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Crisis and Opportunity in Agriculture

Current Signs Are Not Good, But There Is a Future!

By John Ikerd

[University of Missouri; condensed from *Crisis and Opportunity in North American Agriculture*, presented at a farm conference in Brandon, Man., in 2000]

In a recent book, *The End of Agriculture* in the *American Portfolio*, University of California economist Steven Blank envisions the imminent end of the American farm. American agricultural production is destined to end, he argues, but he claims this should be no cause for alarm. He contends that the end of American agricultural production is the result of a natural process that is making us all better off. He foresees a time in the not too distant future when North America will import nearly all of its foodstuffs from other lesser developed countries. Costs of land and labor will be too high for American farmers to be competitive in global food production. He argues that globalization of the food system is not some corporate business strategy, but is simply the inevitable consequence of individual struggles of farmers and agribusiness in America and around the world who quite logically are pursuing their individual self interests to the benefit of society in general.

Blank believes that the current open spaces of rural areas will be transformed from farms to living space for a growing and increasingly affluent population fleeing the problems of urbanization. Cornfields are unable to compete with condominiums for farmland. Farming is a low-skilled, primary industry that has no place in an advanced, high-tech economy. Rural ways of life will give way to urban ways of life as farms become residential ranchettes. Virtual communities of people interconnected by the Internet will replace real communities of people who meet face-to-face in church or at the grocery store. Communities of interest will replace communities of place. Agriculture will no longer be a significant factor in the rural economy. Most people in the community will be employed elsewhere,

Importing food from the cheapest source may benefit corporations, but does it ensure food security and high nutrition?

perhaps by companies thousands of miles away. Blank claims the only forms of truly sustainable agriculture will be those compatible with urban life, mainly golf courses, nurseries, and turf farms.

Blank's fundamental arguments are based on the premise that economic considerations ultimately will prevail over all others. He assumes that industrial agribusiness will replace family farms because they are more economically effi-

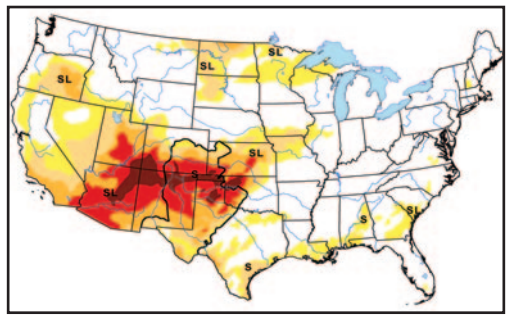
See Parity Pricing Would Help, page 2

Weather Worries Stalk the Plains

Will 2018 Bring a Return to the Dust Bowl Days?

By Paul W. Syltie, Ph.D.

This summer may bring a return of serious drought to much of the U.S. Plains, if springtime weather is a harbinger of things to come. Already in May excessive heat has struck the entire length of the Great Plains and parts of the Corn Belt. Parts of Minnesota and South Dakota reached 102 F on May 27, with high winds that dried the soil quickly after an unusually late and snowywinter, that produced a blizzard in many areas on April 14, well after spring's arrival.



The drought in the Southwestern U.S. extends from southern California to central Kansas, but conditions are even worse in the Four Corners, where Montezuma and La Plata counties have warranted the description "exceptional drought." Brad Rippey, a meteorologist with the U.S. Department of Agriculture, said the conditions that arise for an "exceptional drought" are considered a 1-in-50-year chance (*https://the-journal.com/articles/94125*).

Rippey authored the U.S. Drought Monitor, which produces a drought map as seen to the left. The darkest areas show exceptional drought, and the yellow areas indicate short-term drought. Rippey blamed the current conditions on a dry winter and early spring. "Winter

See Deepening Drought Fears, page 7

Rural Communities Must Be Sustained

Continued from page 1

cient, and American agribusiness eventually will be displaced by even more efficient agribusiness elsewhere in the global market. Residential ranchettes will replace rural farmsteads because people with high-tech jobs can pay more for land to look at than farm families can afford to pay to work it.

Blank might well be right. If we allow short-run economic thinking to continue to dominate every aspect of our lives, then Blank's forecasts for the future of American agriculture appear quite rational and reasonable. The current crisis might well foretell the end of the North America farm. However, the end of farming in North America is neither inevitable, nor is it desirable. There are sound, logical, ecological, and social reasons to keep farm families on the land and for every nation to maintain the integrity of its agricultural sector for purposes of national security. We need not sacrifice our overall long run quality of life for the sake of short run economic efficiency. But, we may well be forced to rethink the role and scope of agriculture within the global economy as well as within the broader human society. We may have to develop a new American farm to prevent the end of the American farm.

