The Vital Earth News

Agricultural Edition

Volume XI, Number 2 | Vital Earth Resources • Gladewater, Texas | Summer 2004

The KEY to GOOD HEALTH

by Eric Eweson

[This is part 2, and the conclusion, of an eye-opening special report by this noted Swedish biochemist as reported in The Plain Truth*, March, 1962, from a lecture delivered at Ambassador College, Pasadena, California.]*

What can be done to correct this situation is of course the big problem. There is a great deal of difference in opinions. There are still some people who believe that with more and better chemicals we can restore our soil. There are even those who think that by new methods of growing — producing more or less synthetic food — we can solve the problem. But there are others of us who believe this to be wishful thinking.

You have probably heard of *hydroponics*, a method of growing plants in a water solution of the major plant nutrient elements. No doubt one can grow plants that way — I have grown some myself — but there are some very significant consequences. The plants will, for instance, not produce seeds capable of germination. They are also extremely frail and spoil quickly.

The *nutritional value* is, however, where the changes are the most fatal, as the plants contain *practically no protein*! While you will find nitrogen in them, it has not combined to build up proteins but remains in the form of nitrate or, still worse, nitrite.

These men from the Republic of Georgia in the Caucasus Mountains were born in 1862, making them 114 years old when this photo was taken. Soil fertility plays a big role in longevity.

Our bodies can't produce protein from these simple elements. We must have the proteins more or less ready made for us as all we can do is to modify them to suit our particular requirements. The same holds true of our animals since only plants and microbes can build proteins.

If plants are grown in a manner that they lack in protein, as hydroponically grown plants do, then there isn't much use in growing them! Other ideas have been proposed for producing food. Growing fungi or algae would seem both logical and sensible until you begin to scrutinize what it implies. I have considerable experience from large-scale manufacture of fungi which may help to throw light on the problem. Let me tell you the background.

Substitute Nutrients Tried

As you probably all know, paper mills have a very objectionable waste that pollutes rivers and spoils the water for fishing and bathing. It has long been considered to be a useless waste product, but it isn't so at all!

An old Swedish friend of mine conceived, many years ago, the idea of man-

See Compost Brings Soil, page 2

The Glues That Boost Your Yields

By Paul W. Syltie, Ph.D.

The subject of "glues" for agriculture has probably never crossed your mind, unless perhaps for repairing truck upholstery or punctured tires. Yet, glues have a great deal to do with successful farming and profitability, in ways you may have never imagined.

The glues and adhesives we are talking about here are those found in the soil which bind together clay, silt, sand, and organic particles to create the structure that is so vitally important for proper air and water movement throughout the root zone. Without the efficient movement of air and water, plants roots cannot reach out into the soil to gather nutrients and water effectively, nor can the critically important rhizosphere organisms that colonize root surfaces multiply and feed the plants their array of available nutrients, vitamins, growth regulators, and antibiotics. Neither can rain water rapidly infiltrate the soil to replenish surface and subsoil stores, but will collect on the soil surface and run off, eroding valuable topsoil. While many factors are important in establishing and maintaining soil structure (see the box on the left), these glues are perhaps the most important.

Factors Affecting Soil Structure Development

- ***Organic matter: character, amount***
- ***Sand, silt, and clay content***
- ***Nature of the clay minerals***
- ***Microbial populations and activity***
- ***Freezing and thawing***
- ***Wetting and drying***
- ***Earthworm activity***
- ***Ant and insect activity***

Glues That Bind

The sticky substances that bind soil

See Polysaccharides , page 6

© 2004 Vital Earth Resources
All rights reserved

Compost Brings Soil Back to Life!

Continued from page 1

ufacturing baker's yeast from this very serious polluting agent. After some experiments a factory was built in Finland — it was a great success — whereupon I built two similar factories in Canada.

This paper mill waste, usually referred to as sulphite liquor, is a much worse polluting agent even than sewage, although the latter is probably the one that we are most generally disturbed by, since now most of our rivers are polluted by it. I am making this introduction to show you that "waste products" is really not the proper name. They should better be called "by-products" because they are seldom useless and become objectionable *waste* products only when we fail to use them properly.

