The Vital Earth News
RESOURCES
Agricultural Edition
Volume XXIX, Number 2 Vital Earth Resources • Gladewater, Texas Summer 2022

Dealing With the Fertilizer Crisis

Coping With High Costs and Possible Shortages

By Paul W. Syltie, Ph.D.

To say that we live in a time of crisis is an extremely trite phrase nowadays. It seems like the whole fabric of society is being challenged by a host of factors. These factors have begun affecting us all in very direct ways, and at the farm level no less so.

I am going to restrict this article mainly to one major facet of agriculture, that of fertilizer availability and pricing. When I do that, however, I cannot avoid the energy crisis and coming food shortages that will result. This subject is an extremely critical one, since all of the crops we raise are dependent upon the store of soil fertility to produce a reasonable yield, as well as the nutrients we add through fertilizers purchased through various outlets.

Rising Costs, Less Availability

First, let us take a brief review of where we are in this crisis. It appears that a lack of fertilizer will mean that significantly less food will be grown in 2022 than anticipated for a normal year. This is due to an unprecedented explosion in energy prices, which began in early 2020 and restricted U.S. energy independence. Then, the Ukraine war further exacerbated the shortages, which caused fuel prices to spike, reaching over $4.00/gallon for gasoline and over $5.00/gallon for diesel fuel. With the high price of energy came the escalated price to produce ammonia, which forms the base of all commercial nitrogen fertilizers. The Haber-Bosch process converts atmospheric nitrogen into ammonia using natural gas, and that is converted chemically to urea, ammonium nitrate, and other nitrogen fertilizers. With the high price of natural gas, so has risen the price of nitrogen fertilizers.

Fertilizers have become expensive and sometimes hard to find, but there are ways to reduce usual high rates of application.

However, the cost of all fertilizers—not just nitrogen—has risen dramatically. Normally, a goodly portion of the world's fertilizer comes from Russia, Belarus, and Ukraine. These countries provide about 40% of the world's exports of potash. Russia's exports were hit by sanctions. Further, in February of 2022 a major Belarus producer declared *force majeure*—a statement that it wouldn't be able to uphold its contracts due to forces beyond its control.[1]

Russia also typically has exported 11% of the world's urea and 48% of the ammonium nitrate. Russia and Ukraine together export 28% of fertilizers made from nitrogen and phosphorus, as well as potassium. Since the beginning of 2021 some fertilizer prices have more than doubled, and

A Food Crisis a Real Possibility, page 2

The Solar Corridor Cropping System

A New Innovation Towards a More Natural Way

By Robert J Kremer and C. LeRoy Deichman

[Abridged from an article in www.medcraveonline.com]

Current industrial-scale crop production is managed as monocultures of commodity crops on thousands of hectares, with indiscriminant inputs of synthetic fertilizers and pesticides that inherently reduces biological and ecological interactions that are critical in ecosystem-level mediation of nutrient cycling and suppression of pest populations. The environmental impacts associated with such inputs have raised concerns about the sustainability of industrial agricultural practices, and have triggered efforts to develop alternative management practices designed to maintain yields while minimizing the need for external inputs to ensure economic and environmental sustainability.

Innovative management systems for improving crop production and yield can be developed by integrating cultural practices for effective utilization of abundant, readily available environmental inputs of sunlight and carbon dioxide.

See The Solar Corridor Captures, page 3

A Food Crisis a Real Possibility

Continued from page 1

some have more than tripled. In Peru the costs have increased almost four-fold, imperiling the rice crop there since some farmers cannot afford the cost and may not even plant.[2]

One market expert stated that potash traded in Vancouver was priced at about $210/metric ton at the beginning of 2021, but is now valued at $565. He added that urea for delivery to the Middle East was trading at $268 per metric ton on the Chicago Board of Trade in early 2021, and was valued at $887.50 by early April.[3]

Of course, inflation is playing a direct part in the rise of all prices across the board. As of the writing of this article, the inflation rate is between 8 and 9%, but it is probably much higher if food and fuel costs are plugged into this calculation.

Because of the rising costs, farmers in the United States will likely plant fewer acres of corn, a high-fertilizer-input crop, and revert to crops requiring less fertilizer such as soybeans.

