of sun, rain, and wind.** All of the sun's energy is used in the forest canopy and undergrowth, and much in the prairie ecosystem. Leaves break the force of raindrops to a mist or splatter, and roots and structural units bind the soil together.

3 **Rainfall is carefully conserved.** Much water is retained in the surface soil, and excess is gently transmitted downward through pores and cracks along structural units.

4 **The forest and prairie manure themselves.** A persistent rain of organic matter — leaves or grass — settles on the soil surface where scores of bacteria, fungi, and other organisms break it down to humus and plant nutrients.

5 **Mineral matter needed by trees and grass is obtained from the subsoil.** These minerals are also recycled through vegetation as it falls, and decomposes on the soil surface. No phosphate, potash, or other minerals need to be added to a properly functioning system.

6 **Soils always carry a large fertility reserve.** These reserves are contained in the humus of the surface horizons as well as in the native minerals of the soil mass.

7 **Crops and livestock look after themselves.** No spray machine or vaccine is supplied in nature, only natural immunity to diseases and insects that will hold at bay the pests that are usually present. Nature's rule is "Live and let live".

In Steps Ann Clark

Let us search further to discover the type of environment that needs to be built to fulfill these laws on the land. It is a system that Dr. Ann Clark alluded to in her message The Future Is Organic: But It's More Than Organic.[3] What did she mean?

Her thesis is based upon a revolution in energy for agriculture, with petroleum being replaced by other forms of power. She also believes that post-oil "design drivers" will necessarily demand not just organics, but novel agri-food systems emphasizing local/decentralized food production, and seasonal consumption expectations from minimally processed foods.

However, organic is not enough. Ecological soundness requires a de-emphasis on annual cropping coupled with the re-integration of livestock, both to mimic the principles that sustain nature and to dramatically reduce dependence on fossil fuels. ***We must acknowledge that agriculture was not designed to be sustainable!*** Thus, farmers' efforts to make it sustainable are doomed to failure when its underpinnings are by their very nature unsustainable.

So, what will drive the design of agriculture in the future? Arguably, according to Dr. Clark, the overriding design driver from which everything else will follow will be the displacement of systems dependent on stored fossil fuel with systems centering on current solar fuel. In simplest terms, living on current rather than stored solar energy is an absolute prerequisite to inter-generational equity, enabling our children, and indeed all of the earth's children, to be sustained in the future.

Organic standards do indeed help us to avoid many of the needless harms we've imposed upon ourselves in recent decades. But, as practiced today, most organic farms are still ecologically unsound.

How can that be? Several issues can be mentioned, a major one being the one-way nutrient movement from farm to city, or overseas by an export-oriented agriculture. Another major issue is the over-reliance on large-seeded annuals. What is wrong with large-seeded annuals (corn, soybeans, etc.)?

Dr. Clark makes the same claim that Albert Howard made, that nature is the only true and certain model of ecological soundness. In North America, the type of vegetation adapted to most areas is perennial: trees and grasses. An agriculture of annuals is inherently unnatural to the land, so an ecologically sound agriculture—including organic agriculture—will necessarily rely less on annuals and more on perennials, with a central role for grass-fed livestock.

The Future in Summary

1. The future, which is coming faster than most of us think, will be organic.

2. Agriculture, as much of modern society, evolves in response to forces or drivers. Arguably, the dominant drivers in our recent past were cheap oil and the willingness of society to tolerate costs external-

See An Eden Will Be Established, page 3

An Eden Will Be Established Some Day

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ized by seemingly efficient mega-scale production and processing.

3. Drivers change, and the system they drive necessarily also changes. Post-oil realities will advantage small-scale, organic, locally-sourced, seasonal, and minimally processed food, just as cheap oil selected for bigness, resource-based production, globalization, and processing, packaging, and refrigeration.

4. For much of North America, agriculture—including organic agriculture—is not ecologically sustainable, in part due to the absence of perennial forages, and hence, livestock to convert the forage into human-edible food.

