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The Growers Solution

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Revisiting The Kamman Operation

By Jim Halbeisen

In the past *The Growers Solution* has carried articles on Mark and Sue Kamman of Vallonia, in southern Indiana. Their farm has been raising vegetables every year since the late 1800s. Always interested in the happenings at the Kamman's, on a return trip from southern Illinois in the fall of 2006, I stopped in to see them.

Mark said southern Indiana had extremely cold weather in the spring of 2006, so crops started growing very slowly and plant reproductive growth (blossom growth) tended to be weak. To help things along, Mark included Growers Nutritional Additive (GNA) in his early Growers Mineral Solutions (GMS) sprays.

GNA is a plant growth regulator which has been used experimentally as an additive to GMS sprays for well over forty years. GNA functions as a stimulator to reproductive growth which may have been affected by stressful weather conditions.

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Mark and Sue Kamman's attractive Southern Indiana farm market.

Soils, Their Use, Abuse and Restoration

(In this, the fourth segment of the series, Sam Niblett describes his trepidation during his first year trying, on a limited basis, the Growers Program.)

By Sam Niblett

I applied 8 tons per acre on one field and doubled it on one section. Ouch! Sixteen tons per acre and on one of my best fields. Better write that one off. I shuddered!!

1978 - 1979

I called Wilbur one day in March because things were getting much closer to spring and I was nervous. I had come through a tough winter of low prices and potatoes that didn't keep too well, plus I had a field with 8 to 16 tons of lime per acre on it! What next?

I said, "Wilbur, I have shown faith in you. I have put on the limestone, and, now, I am not doing another thing until you come to Maine." So, on May 3, 1978, Wilbur Franklin came to Aroostook County, Maine, 1200 miles from his home base, to try to convince me that I was not crazy after all. In an attempt to free up funds for limestone and not reduce yields, we made plans to reduce the dry fertilizer and to foliar feed the potatoes through the summer with Growers 10-20-10. Planting arrived and in went the check plots with 500, 700 and 1200 pounds of dry fertilizer. Actually nothing received over 1200 pounds that year, a far cry from the 2300 pounds per acre the year previous. I spent the summer looking for trouble and didn't find any. That fall a field that had received 5 tons of limestone (half the recommendation) yielded 178 barrels with 500 pounds of fertilizer, 175 barrels with 1200 pounds of fertilizer and 205 barrels on Wilbur's 700 pound suggestion. Good guess, eh Wilbur?

What about the 15 ton strips? I didn't dare look all summer. Finally, I had to kill the tops for harvest and that day they showed a yield of 209 barrels an acre. Three weeks later when I harvested them, they yielded 232 barrels per acre of the most beautiful superiors I had ever seen. And no scab either! "Father Franklin" had

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Inside The Solution

Nutrient Functions in Plants

By Jim Halbeisen
Director of Research

In recent years, farm producers' interest in trace elements (micronutrients) has increased significantly. Specialty crop farmers have regularly sought micronutrient knowledge, but today even grain farmers are coming to realize trace elements can be important in everything from row starters to foliar applications.

One of the best of the more recent plant nutrition books is Horst Marschner's *Mineral Nutrition of Higher Plants*. The book is a very thorough reference and forms the basis for this article. It also is the source for the tables (shown at right) that originally appeared in Emanuel Epstein's *Mineral Nutrition of Plants: Principles and Perspectives*.

We agree with the plant physiologists who maintain plants grown in soil cannot be reliably used to establish whether a mineral element is essential. Water or sand culture experiments need to be used to determine the extent of an element's need. Dr. V. A. Tiedjens, an accomplished chemist as well as a noted agricultural scientist used water and sand culture techniques along with analytical chemistry in formulating Growers Mineral Solutions more than 50 years ago. It was a very long, tedious and complicated process, but he successfully determined the roles of various elements in plant nutrition and, eventually, the balanced nutritional content of GMS.

For an element to be considered essential for plant growth and reproduction, scientists say three criteria must be met:

1. A given plant must be unable to complete its life cycle in the absence of the mineral element.

2. The function of the element must not be replaceable by another mineral element.

3. The element must be directly involved in plant metabolism. For example; As a component of an essential plant constituent such as an enzyme, or it must be required for a distinct metabolic step such as an enzyme reaction.

Essential elements are needed for plant growth and enable the plant to perform its basic functions:

1. They serve as constituents of the plant's structure.

2. They activate chemical reactions in the plant which allows the plant to grow to maturity. These reactions are called enzyme reactions. (Enzymes are proteins that allow chemical reactions to occur.)