Less Fertilizer, Less Food

Most crop varieties grown today have been bred to utilize high amounts of nitrogen fertilizer, and thus are prone to yield reductions if not fed their nutrient quotas. So, with reduced fertilizer availability and high costs, production levels will naturally drop; by how much is yet to be seen.

Farmers are also hit by three more major obstacles to reasonable profit prospects for 2022:

- The high cost of seeds, herbicides, and other plant protection chemicals
- The high cost of fuel to power their tractors and machinery
- The availability of tractors and other equipment, and their parts, to carry out field operations

Looking at all of these issues together, plus the following six points, there appears to be an approaching global food crisis:[4]

- Floods and droughts have caused drops in crop production in China, Russia, Brazil, the U.S., and other nations.
- Economic sanctions against Russia are causing a disruption of food and fertilizer exports.
- War in Ukraine is limiting 2022 plantings of wheat, corn, soybeans, and other crops.
- Shipping out of the Black Sea ports, such as Odessa, is being severely limited, disrupting exports of grains.
- Petroleum production in the U.S. has been substantially diminished.
- Global fiat currency money printing has expanded, spiking food inflation.

All over the world, far less fertilizer will be used in 2022, which means that less food will be grown.

During a recent interview with Tucker Carlson, farmer Ben Riensche warned that Americans could soon be paying a thousand dollars more a month for their groceries. "Soaring fertilizer prices are likely to bring spiked food prices. If you're upset that gas is up a dollar or two a gallon, wait until your grocery bill is up $1,000 a month, and it might not just manifest itself in terms of price. It could be quantity as well. Empty Shelf Syndrome may be starting."[5]

Goals of Regenerative Agriculture

1. Incorporate natural processes into the program, such as nutrient cycling, nitrogen fixation, and pest-predator relationships

2. Reduce the use of off-farm inputs that have the greatest potential to harm the environment, or the health of farmers and consumers

3. Match the cropping patterns, productive potential, and limitations of soils to ensure long-term sustainability at current production levels

4. Improve farm management and the use of soil, water, energy, and biological resources to insure profitable and efficient production

Reducing Fertilizer Dependency

What can farmers do to help overcome these barriers to food production? Here are two key solutions:

(1) Produce more on-farm nitrogen and rely less on off-farm inputs.

(2) Utilize technologies, such as biostimulants, that improve the efficiency of fertilizers currently used.

We can hearken back to an extensive 1989 study produced by the National Academy of Sciences entitled *Alternative Agriculture*.[6] This study revealed the benefits of a spectrum of farming systems, ranging from organic farming that attempts to use no purchased synthetic chemical inputs, to those that utilize prudently targeted chemicals for specific needs. These systems can be termed biological, low-input, regenerative, and sustainable. All of these systems include the goals shown within the box in the center of this page.

While these alternative farming practices typically require more information, trained labor, time, and management skills per unit of production than conventional farming, the rewards in cost reductions are impressive.

According to the report, "Well-managed alternative farming systems nearly always use less synthetic chemical pesticides, fertilizers, and antibiotics per unit of production than comparable conventional farms. Reduced use of these inputs lowers production costs and lessens agriculture's potential for adverse environmental and health effects without necessarily decreasing—and in some cases increasing—per acre crop yields and the productivity of livestock management systems."[7]

Biostimulant Applications

Another excellent way to improve fertilizer—especially nitrogen—efficiency is to apply a biostimulant, which costs relatively little and can improve efficiency of use markedly. The usual program is to reduce the fertilizer application rate by 10 to 30% of the usual rate for an optimum yield potential, and apply the product to the seeds or in-furrow at planting, and then once more to the leaves later on. With a product like Vitazyme, yields have not been reduced by restricting nitrogen levels, and in some cases even increased.

The reason that such efficiency improvements can be achieved is due to the stimulation of photosynthesis, which leads to greater energy translation into

Continued on page 3

Continued from page 2

the rhizosphere, where an array of microbes — bacteria (including nitrogen fixing Rhizobium), fungi (including mycorrhizae), algae, protozoa, and actinomycetes — proliferate to convert nutrients into available forms. This natural process is accelerated by applying compounds like brassinosteroids to the plant.