Compost , properly made, is as sanitary as it is nourishing to plants. This compost in Germany is near a populated area but causes no offensive odors.

In modern yeast manufacturing methods one uses *cheap chemicals* for most of the nutrients instead of the more expensive organic materials like malt or grain, from which yeast was originally made in bygone days. In other words, *one substitutes inexpensive CHEMICALS for expensive ORGANIC materials*! This has a drastic effect on the fungi.

One effect is that they become weak and lose much of their virility and resistance to infections, so that a yeast factory has to be conducted under sterile conditions much like an operating room in a hospital. There must be no *wild* yeast or other microbes in the air, because if any such microbes — especially wild yeast which has been produced *naturally* and therefore is *very virile* — should get into a mash of *synthetically fed yeast*, they would quickly devour the whole batch!

Another very significant point is that after a number of generations the *chemically grown yeast fungi lose their powers of reproduction*. The yeast is then no longer usable as seed and one has to start with a fresh culture of naturally grown yeast every few weeks.

The above is particularly significant from the point of view of plant nutrition, as we know that *exactly the same thing* occurs in modern agriculture in respect to corn. Few farmers today can use their own grain as seed. They have to buy special seed because their own grain, if grown many years on poor, chemically fertilized soil. won't germinate. This may be looked upon by many as comparatively unimportant. But it is of basic importance for understanding that what we produce as food and what man has been accustomed to existing on for so many thousands of years cannot suddenly be changed without serious consequences to man's health.

By not giving back to the soil the by-products of life, like our city wastes, and by soil not deriving any benefit from the "droppings" of tractors and other machinery, there is a new situation in modern agriculture which necessitates a drastic change in point of view.

We have to find some way of returning our organic *by*-products — not *waste* products — to the land. In our urbanized civilization, with the greater part of the population living in cities and only a very small part on the land, it is becoming a question of "to be or not to be".

Composting an Ancient Solution

In manuscripts from the 8th and 9th centuries, we find descriptions of the methods they used to convert their by-products into soil. They had seen that organic matter would disappear if it was not put in the soil, and they took the hint from that and developed it in a very efficient and a very systematic way.

In densely populated countries they could not well afford to conduct the process of by-product conversion on the crop land. Thus they always built their compost piles away from the productive fields, and not until the compost was ready did they put it on the land. This was more efficient than our ways.

When our farmers do have a fair supply of manure, it is put directly on the land to let it slowly decompose there. Naturally that is a good method, too, but if productive land is short in supply, it is well to prepare the fertilizer away from the field and not put it on the land until it has been fully converted into humus, and is immediately available to plant life.

It is to be noted that as long as the ancient agriculturist used his "wastes" in the described manner, as was done in China, Persia and Babylonia over long periods, his soil would not lose, but increase in, fertility. It was usually as a result of prosperity gained through wars, conquest and commerce that neglect of the soil and its "law of return" developed and the land gave out.

Coming back now to this fermentation process whereby organic waste materials are converted into humus by soil microbial activities: Pasteur was first to teach us what was going on in those old compost piles. Today, we know better how to process garbage and sewage and how to inoculate with the right kind of soil microbes for the best utilization of these materials to produce a high-grade natural compost or humus that looks and smells like fertile topsoil.

"... as long as the ancient agriculturist used his "wastes" in the described manner ... his soil would not lose, but increase in, fertility. "

It will be startling to many to learn that this process can now be completed in less *days* than it formerly took *months*. It can be done on a very large *industrial scale* to suit any size of community. Costly-to-dispose-of city refuse and sewage now causing serious air and water pollution can thus be the means of rehabilitating our abused soil! □

Weed Resistance to Roundup Is Increasing

Washington (AP)

Increased findings that weeds are developing resistance to Roundup, the world's most popular herbicide, have some scientists urging new planting practices while the product's manufacturer says the problem is being overblown.

