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The Growers Solution

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On The Road Again in 2001

HOPE TO SEE YOU

Growers Nutritional Solutions is scheduled to set up and staff booths at the following upcoming farm shows and conventions this spring, summer, and fall. It's a great time to stop in and review your fertilization program, hear about new developments at Growers, or just chat with the folks who make it all happen - your friends and neighbors.

March 29-31	Pennsylvania Beef Exp State College, PA
July 10-12	Michigan Ag Expo E. Lansing, MI
August 7-8	Farm Focus Van Wert, OH
August 7-9	Empire Farm Days Seneca Falls, NY
August 7-9	FarmFest Redwood Co., MN
August 14-16	Ag Progress Days Rock Springs, PA
September 18-20	Wisc. Farm Progress Days Janesville, WI
September 18-20	Ohio Farm Science Review London, OH
September 25-27	Farm Progress Show Lafayette, IN
October 4-6	Carolina Farm Show Kinston, NC

Annual Meeting: Special Report

Solution to Cadmium Toxicity

Cadmium is considered one of the most dangerous occupational and environmental poisons for humans. For years numerous scientific reports, primarily from Europe and Japan, have indicated that chronic environmental cadmium exposure is potentially very detrimental to human health. However, there has been very limited information on the effect of chronic environmental cadmium toxicosis in plants and livestock. It wasn't until we became aware of the work of Dr.T.W. Swerczek, DVM, Ph.D., which was featured in "Heavy Metals in Fertilizers" in the *Farm Journal's* 1998, April issue, did we at Growers Nutritional Solutions and likely many others in the industry, realize the significance of this widespread environmental toxicosis which is affecting crops and livestock.

Dr. Swerczek was an invited guest speaker at our annual meeting 3 years ago. At that time he discussed his research on the effect of chronic environmental cadmium toxicosis in plants and animals. He reported that he suspected zinc sulfate as one of the several sources of cadmium toxicosis for feedstuffs and fertilizers. The Environmental Protection Agency recently confirmed Dr. Swerczek's findings by reporting that several thousand tons of zinc sulfate, highly contaminated with cadmium, have been imported from China over the past several years. This contaminated zinc sulfate has been used in feedstuffs and fertilizers throughout the U.S. Other significant sources of cadmium are zinc containing minerals that are not purified, rock phosphates, industrial wastes in sewage sludge and polluted air from the burning of fossil fuels.

Three year-old Hostein heifer showing signs of poor body condition, elevated back, thin narrow neck and rough, rust color hair coat that failed to shed. Dr. Swerczek believes these symptoms are related to cadmium toxicity.

Dr. Swerczek also discussed with us 3 years ago that many feedstuffs, forages and soils have excessive amounts of iron. He pointed out that excessive iron acts like a double-edged sword in that it will not only tie up essential minerals, like copper, which is essential for the immune system, but excessive iron may aggravate gram negative bacterial infections like E.coli and Salmonella. Excessive iron in rations along with cadmium contamination will severely deplete animals of copper making them susceptible to a host of opportunistic diseases. Fortunately, major feed companies are now reporting that they will no longer fortify mineral supplements with iron, primarily iron oxide, as excess amounts will tie up copper.

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Iron is an essential nutrient in small amounts, but may be toxic in excessive amounts. Like iron, cadmium, which is one of the most toxic of all heavy metals is found in trace amounts in the environment and in most soils as a contaminant of zinc. But, unlike iron, cadmium is not an essential nutrient, and in minute amounts may induce toxicosis.

RESEARCH RESULTS UPDATE

Again this year, Dr. Swerczek was an invited guest speaker at our Growers Nutritional Solutions annual meeting and he gave us an update on his research on chronic environmental cadmium toxicosis in plants and animals. He reiterated that cadmium toxicosis is the most overlooked and the most difficult heavy metal toxicosis to diagnose because of the nature the

Two year-old Semmental heifer showing signs of chronic wasting. Note the elevated back, emaciation, rough hair coat, submandibular edema, and staining of the tail from fecal matter due to watery diarrhea. These are symptoms Dr. Swerczek believes are related to cadmium toxicity.