If we are to seize the opportunities in agriculture today, we must be willing to confront the crisis. The current crisis in agriculture is not a consequence of the weather, of world trade problems, or of unwise government policies. These things only magnified the symptoms of problems that are rooted in causes far more fundamental. Crisis is a chronic symptom of the type of agriculture we have been promoting on this continent for at least the past fifty years.

Symptoms of Industrial Agriculture

Reoccurring financial crises are the consequence of our encouraging farmers to industrialize to become more specialized, standardized, and larger in scale so we can make agriculture more efficient. We rationalize the industrialization of agriculture as a means of providing lower cost food for consumers. We rationalize the displacement of family farmers in the process as a means of freeing people from the drudgery of farming so they can find better jobs in town.

Chronic crisis in American agriculture also has meant chronic crisis in America's rural communities as farms have become more specialized, larger, and fewer. The fundamental purpose of most rural communities was to support those engaged in agriculture or some other natural resource based enterprise, such as mining or timber. But, it takes people, not just production, to support a community. Larger farms tend to bypass rural communities in buying the production inputs and marketing their products. In addition, a rural community is far more than a rural economy. It takes people to fill the church pews and school desks, to serve on town councils, to justify investments in health care and other social services, to do the things that make a community. As farms have grown larger and fewer, they have lost their people, their human and social resources, and many rural communities have withered and died.

Livestock judging at the county fairs across the U.S. is a common rural activity among 4H kids, but is becoming increasingly rare as farmers leave the land.

The current crisis is different in at least one respect: it signals the final stage of industrialization. The final stage of industrialization is consolidation of decision making under corporate control. The giant multinational corporations are now seizing control of all aspects of American agriculture, moving beyond specialization and standardization, beyond consolidation into larger farms, and are now consolidating agricultural decision making in a handful of corporate boardrooms. This final stage of industrialization is turning once peaceful farms into odious factories, with all of the noxious odors, environmental degradation, and inhuman working conditions that characterized heavy industry of earlier times. This final stage of industrialization is turning remote rural communities into the dumping grounds for the rest of society whether as prisons, landfills, toxic waste dumps, or giant hog factories. This final stage of industrialization could well spell the end of the American farm, and with it, the end of the American rural community.

The food and fiber industry most certainly has a future; people will always need food, clothing, and shelter, and someone will provide them. But there will be no future for farming in North American, or for rural communities, unless we challenge the conventional wisdom that food should be produced wherever on the globe it can be produced at the lowest cost, and that free markets should be the final arbitrators of all value. In fact, there will be no future for farming anywhere ... unless we have the courage to challenge and disprove the conventional wisdom that farmers must get bigger, give in to corporate control, or get out. But there are better alternatives for farmers and for society if we can find the courage to challenge the basic forces driving the corporatization of agriculture and of North American society.

In essence, as agriculture moves from competitive capitalism to corporatism, it changes from a market economy to central planned economy. Central planning didn't work for the Communists, and it won't work for the corporations. The problem wasn't that the Communists weren't smart enough or that their computers weren't large enough. Central planning is a fundamentally wrong-headed approach to managing an economy for corporations as well as govern-

See The Promise of Sustainable, page 6

Are Electric Tractors in the Future for American Agriculture?

By Agriland Team

John Deere's latest research and development work was recognized with several awards at the SIMA 2017 show in Paris from February 26 to March 2.

A 'Special Mention' has been given to John Deere's SESAM electric tractor. SESAM (Sustainable Energy Supply for Agricultural Machinery), says the company, is the industry's first fully battery-powered tractor. This prototype machine produces 130kW (174hp) of continuous power and is based on the 6R Series tractor chassis (with an adapted 6M Series cab), using an adapted DirectDrive transmission, with a speed range from 3kph to 50kph at full power.

The tractor is emission-free and develops "high torque at low speeds" and a maximum output of around 400 hp, with "no energy losses when idling."

John Deere says that the SESAM tractor is a central component of its vision for the "energy-autonomous farm of the future". Potential benefits, says the company, include the use of farm-produced renewable energy and new farm business models that would allow farms to provide electric power-to-grid services in rural areas.