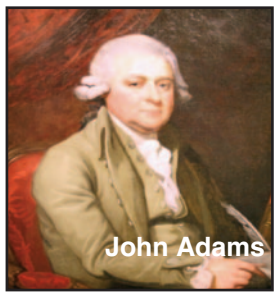
There are ways to improve fertilizer use in the face of the current crises facing farmers, but there are things you can do to help alleviate the bite, and without sacrificing yields. Some of the changes take time, but efforts to conform with nature's laws are well worth the effort! ❒

Footnotes

1, 2, 3, 5. M. Snyder, April 7, 2022, 2. Anonymous, Mixed Farming, *www.thewashingtonsatndard.com*.
4. J. Patrick, April 18, 2022, *www.lawenforcementtoday.com*.
6, 7. National Research Council, *Alternative Agriculture*, National Academy Press, Washington, D.C., 1989.

A Garden, or War: Which?

This provocative title is actually not far off the mark. As British troops closed in on New York City in the fall of 1776, General George Washington had something crucially important on his mind. Congress had ordered him to hold the city, but on the eve of the battle, he set aside his maps and documents and began a letter to the steward of his estate, Mount Vernon, detailing the construction of a new garden.


John Adams

According to Andrea Wulf, author of *Founding Gardeners: the Revolutionary Generation, Nature, and the Shaping of the American Nation*, "What is more remarkable than the timing, really, is that he's asking for only native species ... as if he wants to create an all-American garden where no English tree is allowed to claw its roots in the soil."

The Founding Fathers — George Washington, Thomas Jefferson, John Adams, and James Madison were all avid — even obsessive — gardeners. Washington dreamed up a new way to collect and use manure in his gardens. Jefferson treasured the seeds brought back by the Lewis and Clark expedition and tried them all out at Monticello. Adams loved to get his hands dirtied in the soil, and work in his garden; it soothed his sometimes vitriolic temper.

The connection with the soil was a central part of the founders' vision, Wulf says in her book. "They all agree that agriculture should be the foundation of the American republic .... They believe that the independent, small-scale farmer ... is really the foot soldier of the infant nation." ❒

The Solar Corridor Captures More Light

Continued from page 1

One such management approach is based on wide-row spacing of single or twin narrow rows of tall-stature crops (i.e., maize [*Zea mays* L.]), forming a corridor to provide more uniform vertical distribution of incident sunlight available to all chloroplasts within fully exposed leaves. This solar corridor planting system (SCPS) increases availability of sunlight to plants in all rows in the field.

The SCPS is a novel planting arrangement and method that rearranges the spatial positioning of plants in an alternative crop architecture designed to maximize the capture of solar radiation and carbon dioxide to improve crop growth and yield. In practice, the SCPS uses wide rows of a main crop, combined with inter-row planting of either a compatible cash crop or non-cash crop such as a cover crop or forage species, to maximize use of light and other resources by the main crop. The SCPS is an advancement of the strip intercropping design, which is based on cultivating two or more crops simultaneously in different strips across the field for greater use of resources including solar radiation, water, and nutrients compared with either of the component crops grown in monoculture....

Because light energy initiates the photochemical processes required for photosynthesis, incident solar radiation provides a most productive low cost and abundant form of light as well as atmospheric carbon dioxide needed for essential

Despite having fewer rows, corn yields with the SCPS can equal or exceed complete row plantings due to better sunlight and CO_2 interception.

carbon compounds.... Determination of optimum plant densities for the most efficient capture of solar radiation has been challenging since the early days of crop production research. Current high-yield production systems based on planting dense, mono-cropped fields use a fraction of the available supply of incident sunlight and atmospheric carbon dioxide. In most production systems, maize leaf canopies intercept between 59 and 79% of the incident photosynthetically active radiation (PAR), which suggests inadequate leaf area is available for efficiently capturing radiation. However, maximum grain yield could be achieved when leaf canopies intercepted 95% PAR due in part to using hybrids selected for large leaf area regardless of row spacing or plant population size.