metal. Cadmium is very similar in structure to essential nutritional metal ions, but it is not an essential nutrient, even in minute amounts. Chronic exposure to this very toxic heavy metal will produce an indirect form of toxicosis as it has a negative influence on hundreds of enzymatic systems of cells as it will substitute for essential metal ions, primarily zinc and copper in metalloenzymes.* Also, cadmium has a strong affinity for biological structures containing SH groups.* As a result, the indirect effect on multiple cellular and enzymatic systems will produce many negative effects on the health of plants and animals. The clinical effects of poor health are seen as deficiencies of essential metal ions like copper and zinc, and perhaps others like selenium and magnesium, which are induced deficiencies caused by the cadmium. In most cases, all of these essential minerals are adequate in the diet, but are being inhibited by or substituted for in critical cell and enzymatic systems by cadmium. Probably the most significant negative effect of cadmium toxicosis is on the immune system where it produces a severe immune suppression. The end result of cadmium toxicosis is poor health and the induced susceptibility to a multitude of metabolic and hormonal disorders and numerous opportunistic diseases of plants and livestock.

Calcium will protect against the uptake of cadmium.

Because cadmium toxicosis produces toxic effects indirectly, tissue levels of cadmium by themselves are meaningless as an indicator of cadmium toxicosis. Rather, an understanding of the indirect effects of cadmium toxicosis, primarily induced deficiencies of essential metal ions in important cellular and enzymatic systems, and induced immune suppression, have to be taken into account. Unless the overall clinical syndrome and the indirect effects of cadmium toxicosis are understood, the massive destructive effects of cadmium toxicosis in plants and animals will continue to go unrecognized.

INADEQUATE ANALYTIC PROCEDURES

Another reason that cadmium toxicosis has been overlooked and misdiagnosed is because the analytic procedures for cadmium have been inadequate. Cadmium is very difficult to analyze for and only a few certified laboratories are capable of accurately analyzing for cadmium. In testing for cadmium, other minerals in the sample matrix, primarily phosphates and organic materials in the sample being tested may interfere with cadmium which results in false negative values.

Because cadmium is toxic in very small amounts it is essential that analytical procedures be performed accurately with adequately controlled procedures. The most accurate method to test for cadmium is neutron activation analysis. Other procedures may be used but they are not as sensitive or accurate.

The willow tree grown in zinc and cadmium contaminated soils is concentrating cadmium, and is causing toxicosis to many forms of wildlife.

With all analytical procedures, during the processing and testing, cadmium is broken down to the elemental form, which is then quantified. It is very important that any test results be interpreted with caution. Most testing procedures are very limited and they have to be interpreted in regard to the form in which the cadmium is found. For example, cadmium found in a sample of calcium is likely in an inorganic form and may be relatively non-toxic to plants and animals, as calcium will protect against the uptake of cadmium. On the other hand, the same amount of cadmium found in a sample of zinc or phosphates may be very significant, as it may be highly toxic to plants and animals, especially when there is a calcium deficiency in soils and in livestock rations.

When cadmium is coupled or chelated by organic materials like amino acids, peptides, proteins and carbohydrates, it may be extremely toxic in minute amounts and readily available to plants and animals. Dr. Swerczek feels that bioactivation of cadmium, either naturally by microorganisms and plants or unintentionally during processing of feedstuffs and fertilizers, is the most significant and unrecognized form of cadmium toxicosis in plants and animals today. Dr. Swerczek pointed out that the tobacco plant may concentrate cadmium, but with the currently available analytical techniques for cadmium, only the elemental form of cadmium is quantified. The very toxic bioactivated organic forms that these plants likely contain, most all of which are unknown, are not determined by currently available testing procedures.

THEORY SUPPORTED

To help support his theory on the bioactivation of cadmium, he cited recent research by scientists working in the Rocky Mountain area of Colorado. This work showed that the willow tree grown in zinc and cadmium contaminated soils is concentrating cadmium, and is causing toxicosis to many forms of wildlife in the area, including birds, beaver, deer and elk that feed on these trees. These workers concluded that cadmium poisoning may be more widespread than shown in their study. Like Dr. Swerczek, these workers state that their results suggest that cadmium poisoning may be more common among natural populations of vertebrates than has been appreciated to date and that cadmium toxicity may often go undetected or unrecognized. They also state that even trace quantities of cadmium not only influence the physiology and health of individual organisms, but also the demographics and the distribution of species.