In standard mode, one of two "maintenance-free" electric motors operates the drivetrain; the other is used for the PTO and auxiliary systems. If required, both motors can be linked together in order to supply full power, either for driving on the road or for PTO and hydraulic work.

Another advantage, says the company, is that the SESAM tractor runs at the "lowest possible noise levels," which might prove particularly useful when operating close to residential areas or when working at night.

Battery Range and Charging Time

Currently, one battery charge lasts for up to four operating hours in typical mixed mode operations, or for around 34 miles of road transport work. Charging time is about three hours. The battery is designed to last for 3,100 charging cycles. These are the figures that will ultimately determine where this electric tractor project goes from here. ❒

[From *https://www.agriland.ie/farming-news/electric-john-deere-tractor-runs-for-4-hours-on-a-charge/*.]

10 Facts of Life Only Farmers Know Are True

By Molly B. Heilman

[Condensed from https://twitter.comilk-maid_molly]

Here's a list of some things your non-farm friends just don't understand.

1. You don't have set work hours. When your non-farm friends want to hang out it's hard for them to realize you don't work from 9-5. They might think you're making up excuses when you tell them "sorry I was late, I had to deliver a calf."

2. Your hygiene levels are not equal to theirs. No matter how much you clean up for a night out on the town your non-farm friends can pick out the lingering odor of barn that you've become immune to.

3. You wear boots everywhere. Work, casual, weddings: boots are not for just out in the barn and can go with any outfit even if the general public doesn't find it fashionable. Your non-farm friends just don't understand that wearing anything besides boots on your feet just doesn't feel right.

4. You're not the life of the party. It's 11 p.m., the music's blaring, people are up and about socializing and you're half passed out on the nearest couch. You've been up since the crack of dawn and its way past you're normal bed time.

5. You're so fit and tan. Your non-farm friends are sometimes jealous of the fact that you pretty much eat whatever you want and don't gain weight or that you're a golden bronze color all summer long. If they knew how hard you worked all day they probably wouldn't be so envious of your appearance.

6. You avoid certain conversations. "Wait, What, you stuck your arm where in a cow?!" Sometimes when your non-farm friends ask you "so what did you do today?" it's better to just leave out some parts.

7. You make a big deal over what color a tractor is. To your non-farm friends it's just a different paint color, but to you it's one of the greatest debates in history.

8. You take farm terminology seriously. If your friends ever come over to the farm and point out a steer and call it a bull, you'll be the first to correct them.

9. You have different life goals. While your non-farm friends might be busy trying to climb the corporate ladder, you're busy at an auction trying to see if you can get a steal on some cattle.

10. Your pictures on social media don't look like theirs. Your friends that don't come from a farm sometimes find it strange that all your pictures on your social media are of nothing but animals, barns, tractors, and crops, and you only take selfies with your livestock. ❒

15-Minute Soils Course

Lesson 47: Soil Air

Just as living organisms above the soil need air to exist, so do organisms within the soil. They need the oxygen, CO_2, and other gases within the soil air to metabolize and grow.

A well-aerated soil is one in which gases are available to growing aerobic organisms, especially the roots of higher plants, in sufficient quantities and proper proportions to encourage optimum metabolic rates of these organisms.

Typical Soil Air Composition

Typically a productive soil will contain about 50% pore space and 50% air space, with about half of the pores filled with water and half with air. Mineral matter makes up about 45% of the soil mass, of which about 5% is organic matter.

There is a reciprocal relationship between soil water and soil air within the pore spaces of soils. In fact, aeration is almost totally controlled directly or indirectly by the management of soil water.

Composition of Soil and Atmospheric Air

	O_2	CO_2	N_2	Other gases
Atmosphere	20.94	0.03	78.05	0.95
Soil	18.0-20.0	0.15-0.65	78.8-80.2	—

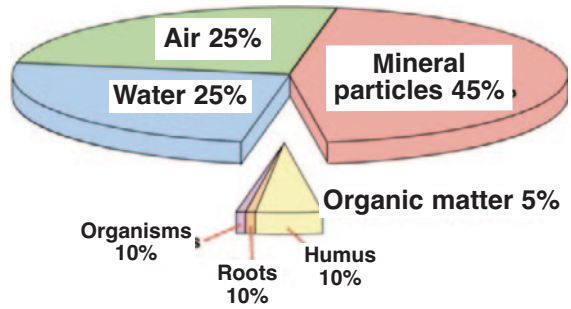
Factors Affecting the Composition of Soil Air

1. Available pore space. These pores are directly related to soil bulk density (weight/volume of soil), and are in response to the following factors:

a. Soil texture.
b. Soil organic matter.
c. Soil structure.