Early research also suggested that maize hybrids respond differently to plant population density due to differences in photosynthetic effectiveness under low light conditions. Some modern maize hybrids selected for high radiation-use efficiency (RUE) show increased dry matter accumulation at all growth stages through the grain-filling period, and thus provide a basis for selection of hybrids for efficient use of solar radiation in the SCPS....

Although the primary focus of the

See Intercropped Species Gain, page 7

15-Minute Soils Course

Lesson 55: The Essentiality of Soils for Civilization

The causes of the rise and survival of civilizations of men is a topic that has been written about and debated by countless authors, beginning with the most ancients texts. The earliest source is the Bible, which states that reverence and obedience to the Creator is the prime cause for the prosperity and longevity of a nation. This is stated emphatically in Leviticus 26:3-4, where it says, "If you walk in My statutes and keep my commandments, and perform them, then I will give you rain in its season, the land shall yield its produce, and the trees of the field shall yield thier fruit". The nation would have abundant food, peace and safety, freedom from war, and prosperity of field, families, and livestock. On the other hand, failure to obey the Creator would result in disease, failure of timely rains, crop failures, famine, all sorts of calamities, and finally captivity of the nation by foreign aggressors (Deuteronomy 28:15-68). The success of the nation depended on a moral code of selfless serving, hard work, and respect for the Creator and His laws.

Reasons for the Decline of Civilizations

1. **War**
2. **Moral decay**
3. **Political corruption**
4. **Economic maladjustment**
5. **Deterioration of the people**
6. **Poor leadership**

Other sources have pointed towards the moral decay of a people as being a cause of the collapse of civilizations, one of several causes that include war, political corruption, economic maladjustments, the deterioration of the people—and poor leadership. Vernon Carter and Tom Dale in *Topsoil and Civilization*, Edward Hyams in *Soil and Civilization*, and Walter Lowdermilk in *Conquest of the Land Through 7,000 Years*, for example, support these claims for why a once-thriving nation will eventually begin to decline, and finally be extinguished after a few hundred years.

While it is the Creator's contention that the abrogation of moral laws on the part of the citizenry is the trigger to national decline, how does this actually happen? The answer ties directly to what a self-serving, amoral population and its government does to the land. The farmers and tenders of the natural resources of the land focus on one major point: Exploit those resources for the sake of enriching oneself in the short term rather than conserve them for future generations. As one author put it, "Civilized man has marched across the face of the earth and left a desert in his footprints."

First of all, what is civilization? It is a condition of mankind coexisting with the environment in such a way that progress in his affairs results. This requires that a *surplus* of the things beyond what is actually needed to live—food, clothing, and shelter—are produced to give opportunity for education, the arts, engineering and manufacturing projects, and in the modern age, technology and communications. To achieve this surplus, the farmers, fishermen, miners, and loggers must produce enough to release themselves and others from merely searching for food and shelter.

To achieve these surpluses of the essentials, there must be fertile soils and a dependable water supply, both of which are found in abundance in the ancient "cradles of civilization" in the Nile Valley, Mesopotamia, and the Indus Valley. In all three of these areas there was, and still is, (1) fertile soil, (2) a dependable water supply for irrigation, and (3) relatively flat land and little rain that did not allow for erosion.

Other nations throughout history, such as Rome, Medo-Persia, Greece, and in more modern times, Germany, France, England, and the United States have had to produce their crops oftentimes on sloping lands that are watered by rainfall. Rainfall on unprotected soils causes soil erosion, and over time this loss of soil and its fertility leads to reduced yields and a reduction

15-Minute Soils Course

in the nutritional quality of the food grown on it. Even so, as long as the soils remained fertile and productive, the nation usually endured through wars, poor leadership, civil disorder, and other calamities.

Inflation and other government-inspired effects can pressure farmers to maximum yields, and efforts to conserve soils and build fertility is sacrificed for the sake of short-term gains, and the need to survive the economic squeeze placed upon them: high costs of fuel and fertilizer, taxes, and land itself. In modern times, as in times past, such pressures upon farmers, ranchers, loggers, and fishermen have resulted in practices such as clean tillage and clear cutting, which leave the soil uncovered at times and susceptible to erosion by both rainwater and wind; witness the terrible dust storms of the 1930s in Oklahoma, Texas, and Kansas.