Roundup, whose generic name is glyphosate, has been on the market for more than 30 years. It long has been a favorite of farmers, home gardeners, and golf course greenskeepers because of its effectiveness in killing weeds.

It allows growers to cut back on tilling, a more labor-intensive and expensive method of controlling weeds and does not pollute the environment.

"Roundup Ready" crops, which have been genetically altered to tolerate the chemical, now cover much of the nation's farmland since their development in the late 1990's. They allow farmers to widely spray the glyphosate herbicides without harming the crops.

The Agriculture Department estimates that 80 percent of the 73 million acres of soybeans in the United States are Roundup Ready soybeans and that Roundup Ready cotton accounts for more than 30 percent of the 12 million acres planted. The corn variety, still new to the market, covers 11 percent of 70 million acres.

"Farmers are planting too many Roundup Ready crops," said Stephen Powles, an expert on weed resistance at the University of Western Australia. "It's vital for the food production system in the United States and many other parts of the world. I think the problem will become a crisis."

In 1996, Australia was the first to note weed resistance to glyphosate was developing in rigid ryegrass found in a few grain and sorghum fields. Five years later, South Africa reported seeing the rigid ryegrass had infested a few hundred acres of vineyards.

In 2000, University of Delaware scientists reported to the Weed Science Society of America, which tracks farm chemical resistance, that in some soybean fields, mare's tail was resisting glyphosate. Since then, resistant mare's tail has been reported in other states — Indiana, Kentucky, Maryland, New Jersey, Ohio, Arkansas, Mississippi, and Tennessee.

Far more worrisome are cases in Iowa, Illinois, and Missouri, where glyphosate is becoming ineffective on abundant weeds such as velvet leaf and waterhemp.

Allan Felsot, an environmental toxicologist at Washington State University, said it is inevitable that weeds will naturally develop resistance to a pesticide. He dismissed the idea they might be picking up a resistant gene from Roundup Ready soybeans, corn, or cotton.

"Anytime you have a place where you're using a strictly singular herbicide, you may end up with some resistance in some cases," he said.

Nonetheless, some scientists want farmers to alter their planting practices to assure that Roundup and competing brand names of Gylyphosate maintain their effectiveness as a herbicide in the future. Powles advocates cutting back on plantings of Roundup Ready crops.

Mark VanGessel, a scientist at the University of Delaware, advocates a more

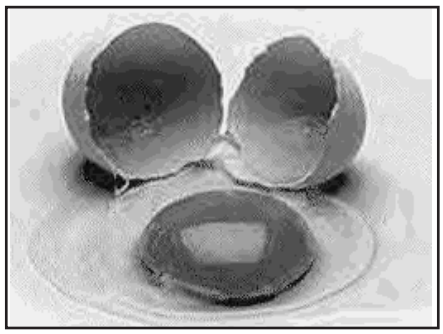
See Weed Resistance, page 7

The Egg: A Nutritional Heavyweight

by E.W. McDonagh

If chickens had a union, they would undoubtedly go on strike over the "bum rap" given to this ultimate in square meals — the egg. Literally chocked with vital nutrition, eggs are a powerhouse of protein (from 3 to 6 grams), carotenes, choline, vitamin B_{12}, calcium, zinc, sulfur, magnesium, vitamin A (which makes the yolk yellow), vitamins D, E, and K, iron, riboflavin, niacin, potassium, and sodium. The controversy over cholesterol (one egg supplies a day's quota) resulted in heart patients being restricted to one or two eggs a week. But research has shown that eggs raise HDL (good) cholesterol, a substance the body can't live without for insulation of nerve fibers, maintaining cell walls, producing vitamin D, hormones, and digestive juices. Even a Harvard study in the *Journal of the American Medical Association* found no relationship between eating whole eggs and risk of heart disease or stroke in men or women.