After a rain or irrigation the pores will be mostly filled with water, and air will come in to replace the water in the pores as the water infiltrates down into the soil. Poorly drained, heavy, and compacted soils will allow slower drainage, and pores will remain water-filled and reduce O_2 levels so that, unless drained within a certain number of hours, plant roots of most crops will begin to die from O_2 starvation.

2. Soil biological activity. Much of the CO_2 released in the soil comes from bacteria and fungi consuming manure, crop residues, and dead root tissue, and other organic matter, plus the respiration of plant roots, especially under favorable moisture and temperature.



3. Soil depth. The subsoil normally is more compact than surface horizons, and the pores are much smaller, so the air exchange is reduced and CO_2 levels are much higher than in surface horizons. This is especially true for heavier, clayey subsoils, where CO_2 levels may rise to 15% of the soil air.

4. Season of the year. Soil air varies greatly with the season, higher in CO_2 and lower in O_2 during wet, cool periods such as winter and late spring in temperate regions. The reverse tends to be true for warmer, drier seasons such as in mid-summer, unless in summer periods there is plenty of decomposing organic residues that give off much CO_2.

Effects of Soil Air on Soil Biological Activity

Soil air affects soil biological activity in several ways.

1. Rate of decomposition of organic residues. This rate is greatly reduced in compacted and heavy soils having small pores, since O_2 levels are low and cannot sustain high levels of microbial activity.

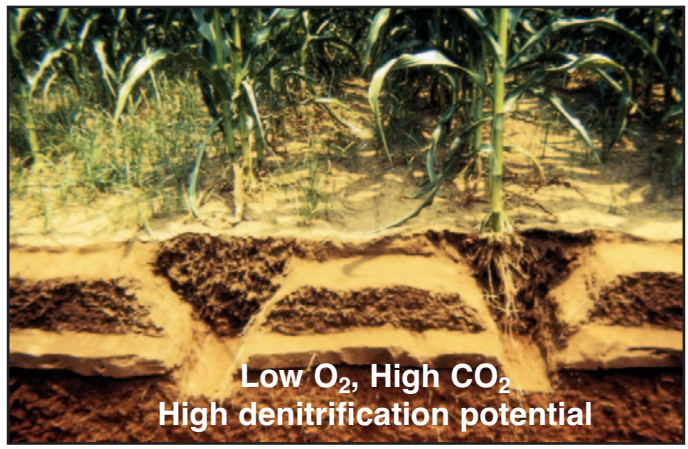
2. Availability of nutrients to plants.

15-Minute Soils Course

Anaerobic, compact, low O_2 soil conditions will greatly hamper crop growth by...

a. Reducing the conversion of essential elements into available forms. All nutrients require microbial conversion in the process of becoming available. Also, nitrogen fixing bacteria and other important microbes are slowed or shut down. Anaerobic conditions will actually foster the creation of toxic forms of elements, as shown in the box below.

b. Slowing root growth. A corn root may grow 3 inches per day in a well-aerated soil, but only 0.5 inch in compacted, low O_2 soil. Low O_2 is not the only factor here; physical compaction itself is a problem.



c. Reducing the rate of water absorption. Root respiration requires O_2, and a deficiency will slow water uptake, and with it reduce nutrient uptake.

3. Slowing the Oxygen Diffusion Rate (ODR). This is expressed in grams of O_2X10-8/cm^2/minute. If the ODR is less than 20, then roots stop growing. Oxygen is essential for many root functions, and some researchers have found that at least 3% O_2 is necessary to prevent root death, 5 to 10% for the growth of existing roots, and 12% for new root growth. Thus, maintaining proper soil porosity to allow the diffusion of gases through the soil profile is extremely important.