Moreover, the breeding of crop varieties such as hybrid corn, canola, and semi-dwarf wheat, which require high inputs of fertilizers (especially nitrogen), has made the farmers totally dependant upon agribusiness industries that produce the seeds, manufacture the fertilizers, and produce the tractors and machinery that are required to grow the crops. Because of these modern agribusiness innovations, the nutritional value of the crops has diminished as hybrids and GMO varieties contain fewer minerals, vitamins, and high-quality protein than their open-pollinated counterparts. Coupled with extensive pesticide and herbicide use, and food processing, the health status of the people is seriously compromised, resulting in increases in diseases such as cancer and heart disease.

Thus, we can see the connection between rejecting moral laws that would lead farmers to grow high quality crops for health, clear thinking, and proper judgement of the people, and the collapse of the nation from a series of complex and interrelated causes. The soil, and the yields and quality of production from it, relate directly to the strength of the people living on it, and the trajectory of their civilization. The surplus production from fertile, vibrantly rich soils leads to people who are able to fend off the ravages of war, poor leadership, political corruption, and economic maladjustments. Truly, all new wealth comes from the soil, as Carl Wilken revealed in his book *All New Wealth Comes from the Soil*. Soil fertility is the heartbeat of all civilizations, as the lessons of history dramatically show. ❒


Soil erosion on unprotected land


Overgrazing

See How Much You Learned

1. The major force that gives strength and success to a nation is its soil fertility. T or F.
2. Civilizations decline because of a. poor leadership, b. war, c. fertile soils, d. economic trials.
3. For civilization to exist, it is required that there be a _____of basic needs provided.
4. The ancient cradles of civilization thrived because of a. a dependable water supply, b. flat land, c. fertile soils.
5. Carl Wilken in his book claimed that all new wealth for a nation comes from the_____.
6. Even if a nation is assaulted by many setbacks, even war, it will likely survive if its soils remain fertile and productive. T or F.
7. The oldest reliable source concerning the rise or fall of civilizations is the _____.

Answers: 1. T; 2. a, b, d; 3. surplus; 4. a, b, c; 5. soil; 6. T; 7. Bible.

Inter-Cropped Species Give Benefits

SCPS is to improve grain yield of the main crop (i.e., maize), the inter-cropped species have important implications for soil conservation, fertility management, soil organic matter maintenance, pest suppression, and soil health. Cover crop mixtures including legumes in intercrop combinations may serve as nitrogen fertilizer resources for the main crop, and minimize chemical fertilizer inputs and their potential environmental impacts. Cover crops integrated into the SCPS may further promote soil microbial biomass and biodiversity including soil mycorrhizal fungi that associate with numerous crops to enhance nutrient acquisition, disease resistance, and drought tolerance....

The inter-cropped species may reduce damage to main crops by insect pests and simultaneously suppress weeds through potential allelopathy. Such interactions may provide yield stability for the main crop because the crop mixture in the SCPS maximizes light capture and water and nutrient use, and thus a more efficient resource utilization strategy by limiting competition by weeds.

Proper management of the complexity of an intercropping system such as the SCPS will accommodate the physical, biological, and ecological interactions between the crop components to maximize biomass and grain yields while contributing to essential ecological services, including nutrient cycling, biological pest control, water and soil conservation, and soil health. The keys to effective management in the SCPS are,

(1) selection of maize hybrids responsive to the solar corridor planting arrangement to fully utilize radiation, and

(2) compatible inter-crop species that do not interfere with maize, yet provide the benefits of a secondary crop in grain or forage yields or for soil improvement and conservation.

The solar corridor is a paradigm shift for crop production that allows direct access of more leaf chloroplasts to incident sunlight over a longer period of time. Limited field trials have shown the potential for increased maize yields of specific hybrids.

Early work with the SCPS demonstrated that specific maize hybrids could be selected for high yield performance; however, seed sources of these classical hybrids are limited or have disappeared as alternative germplasm has been developed for current industrial maize production. Screening of modern hybrids for high yields is critical for the SCPS to be operational in conventional crop production settings. Replicated studies on the solar corridor crop system paired with conventional production systems across various crop production regions and major soil groups is needed to validate the SCPS protocol. We believe the SCPS readily offers a solution for improving diversification of crop production systems, which provides more efficient utilization of soil nutrients, improves soil organic matter and soil structure, suppresses weeds and insect pests, reduces chemical inputs, and improves environmental health relative to current monocropping systems.