The need for beauty on our surroundings is just as critical for abundant, healthful living as is the sheer growing of food crops. City environments are thus not an appropriate place for families to grow and prosper, nor is a countryside of boringly endless miles of monocultured annual crops. The Garden of Eden, man's perfect environment, was noted for "... every tree that was pleasant to the sight and good for food" (Genesis 2:9), showing that the production of optimum quality food crops and beauty of the environment go hand-in-hand, and should not be in conflict as in today's world.

It goes without saying that the varieties of plants for this renewed agriculture must provide optimum quality to sustain the highest levels of vitamins, minerals, antioxidants,and other health-enriching components. With perennials the rule, then hybrids and GMOs will not qualify for this new system. Compare that with the current array of supermarket foods of which 70% contain GMOs—mostly corn and soybean products—and most food crops are hybridized, which are inferior in nutritional value compared to natural, open-pollinated varieties.

Most people would prefer to live in an Edenic environment compared to where they live now, if they had a choice. The Laws of Nature predict that agriculture's future is in Eden's direction.

Tomorrow's agriculture will be designed around the Laws of Nature that operate within a natural forest of prairie environment. The health and well-being of people will come first, rather than the profits of corporations, and beauty of the landscape will be of the highest priority to grant life its highest pinnacle of enjoyment.

You can count on it. It is only a matter of time for these laws to win, for, as Horace once said, "You may drive out Nature with a pitchfork, yet she still will hurry back." ❒

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The GMO Labeling Battle Continues

Extracted from Just Label It!
http://www.justlabelit.org

Fifty countries have mandatory labeling. We're one of the only developed countries that doesn't. GMOs are labeled in China, Russia. Why would consumers in those countries have this information and we not have it here?" said Megan Westgate, executive director of the the Non-GMO Project, a group that verifies and labels products as free of genetically altered ingredients.

In the European Union, where labels are required, some manufacturers have started using non-GM ingredients to avoid labels that, warranted or not, raise red flags for some consumers.

The debate over labeling is nothing new. Genetically engineered crops were first cleared for approval in the US in 1996, but even before then, some consumers worried that they had not been adequately safety tested or that they might cause allergic reactions. Some consumers say they want to avoid genetically modified foods for ethical reasons.

Pro-labeling advocates say the matter is simple—an issue of a consumer's right to know. But the biotechnology industry calls it more complicated. The FDA has long held that genetically modified foods are "substantially equivalent" to, and as safe as, naturally-derived foods. Therefore, they shouldn't require a label.

With an estimated 60 to 80 percent of processed food in an typical American grocery store containing genetically modified ingredients, the price of labeling them all—and of tracing the ingredients through the system—could be significant.

"The more GMOs you have in the market, and the more they're in products that are mixed and matched through the supply chain, the cost of separating them is not trivial," said Nicholas Kalaitzandonakes, a University of Missouri economist.

Advocates for labels point to survey after survey showing that 80 to 90 percent Americans want the information. Labeling advocates question the industry's insistence that labeling is too complicated or costly.

"Of course it's feasible," Andrew Kimbrell of the Center for Food Safety said. "Most of the world is doing it. We know it's feasible. We know it's traceable. Virtually all of our major trading partners are labeling. If they're doing this for the rest of the world, what's the problem with letting us know?" ❒

Supermarket foods that contain GMOs (unless organic)

Dairy and eggs. rBST milk, and animals and birds are fed GM grains.
Meat. Nearly all animals are fed GM feeds.
Fresh produce. GM sweetcorn is now available.
Cereals. Most corn, soybean, and milk products, and HFCS are GM.
Cookies, snacks, chips. Nearly all have GM HFCS and GM oil/additives,
Ice cream, frozen prepared meals. Nearly all contain GM corn, sugar beets, and soybean products,
Oils, shortening, fats. Any vegetable oil or shortening is GM.
Condiments, prepared foods. All contain GM corn, soybean, or canola
Bread, crackers. Nearly all are made from GM HFCS and soybeans.

15-Minute Soils Course

Lesson 42:

A Lesson in Philosophy: Natural Laws Show How to Manage Soils and Crops

The Laws of Nature, which operate more-or-less perfectly in a native, undisturbed forest or prairie ecosystem, teach us a lot about how we ought to care for the soil beneath our feet. These rules are outlined on page 2 of this issue.