Oxidized and Reduced Nutrient Forms in Soils

Element	In oxidized soils	In waterlogged soils
Carbon	CO_2	CH_4
Nitrogen	NO_3^-	N_2 and NH_4^+
Sulfur	SO_4^{-2}	H_2S, S^-
Iron	Fe^{+3}	Fe^{+2}
Manganese	Mn^{+4}	Mn^{+2}

Encouraging Good Soil Aeration

Good soil aeration means good soil water management. To properly aerate soils, encourage drainage through tiling, especially on heavy soils, or growing alfalfa in rotation to punch through compacted soil horizons. Build a strong soil structure by limiting tillage and compaction, and especially add organic residues and/or manure or compost annually, since microbial action is the key means of building a strong, stable soil structure.

See How Much You Learned

1. Soil air is largely a function of the management of soil water. T or F

2. Soil air affects biological activity by a. affecting the oxygen diffusion rate, b. influencing root growth, c. changing soil texture, d. affecting plant nutrient availability.

3. Good soil aeration is encouraged by proper _____ and strong_____.

4. A typical soil will contain about ___% mineral matter and ___% pore space, of which ___% is air and ___% is water.

5. The subsoil usually contains larger pores than the surface horizons. T or F

6. Soil compaction is so damaging to crops because a. it slows root extension, b. increases the O_2 content of the soil air, c. increases the potential for nitrogen loss, d. reduces the rate or decomposition of organic residues.

7. Aside from the natural CO_2 in the air, the CO_2 found in the soil comes from _____ and _____.

Answers: 1. T; 2. a, b, d; 3. drainage, soil structure; 4. 45, 50, 50; 5. F; 6. a, c, d; 7. soil organisms, plant roots.

The Promise of Sustainable Agriculture

Continued from page 2

ments. The corporate system of food production will prove to be fundamentally incapable of meeting the needs of the people. Its emergence as the dominant system, therefore, represents a prime opportunity for an alternative to corporate central planning, to create an agriculture that will truly meet the needs of the people of an enlightened society.

As society becomes more enlightened, we are beginning to realize that we are destroying our natural environment in the process of trying to produce cheap food. We are mining the soil through erosion and depletion of its natural product in the process of maximizing production and minimizing dollar and cent costs of production. We are polluting our streams and groundwater with residues from the pesticides and commercial fertilizers necessary for large-scale, specialized, industrial crop production and with wastes from giant confinement animal feeding factories. We are destroying the genetic diversity, both below and above the soil that is necessary to support nature's means of capturing and transforming solar energy into energy for human bodies. As society becomes more enlightened we are beginning to realize that we are destroying the social fabric of society in the process of trying to make agriculture more efficient. We are destroying opportunities for people to lead productive, successful lives. We are turning thinking, innovative, creative farmers into tractor drivers and hog house janitors. There is dignity in all types of work, but all people should have opportunities to express their full human potential. Consolidation of decision making concentrates the opportunities among the privileged few while leaving the many without hope for a rewarding future. Industrial specialization also tends to separate people within families, within communities, and within nations. We are just beginning to realize that industrialization destroys the human relationships needed to support a civilized society.

Enter Sustainable Agriculture

A new American agriculture is emerging under the conceptual umbrella of sustainable agriculture. Sustainable agriculture is a response to a growing awareness that an agriculture that degrades the natural environment and weakens the social fabric of society cannot meet the needs of people over time, no matter how productive and profitable it may appear to be in the short run. Farm profitability cannot be sustained unless farms are also ecologically and socially sustainable. The focus of agriculture sustainability is in the long run on intergenerational equity. A sustainable agriculture must be capable of meeting the needs of the present while leaving equal or better opportunities for the future. In order to fulfill this purpose, it must be ecologically sound and socially responsible as well as economically viable. Systems of farming that are lacking in any one of these dimensions quite simply are not sustainable.

Farming sustainably is no simple task. But, thousands of farmers are finding ways to create a desirable quality of life for themselves and to support their local communities while being good stewards of the land and the natural environment. These farmers, like people in general, are pursuing their self-interest. Pursuit of self-interests is an inherent aspect of being human. But, people, by nature, do not pursue only their narrow, individual or personal self-interest. It's also within the inherent nature of people to care about other people and to care of the earth. People are perfectly capable of rising above selfishness and greed to pursue a higher concept of self-interest, a self-interest that values relationships with other people and stewardship of the earth as important dimensions of one's self-interests. ❒

[To view the complete article, go to *http://web.missouri.edu/ikerdj/papers/NAF1-CrisisandOpportunity.htm*.]