Although a perceived risk is often associated with adopting diversified systems, farmers who decide to implement this approach for crop production and deliberately follow management practices required to fully exploit the benefits of the system reduce their risk considerably. Knowledgeable producers can adapt the solar corridor to fit their crop production system for consistent and economic yields while maintaining environmental sustainability. ❒

Kremer RJ, Deichman CLR. The solar corridor: a new paradigm for sustainable crop production. Adv Plants Agric Res. 2016;4(3):273-274.

The Single Best Thing to Improve Soil

By Paul W. Syltie, Ph.D.

Of the many management practices a farmer can control to produce top yields of high quality crops, while reducing or eliminating soil erosion and assuring the maximum intake of rainfall, it is imperative that tillage be reduced dramatically. Why do I say this?

Of all the practices that conventional agriculture has used since the development of modern farming methods, tillage by use of the moldboard plow, field cultivators, disks, and other tillage tools which disrupt and overturn the topsoil, and usually leave it relatively bare of residues, has done more damage to our soil resources in the United States than any other practice.

What are the consequences of these practices? Take a look at the information box and see what damage tillage does to the soil. As farmer Steve Groff of Lancaster County, Pennsylvania stated, "Tillage is a disaster for the soil. It's like a hurricane coming through."

Damage from Tillage

1. Soil structure, so essential for air and water movement, is ruptured.
2. Communities of microbes and other soil flora and fauna, essential for critical nutrient transformations, are disrupted.
3. Soil organic matter, the "heartbeat of soil fertility," is exposed to the air and rapidly oxidized, leading to reduced levels, poorer structure, slower water infiltration and greater erosion, and loss of fertility.
4. Compaction is increased, making root penetration more difficult and reducing nutrient uptake.

For alternatives to the tillage methods that are commonly used today, consider the following.

NO-TILL. Planting is done in untilled soil with crop residues left on the surface. Heavy soils that are not well-drained may have difficulty with this method, and soils do not warm up as quickly in the spring.

VERTICAL TILLAGE. Disks chop the residue in the top 1 to 4 inches, leaving residues on the surface.

STRIP TILLAGE. Only a 7 to 10-inch strip is tilled for planting, leaving the interrow area untouched.

The ultimate solution to the tillage problem is to grow perennial crops, so no tillage is required whatsoever once the crop is established. While some progress has been made in this direction, seed producers to have little incentive to do so. ❒

More Frequent and Intense Storms Cause Heavier Rain in Central U.S.

By the DOE/Pacific Northwest National Laboratory

Intense storms have become more frequent and longer-lasting in the Great Plains and Midwest in the last 35 years. What has fueled these storms? The temperature difference between the Southern Great Plains and the Atlantic Ocean produces winds that carry moisture from the Gulf of Mexico to the Great Plains, according to a recent study in *Nature Communications*.

"These storms are impressive," said atmospheric scientist Zhe Feng at the Department of Energy's Pacific Northwest National Laboratory (PNNL). "A storm can span the entire state of Oklahoma and last 24 hours as it propagates eastward from the Rocky Mountain foothills across the Great Plains, producing heavy rain along the way."

Understanding how storms changed in the past is an important step towards projecting future changes. The largest storms, especially, have been challenging to simulate.

"These storms bring well over half of the rain received in the central U.S. in the spring and summer," said atmospheric scientist Ruby Leung, a coauthor with Feng and others at PNNL. "But almost no climate model can simulate these storms. Even though these storms are big enough for the models to capture, they are more complicated than the smaller isolated thunderstorms or the larger frontal rainstorms that models are wired to produce."

Previous research had found more heavy springtime rain falling in the central United States in recent decades, but scientists did not know what types of storms were causing the increase. Different storm types might respond in their own unique ways ... so the PNNL researchers set out to find out.

A severe storm approaches in eastern South Dakota in the spring of 2022.