Similar to the findings in the Colorado Rocky Mountains, the tobacco plant, like willow trees, concentrates cadmium. If either of these plants is grown on soils fertilized with nutrients contaminated with cadmium, these plants will uptake and concentrate cadmium. Dr. Swerczek and other veterinarians have observed that cattle

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*__metalloenzyme:__ *An enzyme is a protein with catalytic properties, that is, it increases the speed of a chemical reaction without being consumed or irreversibly altered by the reaction process. A metalloenzyme is an enzyme (or protein) that is associated with a metal cation (such as calicum or zinc). In many biological processes the enzyme can only function if the enzyme is complexed with a particular metal cation. This reveals that the process (the lock) will not function without the proper metalloenzyme (the key).*

SH groups *are what are termed sulfhydryl groups and they are usually associated with enzymes and allow enzymes to catalyze biological processes in the same lock and key relationship as with metalloenzymes. The only difference is that sulfhydryl groups control the enzyme through pH changes rather than by specific metal cations.*

that graze grass fertilized with tobacco stalks from plants that have been fertilized with phosphates, a known source of cadmium, have a high incidence of metabolic disorders with clinical signs of tetany and paresis.* It is Dr. Swerczek's theory that the cadmium is leaching out of the tobacco plants and is being absorbed

Cattle that graze grass fertilized with tobacco stalks from plants that have been fertilized with phosphates have a high incidence of metabolic disorders.

by rapidly growing grass and a biologically active form of cadmium is readily available to cattle through the grass. The cadmium replaces essential metal ions at the cellular level, especially calcium and magnesium. In many cases there is a hypocalcemia* which further enhances the absorption of cadmium. Magnesium is usually available, in many cases in excessive amounts, but like copper, there may be an induced deficiency of magnesium at the cellular level.

METABOLIC DISORDERS TRACED

Dr. Swerczek has observed that, if cattle graze pastures that are heavily fertilized, seemingly, they are more susceptible to metabolic disorders like grass tetany. Similarly, he has also observed that if fescue grass is heavily fertilized, clinical signs of fescue toxicosis are exacerbated. Interestingly, Dr. Swerczek indicated that many of the clinical signs of fescue toxicosis are identical to those seen in cattle suffering from clinical signs consistent with chronic environmental cadmium toxicosis in that both have clinical signs of an induced copper deficiency. He now feels that the fescue plant may be similar to willow trees and tobacco plants, and may be also concentrating cadmium. The fungal endophyte within the fescue plant may be bioactivating the cadmium, working synergistically to make both the endophyte and cadmium more available and toxic to the animal. Dr. Swerczek suggested that since the fescue plant is native to mountainous areas and thrives on poor high mineral soils where other grasses fail, it may be concentrating cadmium similar to willow trees in the Rocky Mountains.

The fescue plant may be similar to willow trees and tobacco plants, and may be also concentrating cadmium.

He has support for this theory with the work he has observed on the Bill Gess farm, near Lexington, Kentucky, where cattle not only have had clinical signs of grass tetany, but also had severe clinical signs of fescue toxicosis. The forced feeding of both magnesium and copper did not prevent clinical signs of either syndrome. This farm had fertilized pastures that had a considerable amount of endophyte infected fescue grass, with tobacco stalks and phosphates fertilizers.

Three year-old Angus cow showing signs of poor body condition: rough, long rust color hair that is not shedding. All cows in herd showing same clinical signs believed to be signs of cadmium toxicity, and were grazing a mixed grass pasture with fescue grass.

SOLUTION OFFERED

At Dr. Swerczek's recommendations, the farm stopped spreading tobacco stalks on the pastures and the pastures were not fertilized with nutrients likely to contain cadmium. Also, the cattle were not supplemented with nutrients likely to contain excessive amounts of cadmium.

FARM'S PROGRAM

Bill Gess outlined and followed a program with the help of the farm's veterinarian in an attempt to overcome clinical signs of chronic environmental cadmium toxicosis on the farm. For two years, the pastures were not fertilized with tobacco stalks or fertilizers likely to contain excess cadmium, and the cattle were fed non-fortified salt and calcium carbonate with added copper sulfate. On the third year, calcium and Growers Nutritional Solutions were applied to the pastures several times during the growing season. In addition, the cattle had access to free choice Growers Nutritional Solutions.

Remarkably, the grass was lush with this practice and all signs of grass tetany and fescue toxicosis disappeared in a large herd of beef cattle. The cattle on the farm are now healthier, cows have high calving rates, calves are very vigorous at birth and the weaning weights are higher in the calves. What is even more remarkable, the farm has the same amount of endophyte infected fescue, and clinical signs of fescue toxicosis and grass tetany have disappeared in the herd.