Hemp, the New Cash Crop of Many Uses

By CFN Media Group

[Condensed from *www.globenewswire.com*, March 29, 2018]

Hemp is one of the oldest plants that has been in continuous use throughout history. In 1977, Carl Sagan went so far as to suggest that hemp could have been the world's first agricultural crop, leading to the development of civilization as we know it. Hemp was also America's largest cash crop for over 150 years following the Revolutionary War. In fact, the Declaration of Independence was drafted on hemp paper.

In 1957, hemp was banned in the United States due to concerns about its psychoactive cousin, marijuana. The War on Drugs began in 1986 and imposed mandatory minimum sentences and raised federal penalties for the possession and distribution of drugs. In 2001, the Hemp Industry Association and other companies took legal action against the Drug Enforcement Administration and a three year legal battle led to re-legalization of hemp.

Hemp is unique in that every part of the plant can be used, and it's extremely easy to grow in every state. The growing season is so short that farmers can double crop with it. The plant's deep roots improve soil structure, while its dense foliage chokes out weeds. These attributes make it a perfect cash crop for farmers.

Hemp was the world's standard fiber with unmatched tensile strength. Hemp can be used to make any fiber-based or cellulose-based product. The fiber was used to produce over 5,000 different textile products before prohibition.

Hemp seeds are also very nutritious. In addition to a healthy dose of omega-3 fatty acids, the seeds are a great source of vitamin E and minerals. In recent years, the plant has become an important source of cannabidiol (CBD), the non-psychoactive cousin of tetrahydrocannabinol (THC). A growing body of research has found that CBD could help relieve pain, reduce inflammation, reduce anxiety, protect the brain, and even regulate blood sugar levels, making it a potentially valuable alternative to conventional pharmaceuticals. ❒

Deepening Drought Fears on the Plains

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was pretty much a disaster for the Four Corners," he said.

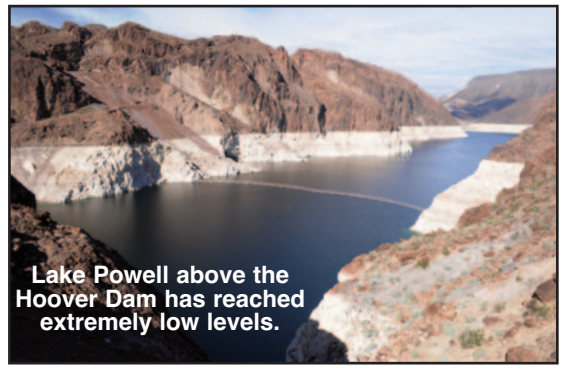
Drought conditions in the Southwest rival conditions that occurred during the Dust Bowl days of the 1930s, when dust clouds whipped up by strong winds blew far across parts of the eastern U.S., even to Washington, D.C., where Congress was motivated to take action to begin remedying this horrible shock to America's agriculture and the entire nation. The Soil Conservation Service (SCS) was born out of this conflagration in April of 1932.

In Oklahoma, some climatological stations in the western part of his state have recorded less than 2 inches of rain since October of 2017. "Some of those stations are pegging the driest 7-to-8 months on record for those locations," said Oklahoma State Climatologist McManus said.

The flow of the Colorado River is greatly reduced. The river will carry only about 43 percent of its average amount of water this year into Lake Powell, one of two big reservoirs on the system (*https://hwd.com/colorado-river-basin-snowpack-43-of-average/*). This means that water supplies to Las Vegas and Los Angeles, which receive much of their water from the Colorado, will be further jeopardized.

In New Mexico, stretches of the Rio Grande have already gone dry as biologists have been forced to scoop up endangered Rio Grande silvery minnows and move them upstream (*https://durangoherald.com/articles/218713*).

Winter wheat production in some areas will be about half of what it was last year. U.S. farmers are expected to harvest their smallest winter wheat crop in more than a decade amid an ongoing drought that has devastated fields across the nation's breadbasket, and a global surplus of the grain that has depressed prices. The National Agricultural Statistics Service forecast the size of the nation's 2018 wheat crop at 1.19 billion bushels. If realized, that would be down 6 percent from the previous year. The last time the nation's farmers harvested such a small wheat crop was in 2002 (*https://wtop.com/national/2018/05/*)



Lake Powell above the Hoover Dam has reached extremely low levels.