A casual look at these points reveals just how far from the Laws of Nature our modern agribusiness-oriented farming systems have strayed. The use of tillage, herbicides, pesticides, commercial fertilizers, heavy machinery, annuals, unnatural genetics for crops, and other modern innovations have pushed the farmer into near-total reliance on petroleum-based energy. With oil a finite resource, which is dependent on a steady supply of electrical power even to fill the fuel tank, this system we have devised is a very unstable and short-term one, out of sync with the principles of natural soil management.

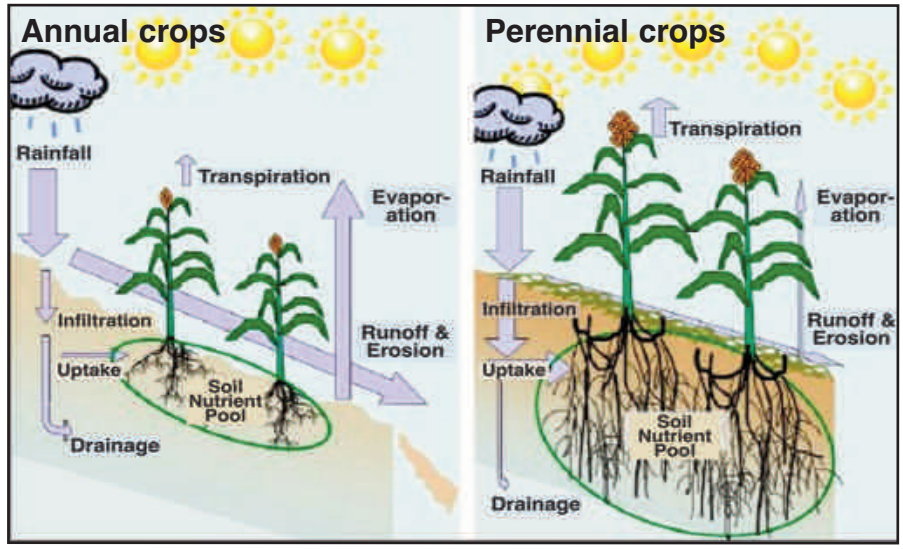
Some of the ideas expressed in this lesson may seem outlandish and unrealistic. Nevertheless, they are potential solutions if an effort is made to enact them. Remember, this is a lesson in philosophy, and all new ideas must have a philosophical underpinning.

Practice Mixed Farming

Our forefathers nearly usually raised livestock along with their crops. Most early homesteaders in American had cows, sheep, goats, and hogs for milk, cheese, butter, and meat, oxen or horses for transportation, chickens for eggs and meat, and perhaps turkeys or other animals or birds that provided food for the family, as well as manure for spreading back on the land of the crops whose harvest was used to feed them. People today could do likewise, rather than raise cattle and sheep in huge feedlots, and chickens and turkeys in massive barns.

Always Keep the Soil Covered

Anyone who has traversed forest or prairie has noted that all of the soil is covered, either by growing trees with their leaf canopies or stands of native grasses and broadleafed plants. In the winter there is dried plant residue or leaves, held together by a stubborn complex of roots and stable soil structure. Never is the soil left uncovered by tillage to endure the direct impact of soil-dislodging raindrops.



Conserve Rainfall

A native growth of trees and perennial crops—grasses, legumes, and other species—and their profuse rooting is essential for building a strong soil structure that invites the rapid intake of rainfall, and helps build the deep channels that move water quickly to the water table. Earthworms and ants build channels to hasten the process, and a continuous vegetation cover prevents beating raindrops from forming a water-resistant crust or encouraging erosion.

15-Minute Soils Course

Plants Manure Themselves

Leaves from the trees and plants growing on the soil die in the fall—or age and fall in tropical areas—and provide the organic residues that feed earthworms, mites, bacteria, fungi, protozoa, and the trillions of other microbes that break down the organics to humic substances, long-term plant nutrient stores, and build strong soil structure. Animal manures add valuable organic substances and microbial inoculum. Also, these microbes mix the soil. Modern minimum-tillage farming has moved in this direction.