3. They carry electrical charges that supply energy to various parts of the plant.

4. They control salt concentrations which controls the flow of water in the plant.

Essential elements have certain functions in a plant's growth cycle and the quantity needed of each element or mineral determines whether it is a macronutrient or micronutrient

The macronutrients most often listed are; N (nitrogen), P (phosphorus), K (potassium), Ca (calcium), Mg (magnesium), and S (sulfur). (Table I)

The micronutrients (trace elements) are usually Fe (iron), Mn (manganese), Zn (zinc), Cu (copper), B (boron), Mo (molybdenum), and Cl (chlorine). (Table II)

See Tables III and IV for macro and micronutrient deficiency symptoms. ■

TABLE I — Macronutrient Functions

Nitrogen (N) — major constituent in the structure of plant tissue; physical shape influences nutrient transfer and conversion; influences growth control; aids in toxin excretion; influences salt concentration to control water flow.
Phosphorus (P) — major component of structures carrying genetic information; controls pH of cell solutions; responsible for storing and transporting energy inside the cell; helps trap sunlight energy.
Potassium (K) — major influence on salt concentration to control water flow; carries electrical energy; modifies cell structures to influence chemical reactions; helps to control nutrient concentration during plant tissue construction.
Calcium (Ca) — major building block in all cell structures which gives the plant physical stability; carries electrical energy related to the plant's environment; serves to neutralize certain toxicities in the plant's environment; stabilizes plant structures to protect the plant from infection; controls water flow by influencing salt concentration.
Magnesium (Mg) — shape is important in forming structural complexes, most important of which is the structure chlorophyll; helps to form complexes that contribute to chemical reactions in plant tissue, some of these reactions influence plant energy conversion.
Sulfur (S) — important constituent of cell protein; directly involved with certain structural synthesis.

TABLE II — Micronutrient (Trace Element) Functions

Iron (Fe) — helps control chemical reactions through its ability to pull and push electrical charges; constituent of certain tissue structures.
Maganese (Mn) — structural shape allows many chemical processes to function within plant tissue; neutralizes possible toxic by-products of breathing.
Zinc (Zn) — structural shape allows protein, carbohydrate and many other building block reactions to occur in plant tissue; neutralizes possible toxic by-products of breathing, influences growth regulator that controls fresh tissue growth.
Copper (Cu) — helps to trap and transfer electrical cell energy; neutralizes possible toxic by-products of breathing; physical shape helps with structural soundness of cell walls and reproductive tissues.
Boron (B) — physical shape helps to bind tissue together that builds structural integrity of the plant's cell walls; helps build integrity in root tissue and various membranes in cell tissue; physical size helps to transport nutrition through out plant tissue.
Molybdenum (Mo) — necessary to allow microbes around the roots to fix atmospheric nitrogen in both legumes and non legume plants; physical size influences chemical reactions that move nitrogen compounds through plant tissue.
Chlorine (Cl) — helps to control pH in cell tissue; influences water movement in plant tissue by controlling salt concentration.

TABLE III
Visual Symptoms of Macronutrient Deficiencies

N (Nitrogen) — pale, yellowish green leaf color in early growth stages; highly colored tints of yellow, orange, red, or purple on older foliage; discoloration starts on old foliage then moves to younger foliage, restricts all tissue growth.
P (Phosphorus) — leaf color is dull, bluish green and shows tints of purple; leaf color may show dull bronzing with purple or brown spotting.
K (Potassium) — leaf color may be dull bluish-green and there may be some chlorosis (whitening or yellowing) in intervenal area; beginning on older leaves there will be browning of the tips; marginal scorching and development of brown spots usually most numerous near the leaf margins.
Ca (Calcium) — young leaves are distorted with tips hooked back and margins are curled; margins show brown scorching or spotting on thin chlorotic marginal bands; roots are poorly developed.
Mg (Magnesium) — chlorotic effects are common and develop initially in the older leaves and proceed systematically toward the younger leaves.
S (Sulfur) — discoloration similar to N deficiency; leaf size is decreased and become rolled toward the upper surface and become stiff and brittle.