QUESTIONS & POTENTIAL ANSWERS

The observations on this farm support Dr. Swerczek's theory that cadmium may be involved with both grass tetany and fescue toxicosis. Currently, the mechanisms of action for the cause of both syndromes are poorly understood. Dr. Swerczek's observations are extremely interesting and merit further study as grass tetany and fescue toxicosis are both very costly diseases of the cattle industry.

He cited another precedent for his theory that cadmium may be bioactivated by microorganisms and plants. The Japanese scientists have shown years ago that inorganic forms of mercury, another similar very toxic heavy metal, are being bioactivated to very toxic organic forms, primarily methylmercury, by microorganisms and fish. For this reason he feels that currently available analytical procedures for cadmium are meaningless in terms of levels found in specimens tested. To determine the significance of cadmium in a sample, the biological form and bioactivity of cadmium is important.

Dr. Swerczek provided us with numerous case histories from several farms from different states that have had severe crop and livestock losses with clinical signs consistent with chronic environmental cadmium toxicosis. He pointed out that in all cases where the source of cadmium contamination was identified and removed, crops and livestock have made dramatic recovery towards better health.

Observations support the theory that cadmium may be involved with both grass tetany and fescue toxicosis.

Unfortunately, these improvements will not occur immediately as cadmium will remain in the soil until plants remove it and in exposed animals it will remain in the body for months and years. The most dramatic results are seen when new crops and new animals are not exposed to significant amounts of this very toxic heavy metal.

Dr. Swerczek pointed out that soils on farms

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*__paresis:__ *partial paralysis affecting muscular motion but not sensation.*

hypocalcemia (milk fever): *a metabolic disorder in which calcium control mechanisms fail to maintain normal blood plasma calcium concentrations at the onset of lactation. In other words blood calcium concentration decline in nearly all cows at calving as a result of the sudden onset of milk production. In some cows, blood calcium falls to the point where it no longer will support nerve and muscle function and the cow goes down with milk fever.*

with an adequate amount of calcium, and farming programs that utilize calcium and purified fertilizers have very healthy crops. The soils on these farms are healthier and farmers are reporting the return of numerous earthworms.

Farms with adequate calcium or that utilize calcium and purified fertilizers have very healthy crops.

Cadmium is not only very detrimental to plants and animals, it is also very destructive to beneficial microorganisms and earthworms that are essential for optimal soil health. Even more remarkable than the health of the plants, crops and vegetables grown on these soils is the health of the livestock that are being fed these high quality healthier crops and forages. These animals will not only consume less feed, but they perform better and are nearly free of metabolic disorders, induced mineral deficiencies and opportunistic diseases that are plaguing the livestock industry today.

Biographical Information

Dr.T.W. Swerczek, DVM, Ph.D received his B.S. and DVM degrees from Kansas State University in 1964, a M.S. degree in Nutritional Pathology in 1966 and a Ph.D. in Comparative Pathology in 1969 from the University of Connecticut.

Dr. Swerczek's research is in the area of Nutritional Pathology and The Interrelationship between Nutrition and Infectious Diseases, and the effect of environmental plant toxins on induced essential mineral deficiencies and immune suppression of livestock.

As a Veterinary Pathologist, Dr. Swerczek has performed several thousand necropsies of livestock of all classes, including fetuses, neonates and adult animals. He has extensive experience in working with veterinarians, livestock owners, farm managers on nutrition and its effect on infectious diseases of livestock.

Dr. Swerczek is a native of Nebraska with a farm background. He consults with his brother Steve who operates the family's farm in Nebraska where their cow-calf operations are raised on native grasslands. Corn, soybeans and alfalfa are grown on land fertilized with purified nutrients. The feedlot cattle are raised on rations free of antibiotics and hormones.

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More About Growers

We hope you will find this newsletter helpful and interesting and we welcome your input. Please send letters-to-the-editor, comments, suggestions, etc. to: Growers, P.O. Box 1750, Milan, OH 44846 or call 1-800-437-4769 or fax 419-499-2178 or **e-mail to: growers@web-seller.com**

Cadmium analyses by various independent testing laboratories on Growers Nutritional Solutions show very low levels compared to other fertility and mineral supplements.

Dr. Tom Swerczek (right, wearing camera) and Wallace Garrett (next to Dr. Swerczek) discuss an examination of Garrett's cattle (review *The Growers Solution*, Fall, 1999).

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FIRST CLASS

Inside:
A discussion concerning one of the most dangerous occupational & environmental poisons

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