Minerals from the Subsoil

Roots of natural forests and prairies search deeply for nutrients, roots penetrating 10 feet or more to search out and absorb nutrients for the current growing cycle, and then deposit those elements through leaf fall to enrich the topsoil. The return of manures from livestock further enriches these recycled nutrients in topsoil.

A Large Soil Fertility Reserve

Rather that rely on commercial fertilizer applications, the forest and grassland store nutrients in the organic matter-enriched topsoil, sourced from the subsoil and regular cycling of nutrients through leaf fall, without elements being lost through erosion.

Plants and Animals Attend to Themselves

Rather than plants being doused with herbicides, fungicides, and livestock with antibiotics or growth hormones, natural immunity to disease is enhanced through optimal nutrition supplied by a properly functioning ecosphere.

A farming system without tillage, using adapted plant and animal species that are left to fertilize the land without outside commercial fertilizer sources, without the need for herbicides or pesticides, nor the need for huge tractors and petroleum energy, livestock roaming the pastures and grasslands and spreading their own manure, perennial plant species not requiring the annual purchase on new seeds...that is a system worth striving for. It will necessitate families moving to the land, a new resettling of America, and that involves political will. It is possible, but will we do it? ❐

Mixed farming, the raising of livestock along with field crops and the recycling of manure, is a rule of nature we ought to follow, but have gotten away from.

See How Much You Learned

1. Perennial crops are better than annuals because they a. have deeper root systems, b. save the farmer money in seed costs, c. reduce soil erosion, d. have more leaf chlorophyll.

2. Mixed farming is a system involving the production of both _____and_____.

3. The root mass of trees and grass is very effective at reducing soil erosion. T or F

4. Soil _____is highly important in insuring that rainfall will infiltrate quickly into the soil.

5. Ways to encourage natural soil fertility include a. planting deep-rooted perennials, b. grazing livestock, c. keeping soil covered, d. burning residues.

6. The use of petroleum-based technologies is a good way to ensure long-term agricultural productivity. T or F.

7. Having the soil always covered by crop residues or growing crops shields the soil from the impact of _____.

Answers: 1. a, b, c; 2. crops, livestock; 3. T ; 4. structure or residue cover; 5. a, b, c; 6. F; 7. raindrops.

A 12.5% Annual Growth Rate Predicted

Continued from page 1

so diverse, and some of them have been proven quite ineffective at stimulating plant growth and yields.

Plant biostimulants include diverse substances and microorganisms that enhance plant growth. The global market for biostimulants has been projected to reach $2,241 million by 2018 and to have a compound annual growth rate of 12.5 % from 2013 to 2018[2]. The European Biostimulants Industry Council (EBIC) reported that in 2012 over 6.2 million hectares (15.3 million acres) were treated with biostimulants in Europe, the largest market in the world.

Resistance to Acceptance

There has been significant resistance to their acceptance by plant and soil scientists. Some major points of resistance have been as follows.

1. Application rates of active agents, such as brassinosteroids, in the range of 20 to 50 mg/ha (about 0.5 oz/acre), were seen as impossible to produce growth effects, compared to fertilizers and manures that are applied at pounds or tons per acre.

2. A lack of understanding of how these materials can work has impeded research on them. In many cases the active agents have not been identified, making many scientists suspicious of them.

3. Many scientists are heavily funded by large agrochemical firms having huge research budgets, which can monopolize academic research programs. Many,promoters of new and novel biostimulants have formed small, sometimes poorly funded companies that simply cannot afford expensive research.

4. Since many biostimulants are organically oriented, there is a definite bias against them in the minds of many research scientists, whose upbringing, education, and research funding have emphasized typical agribusiness inputs.

Things Have Changed

Several changes have occurred over the past few years to change the landscape in this area. First, many other products, in particular herbicides like QuickSilver (carfentrazone-ethyl), appeared in the market. They are applied at very low rates, in this case only 0.1 lb of active ingredient per acre,[3] in the same range as the active ingredients of many biostimulants.

Second, the number of peer reviewed articles concerning biostimulants have slowly increased in spite of the unfriendly landscape. In a recent review article by Calvo, Nelson, and Kloepper entitled Agricultural Uses of Plant Biostimulants[4], nearly 400 references are cited, most of them related to such novel products. Their article dealt only with microbial inoculants, humic acids, fulvic acids, protein hydrolysates, amino acids, and seaweed extracts, but there are many other very effective materials.