TABLE IV
Visual Symptoms of Micronutrient Deficiencies

Fe (Iron) — Chlorosis of the leaves; bleached appearance to chlorosis in a mottled pattern; may have scorching of leaf margins and tips.
Mn (Manganese) — chlorosis of leaves; somewhat yellowish, gray, or buff-colored specks or streaks appear on the leaves; intervenal chlorosis
Zn (Zinc) — intervenal chlorosis often with purple pigmentation; malformation of leaves.
Cu (Copper) — die back of young growth; burning of leaf margins; chlorosis.
B (Boron) — die back of growing point; poor formation of young leaves; browning of leaves or stems.
Mo (Molybdenum) — marginal chlorosis; withering or foliage wilting; young leaves fail to unroll; reproduction growth is severely limited.
Cl (Chlorine) — wilting of leaves at leaf margins; young leaves curl followed by shriveling and necrosis (death of tissue).

Mineral Nutrition of Higher Plants by Horst Marschner, 1995
Mineral Nutrition of Plants: Principles and Perspectives by Emanuel Epstein, 2004

Lime To Win

By Jim Halbeisen

The following (at right) is a letter from Jim Halbeisen to the Field Agronomist of *Farm Journal* and to the author of an article that appeared in the October, 2006, issue of *Farm Journal*. Their report correctly focuses on the important subject of soil life, but, in the process, it puts emphasis on pH as the cure-all. Jim explains that calcium, along with its attendant benefits, truely encourages needed soil bacterial life. (Eds.)

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October 30, 2006

Darrell Smith
Ken Ferrie
Farm Journal
P. O. Box 958
Mexico, MO 65265

Dear Sirs:

The article *"Lime to Win"* in the October issue of *Farm Journal* discusses, what we believe to be, some of today's very important production agriculture topics. It did fail, however, to stress a most important element needed in agriculture, that being calcium (Ca).

We agree completely with the article's heavy focus on microbial management because this area receives little, to no, attention in agricultural literature, or else it is ridiculed as being important only to "organic fanatics."

Those with farming experiences from the past know very well the benefits derived from old bedded livestock manure or from a plowed down alfalfa crop. However, the opportunity to profit using these practices rarely occurs on modern row crop farms today. But by referring to the science of soil biology, options are available which can help microbes exist and function better in today's agricultural environment.

Examining classic soil chemistry references such as; *Chemistry of the Soil* by Firman Bear or the *1938 Yearbook of Agriculture Soils and Men*, we see that adjusting pH is important. But the writers also emphasize that it is necessary to provide the proper cation ratio balance on the cation exchange capacity (CEC) to let the soil achieve proper physical properties needed to promote aeration and water infiltration. According to Firman Bear, the exchangeable Ca in the "ideal soil" should be 65% of the CEC and exchangeable magnesium (Mg) should be 10%. Earlier soil chemists claimed the Ca levels should be even higher in relation to Mg. It is very important that the exchangeable Ca and Mg levels in liming materials used for pH adjustment be addressed. If a soil is in need of pH adjustment and its exchangeable Ca and Mg are improperly balanced, it may be prudent to use a liming material having a higher Ca level in relation to its Mg level. Flocculation, a soil condition which promotes aeration and water infiltration, will be impeded when Ca and Mg are not properly balanced. Recommending the use of lime containing higher levels of Ca is in harmony with the *"Lime to Win"* article's references to the "need to maintain a healthy population of soil organisms". The increased aeration of soil caused by calcium's flocculation effect is paramount for a healthy population of soil microbes. According to Martin Alexander's *Introduction to Soil Microbiology*, "Oxygen (O) is an obligate requirement for all (microbial) species concerned, making adequate aeration essential". Alexander says microbial inhibition is not always the result of "hydrogen ion concentration", but Ca deficiencies can also allow certain types of toxicities to occur which only adequate Ca additions can relieve.

The *"Lime to Win"* article relating residue accumulations in the field to today's reduced soil microbial populations is totally correct and right on the mark. It is interesting to note that the *1957 Yearbook of Agriculture Soil* notes that "Earthworms are important agents in mixing surface organic residues with the underlying soil. The earthworms flourish best in well-drained soils that contain abundant organic matter and continuous supply of available calcium".

Some agronomists feel high levels of Ca in the soil environment could lead to soil solution injury, meaning too high a soil pH could cause trace element tie-ups. Creating high soil pH levels using high calcium lime sources is not likely to happen because the chemistry of the Ca ion can only allow the soil solution to reach a pH of 7.2. If the pH goes over 7.2, it is other elements of higher solubility, such as Mg or potassium (K), which are responsible for the increase in pH. In fact, recent plant physiology literature places great importance on high levels of Ca in the root zone. Horst Marchner in *Mineral Nutrition of Higher Plants* states, "In order to protect roots against the adverse effects of high concentrations of various other cations in the soil solutions, the Ca concentrations required for optimal growth has to be much higher in soil solutions than in balanced flowing nutrient solutions".