To do so, the team worked out a way to identify storms called mesoscale convective systems. This type of storm develops from smaller convective storms that aggregate to form the largest type of convective storms on Earth.... Feng transformed well-established satellite detection methods into a new technique that he then applied to rainfall measured by radars and rain gauges for the past 35 years. This allowed the researchers to identify thousands of the large convective storms and their rainfall east of the Rocky Mountains.

The results showed the frequency of very long-lasting ones increased by about 4 percent per decade, most notably in the northern half of the central region -- just below the Great Lakes. The researchers rated the storms that produced the top five percent of rainfall as extreme events and saw that extreme events have become more frequent in the last 35 years.

But what contributes to the changes in the frequency and characteristics of mesoscale convective systems? To find out, the researchers analyzed the region's meteorological environment. They found that the Southern Great Plains warms more than the ocean does.

This difference in temperature creates a pressure gradient between the Rocky Mountains and the Atlantic Ocean that induces stronger winds that push moisture up from the Gulf of Mexico. The warmer and moister air converge in the Northern Great Plains, where it falls in massive storms.

"Flooding depends not only on precipitation intensity and duration, but also how much water the ground can hold," said Leung.

[Condensed from *www.sciencedaily*.com.]

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.

For further information ...

Stay tuned to our website for the next edition of *The Vital Earth News*! You can find current and back issues at *vitalearth.com/vernews,* and keep up to date with the latest information, product news, and announcements at *vitalearth.com/newsandevents*. If you are interested in purchasing our products, or for other correspondence, please email us at *info@vitalearth.com*.

Please include the following in your request:

Name:

Location:

Message:

Thank you! The Team at Vital Earth Resources, Inc.

Vitazyme Improves Fertilizer Efficiency, Proven By Studies Since 1995

Many replicated field studies on several crops since 1995 have shown that Vitazyme, applied to seeds, soils, or leaves, will improve fertilizer use efficiency, especially with nitrogen. Here is a small selection from those studies. A detailed summary of these studies is available on request from Vital Earth Resources.

Crop	Location	Fertilizer enhancement with Vitazyme
Barley	Ukraine	● Trials in 2012 and 2013 gave yield increases with Vitazyme of 14 to 18% above the untreated controls. Grain protein was increased, and diseases were reduced.
Corn	Iowa	● During a dry year, yields at 80 lb/acre of N were increased by 27.6 bu/acre (22%), and at 120 lb/acre of N by 10.4 bu/acre (7%) with Vitazyme.
	Iowa	● At 80 lb/acre of N, corn yield with Vitazyme was the same as at 160 lb/acre.
	Iowa	● The 50% N application plus Vitazyme improved the yield by 10.8 bu/acre above the 100% N treatment.
	North Carolina	● At North Carolina State University, over several N levels, corn yield was improved with Vitazyme at one site an average of 9%, and at another site by 15%. Blight resistance was also improved.
	Ontario	● The 60 kg/ha N rate plus Vitazyme produced a yield equal to the yield at 120 kg/ha of N.
	South Dakota	 ***This corn trial in eastern South Dakota proved how Vitazyme (left side) can dramatically improve nitrogen utilization.*** ● South Dakota State University trials over several years showed corn yields at 75 lb/acre of N plus Vitazyme equalled yields at 125 lb/acre of N. Nitrogen efficiency was improved from 40.3% for untreated seeds versus 58% for treated seeds.
Cotton	Texas	● At Texas A&M University, the 50% N rate plus Vitazyme produced a lint yield equal to the 100% N rate, and plant and fiber parameters were improved.
Lettuce	Philippines	● At Los Banos, the 50% fertilizer rate plus Vitazyme produced 32% more lettuce yield than did the 100% fertilizer rate without it.
Rice	Cuba	● Rice yields at 75% and 100% fertilizer were increased by Vitazyme up to 52%.
Sugar beets	Ukraine	● Several studies showed yield increases with Vitazyme of up to 26% at the same N level, plus higher sugar percentages.
Sugar cane	Cuba	● At all fertilizer levels, Vitazyme improved both cane and sugar yields, reduced levels giving yields as high as the maximum fertilizer rates.
Wheat	Ukraine	● At the same fertilizer rates, Vitazyme increased the yield in several studies from 12 to 24%, plus boosting grain protein and reducing diseases.