Third, the positive responses to biostimulants keep coming. A case in point is the product Vitazyme. Since 1995 over 900 replicated and split-field trials have been conducted, which have shown a consistently high success rate in terms of yield improvement and other positive growth effects. Yet, finding research scientists within the Land Grant University system to evaluate this excellent biostimulant has been very difficult, and in many cases impossible.

A Summary of Effects of Biostimulants

(This is a partial list, not common to all products.)

- Increased root growth rate and root mass
- Increased leaf and stem growth
- Improved fertilizer fertility utilization, especially with nitrogen
- Greater drought tolerance
- Increased tolerance of soil salinity
- Higher yields of leaves, roots, grain, and other plant parts
- Better pollination, blossoming, and fruit set
- Greater disease resistance and better immune response
- Improved rhizosphere microorganism activity and diversity
- Better soil structure and porosity

The Field Is Still Young

The definition and concept of plant biostimulants is still evolving, which is partly a reflection of the diversity of inputs that can be considered to be biostimulants. One definition states, "Plant biostimulants contain substance(s) and/or micro- organisms whose function when applied to plants or the rhizosphere is to stimulate natural processes to enhance/ benefit nutrient uptake, nutrient efficiency, tolerance to abiotic stress, and crop quality. Biostimulants have no direct action against pests, and therefore do not fall within the regulatory framework of pesticides."[5] Hence, this definition differentiates plant biostimulants from biological control and from induced resistance against diseases by concentrating on effects related to improved plant growth, stress tolerance, and quality.

The EBIC concept of biostimulants includes products with some nutrients, provided that the effect on plant growth is not through direct fertilization.

Interest Is Growing

The interest in biostimulants is underscored by the convening of the first world congress on the use of biostimulants in agriculture, held in Strasbourg, France, in November of 2012. This meeting was attended by over 700 people from 30 countries. A second congress was held in November of 2015 in Florence, Italy, with about 1,100 in attendance. The congresses have aimed at bringing together individuals working on aspects of biostimulants in industry, academia, and regulatory agencies.

The future of biostimulants is very bright, but only if they truly work. Some charletons early on in the quest to invent and market these materials deserve some of the blame for their lack of acceptance. Thus, the name "snake oil" was applied to them by some detractors.

It is expected that the number of these materials will continue to grow during the coming years, and the involvement of large agribusiness firms will also increase. Biostimulants have their place on the farm, just as they did in the Alps of Switzerland and Austria centuries ago. Farmers of today would be wise to use these new technologies, and add that extra yield and quality to their crops. ❐

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Carbon Dioxide Is a Good Friend

By John Carlisle

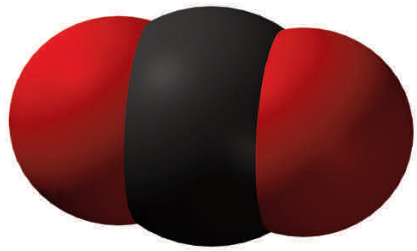
[*This article is abridged from Carbon Dioxide is Good for the Environment, in response to global warming advocates who claim it is a pollutant*.]

Far from being a poisonous gas that will wreak havoc on the planet's ecosystem, carbon dioxide is arguably the earth's best friend in that trees, wheat, and other plants significantly benefit from increased levels of atmospheric carbon dioxide.

Dr. Craig Idso of the Center for the Study of Carbon Dioxide and Global Change, one of the nation's leading carbon dioxide research centers, examined records of atmospheric carbon dioxide concentrations and air temperature over the last 250,000 years. There were three dramatic episodes of global warming that occurred at the end of the last three ice ages. Interestingly, temperatures started to rise during those warming periods well before the atmospheric carbon dioxide started to increase. In fact, the carbon dioxide levels did not begin to rise until 400 to 1,000 years after the planet began to warm. Concludes Dr. Idso, "Clearly, there is no way that these real-world observations can be construed to even hint at the possibility that a significant increase in atmospheric carbon dioxide will necessarily lead to any global warming."[1]