Again, complements on the *"Lime to Win"* article and on your continuing excellent work making *Farm Journal* one of the best sources of information for the "hands on" producer. We frequently have our sales representatives refer to *Farm Journal* for pertinent agricultural information.

Sincerely yours,
GROWERS MINERAL SOLUTIONS

James L. Halbeisen
Director of Research

On The Road Again

SPRING 2007

Growers Mineral Solutions is scheduled to set up and staff booths at the following upcoming farm shows and conventions this winter, spring and summer. It's a great time to stop in and review your plant food and animal nutrition needs, hear about new developments at Growers or just chat with the folks who make it all happen—your friends and neighbors.

Feb. 27-28	Pennsylvania Grazing Conference Grantsville, PA
Feb. 27-Mar.1	Central Minnesota Farm Show St. Cloud, MN
Mar. 7-9	Western Fair Farm Show London, Ont., Canada
Mar. 27-29	Wisconsin Public Service Farm Show Oshkosh, WI
July 17-19	Michigan Ag Expo Lansing, MI
Aug. 7-9	Empire Farm Days Seneca Falls, NY
Aug. 7-9	Farmfest 2007 Redwood Co, MN
Aug. 14-16	Pennsylvania Ag Progress Days Rock Springs, PA

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Inside:

Kamman Operation

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Mark and many other vegetable growers regularly use GNA to invigorate crop blooms when plant vegetative growth and reproductive growth are not in balance. GNA is applied with GMS to the target crop usually at the recommended rate of one gallon of GNA per 15 acres of crop, while the rate of GMS applied depends on the amount of mineral needed for the particular crop.

GNA is usually applied along with weekly GMS one gallon per acre sprays or with other spray applications. In most years Mark finds one spray of GNA at the recommended one gallon per 15 acre rate is enough, but there are seasons when he will need to include the GNA more than once to help achieve uniform vegetative and reproductive growth. Those are years when blossom growth is weak, vine (vegetative) growth is too deep which does not permit good set, or during other periods of stress.

It is important, as Mark says, to recognize and identify stresses early so the GNA can be applied as quickly as possible, but caution must also be exercised not to overdo the GNA, thus getting the plant into excessive reproductive growth for the amount of vegetative growth available. Tinkering with GNA is best before being too overly aggressive with its use.

An interesting side light came out of our visit with Mark. Over the last two seasons he grew strawberries with plastic on raised beds but without irrigation or nitrogen. He ends up spraying a total of about 4 gallons of GMS per acre for the season. Mark said he started picking May 1, 2006 and picked for about 8 weeks. Limiting the nitrogen, he believes, extended his strawberry season nicely.

His experience with other crops has shown him using nitrogen can increase fruit size for a period of time, but the plant will run out of productivity sooner. So, in the long run, he gets more production with a longer picking season without nitrogen. Others trying to duplicate Mark's responses using no nitrogen may not be so successful unless they have similar soil conditions. Mark's soils have received repeated very large quantities (20 to 30 tons per acre) of high calcium limestone.

Because they help early cash flow, Mark plans to incorporate other berry crops into the vegetable mix of his operation. ■

Soils, Their Use, Abuse

Continued from page 1

done it again!

"One robin doesn't make a spring," but I decided to line up some limestone, just in case this "Calcium Guru" turned out to be right predicting potatoes grown on the "Growers Program" would keep until June. This would be because the mineral balance was in line and the specific gravity was higher. It sounded like good salesmanship to me, but I could check the specific gravity because the processor gives bonuses for higher readings. That other business about the "mineral balance" would have to go on the back burner until I could understand it.

That spring, 1979, I planted superiors from the field that had 16 tons of lime spread on it because I found them to have a higher specific gravity and better mineral balance! There was less molecular water found within the tissues, the skin was much thicker, pressure bruising from being piled high in the bins was negligible, and weight loss was reduced. In a word, the potatoes were physiologically complete. ■

The Growers Solution

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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, call 1-800-437-4769, fax 419-499-2178,
email to: growers@hmcltd.net or see our website: www.growersnutritional.com

March is the Last Month for a Discount!

Early Order Discounts

It's not too late to take advantage of the Growers seasonal Cash In Advance of Delivery (CIAD). The CIAD for March is 2%. After March, there will be no additional discounts for the rest of the growing season. Call your Growers representative for an explanation of the early order discounts, quantity pricing, and delivery of Growers Mineral Solutions. ■