Not only are projected U.S. wheat yields down to an average 48 bushels per acre, but the forecast is for just 24.8 million acres of wheat to be harvested, a record low harvested acreage for the United States. Kansas remained the nation's top winter wheat producer even in a dry year like this one, with estimates that the state's growers will bring in 270.1 million bushels. That's compared to the 333.6 million bushels harvested last year. Lane County grower Vance Ehmke said his farm in west central Kansas, where he grows about 2,500 acres of certified wheat seed, has gotten less than 2 inches of rain since October, far less than the 7 inches that would be normal for that period. His neighbor this week plowed up a half section of wheat that was so poor it would not be worth cutting.

"It is just incredibly dry out there," Ehmke said. "Farmers have a well-deserved reputation for whining, but this time we are not kidding."

Yield potential for hard red winter wheat in southwest Kansas and northwestern Oklahoma is roughly half that of a year ago as exceptional drought conditions take a toll on the crop. Some farmers may be forced to abandon their wheat fields due to blisteringly dry growing conditions. Texas prospects are not much better.

Periodic droughts have been the rule for agriculture in the United States, and in virtually all nations. A key to weathering these difficulties is to utilize plants that are adapted to these cyclical assaults of nature, especially deep-rooted perennials that forage for water in the subsoil even in drought conditions. To utilize such field and tree crops is vital if the future of agriculture in America and other nations is to be assured. ❒

Statement of Purpose

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The Enzyme Content of Vitazyme

Studies Into the Active Enzymes in Vitazyme At the Department of Chemistry, Mississippi State University

By Tonia Lane, Ph.D.

This study was designed to determine the presence of enzymes in Vitazyme. The analysis was performed using a modified version of ISO method 22939, which details the use of fluorogenic substrates to measure enzyme activity in soils. The fluorogenic reporting molecule used for this analysis is 4-methylumbelliferone (MUF) and associated MUF-linked substrates are available for each of the enzyme activities listed above.

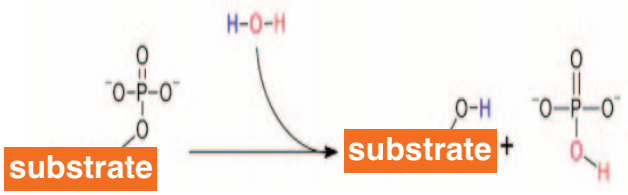
Summary of Enzyme Activity Results

Substrate	MUF Produced (uM)		
	2 hrs	4 hrs	15 hrs
4-MUF-N-acetyl-B-D-glucoamide	1.8	3.6	4.4
4-MUF-phosphate	5.5	18.6	19.8
4-MUF-a-D-glucopyranoside	none	NA	none
4-MUF-B-D-glucopyranoside	none	NR	NR
4-MUF-sulfate	none	NA	none
4-MUF-B-D-cellobioside	none	NA	none

Samples incubated with 2.5 mg/ml substate for 2 hrs at 37°C.
*4-MUF-sulfate concentration is 5.0 mg/ml for sample incubated for 2 hrs.
None = a value of zero or below background.
NA = Data was not collected for the 4 hr time point since no enzyme activity was exhibited at the 15 hr time point.
NR = not reported, values were obtained but the data was not consistent or reproducible.

Conclusions

There is strong evidence of the presence of acid phosphatase in the product. However, it is recommended that additional studies be done using commercially available acid phosphatase as a control to confirm that the breakdown of 4-MUF- phosphate is enzymatically driven, and to quantify acid phosphatase activity in the product relative to microgram amounts of the enzyme. Acid phosphatases are active across a wide range of temperatures and pH. This, combined with inhibition of phosphatase activity by a variety of compounds including phosphate, the product of the reaction, may require some additional refinement of the assay in order to clearly quantify the phosphatase activity. It is also recommended that due to the strong signal associated with acid phosphatase that future investigations and assay refinements be done with this enzyme first.



A phosphatase is an enzyme that uses water to cleave a phosphoric acid monoester into a phosphate ion and an alcohol.

There is convincing evidence of chitinase activity in the product. Additional study using a commercially available chitinase as a control is recommended as a way to both confirm the activity and to quantify chitinase activity in terms relative to microgram amounts of the enzyme. ❐

The Source of Civilization

Let us not forget that the cultivation of the earth is the most important labor of man. When tillage begins, other arts will follow. The farmers, therefore, are the founders of civilization.

Daniel Webster