Scientists have lots of evidence demonstrating that increased carbon dioxide levels lead to healthier plants. A team of scientists in Nevada conducted a five-year experiment in which they grew one group of ponderosa pine trees at the current carbon dioxide atmospheric level of about 360 parts per million (ppm), and another group of pines at 700 ppm. The doubled carbon dioxide level increased tree height by 43 percent and diameter by 24 percent.[2]

Carbon dioxide also makes plants more resistant to extreme weather conditions. In a study discussed in the journal *Plant Ecology*, a team of scientists subjected a Mojave Desert evergreen shrub to three different concentrations of carbon



dioxide—the current level of 360 ppm, and 550 and 700 ppm. The plants responded more favorably in the enhanced carbon dioxide environments. Photosynthetic activity doubled in the 550 ppm environment and tripled at 700 ppm. Increased photosynthetic activity enables plants to withstand drought better.[3]

Dr. Robert Balling, a climatologist at Arizona State University, notes that by making plants healthier and more resistant to extreme weather conditions, higher levels of atmospheric carbon dioxide expands the habitat of many plants, improves rangeland in semi-arid areas, and enhances agricultural productivity in arid areas.[4]

Another benefit of enhanced atmospheric carbon dioxide is that it helps the tropical rainforests.[5] [An] enriched carbon dioxide environment stimulated tree root growth by 23 percent. Expanded root systems help tropical trees by increasing their ability to absorb water and nutrients.[6] ❐

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Some words from Thomas Jefferson

"I know no safe depository of the ultimate powers of the society but the people themselves ; and if we think them not enlightened enough to exercise their control with a wholesome discretion, the remedy is not to take it from them, but to inform their discretion by education. This is the true corrective of abuses of constitutional power."

— Thomas Jefferson, *Letters of Thomas Jefferson*

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Vitazyme Improves Nitrogen and Water Efficiency

A study conducted by Dr. David Clay and Graig Reicks at South Dakota State University, at the Aurora Research Farm in 2014 (photo 1), revealed that Vitazyme improves corn yield, while significantly increasing the efficiency of nitrogen and water utilization. The season was wet and yields in general in the area were high, but even so a typical high nitrogen rate of 125 lb/acre produced superior leaf and stalk growth (photo 2), and expanded the root mass considerably above the non-Vitazyme treated control(photo 3). Ear size was noticeably increased in representative ears sampled at harvest time (photos 4 and 5). Note the longer and wider ears with Vitazyme treatment.


(1)

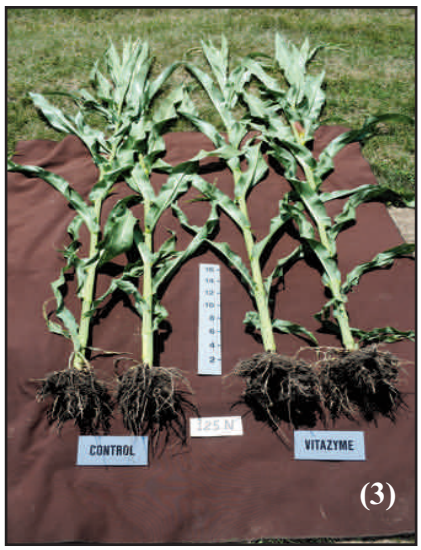
Corn yield at 125 lb N/acre	
Control	161.0 bu/acre
Vitazyme	170.1 bu/acre

Nitrogen efficiency at 125 lb/acre	
Control	0.400 bu/lb of N
Vitazyme	0.466 bu/lb of N

Yield loss from water stress at 125 lb N/acre	
Control	14.2 bu/acre
Vitazyme	5.0 bu/acre

(2)

The yield of grain was increased significantly by about 9 bu/acre, and nitrogen efficiency was improved by 0.66 bu/lb of N. Moreover, the yield loss due to water stress was reduced from 14.2 bu/acre in the control to only 5,0 bu/acre with Vitazyme.



(3)

These results show how a simple addition of this product to the grower's program can improve the yield of grain through improved fertilizer and water utilization. It is a program designed for corn growers everywhere whose intent is to maximize yields with a minimum of nitrogen use.

(4)


(5)