Many of the nutrients are concentrated in the yolk. Up to half the solid part of an



egg is protein, providing all eight essential amino acids. Combined with other protein from meat or cheese, egg enhances utilization. For slowing up the process of macular degeneration, what could be better than the yellow's high concentrations of carotenoids, lutein and zeazcanthin? Responsible for producing lecithin and neurotransmitters, choline in the yolk also boosts memory and reduces body fat. Add to that the homocysteine-fighting capability of B_{12}, absorbable calcium (organic gardeners can apply calcium by using crushed eggshells) and sulfur to reduce inflammation, and the egg comes out a nutritional heavyweight, scrambled, fried, boiled, or benedict.

The only caution is to know your sources. Salmonella has swept through many commercial henhouses, so think twice about "licking you spoon" or using raw whites. Locally produced eggs from sustainable/organic farms are your best bet. It's time to get crackin' and savor the "eggs-tras!" □

[From ACRES U.S.A.*, June, 2004. www.acresusa.com. (800)355-5313.]*

15-Minute Soils Course

Lesson 19:

Roots Build Their Own Soil Structure

Once again we return to the subject of soil structure, continuing from Lessons 7 and 8. Why? Because soil structure is so critical to permit the movement of air and water throughout the root system, enabling roots, and thus the stems and leaves they support, to grow at maximum rates.

Roots build soil structure for rather "selfish" reasons: to enable them to more easily penetrate the soil, and to improve air and water movement to insure better oxygen delivery. Both reasons improve the health of both root cells and of microorganisms that live on and near root surfaces. They strive to develop a granular structure such as shown above that has many strong subunits, and a high percentage of macropores.

The series of figures on the next page illustrates root strategies to create better soil structure. These three methods are ...

(1) mycorrhizal sac formation
(2) root cap and root hair extension, and
(3) polysaccharide "glue" production by microbes.

There is a fourth method as well, which also involves the mycorrhizae. This method is the production of a special cell wall constituent of the mycorrhizae called *glomalin* ... a subject featured in the Summer, 2003, issue of *The Vital Earth News, Agricultural Edition*. Glomalin is notorious for its persistence in the organic fraction of the soil, and for its great benefits to structure.

How the System Works

Mycorrhizal fungi feed on plant energy stores fed to it by root cortex cells. In fact, the energy that feeds a teeming array of trillions of microbes along root surfaces comes from energy rich compounds moved down the stem into the root zone, and excreted into the soil. The fungi grow out from the roots into the surrounding soil and form sac-like structures that bind smaller structural units and sand grains together. Actinomycetes further assist in the binding process.

Polysaccharides – sticky compounds – produced by bacteria, fungi, and algae abounding near the root surface stick together silt and clay particles to form "peds" ... small structural units. Tiny amounts of these polymer sugars are highly effect: only 0.02% of added microbial carbohydrate can markedly stabilize clay aggregates. Roots form channels as they extend through the soil — provided compaction is not too severe — and root hairs assist in the process.

The construction of a strongly aggregated soil may be likened to building a brick house. Note the box below.

Brick House	Soil Structure
Bricks. Sand, silt, and clay are bound together with straw.	***Microaggregates***. Bacteria bind together clay, sand, and silt with polysaccharides.
Walls. Mortar holds the bricks together in large units.	***Macroaggregates***. Fungal hyphae, root hairs, and roots hold together microaggregates.
House. The walls and roof are nailed together in various patterns.	***Larger aggregates***. Arthropods, insects, and earthworms further modify smaller aggregates into even larger structural units.

Continued on the next page

15-Minute Soils Course

See How Much You Learned

1. Why do roots build soil structure?
   a. Enable roots to more easily penetrate soils.
   b. Improve oxygen and water movement.
   c. Increase plant health.
   d. All of the above.

2. An important assist to soil structure, derived from mycorrhizal hyphae walls, is _____.

3. Polysaccharide "glues" are important in binding small soil particles together. T or F

4. Which of these items helps to build strong soil structure?
   a. Polysaccharide "glue"
   b. Glomalin
   c. Mycorrhizal sac formation
   d. Argon in the soil

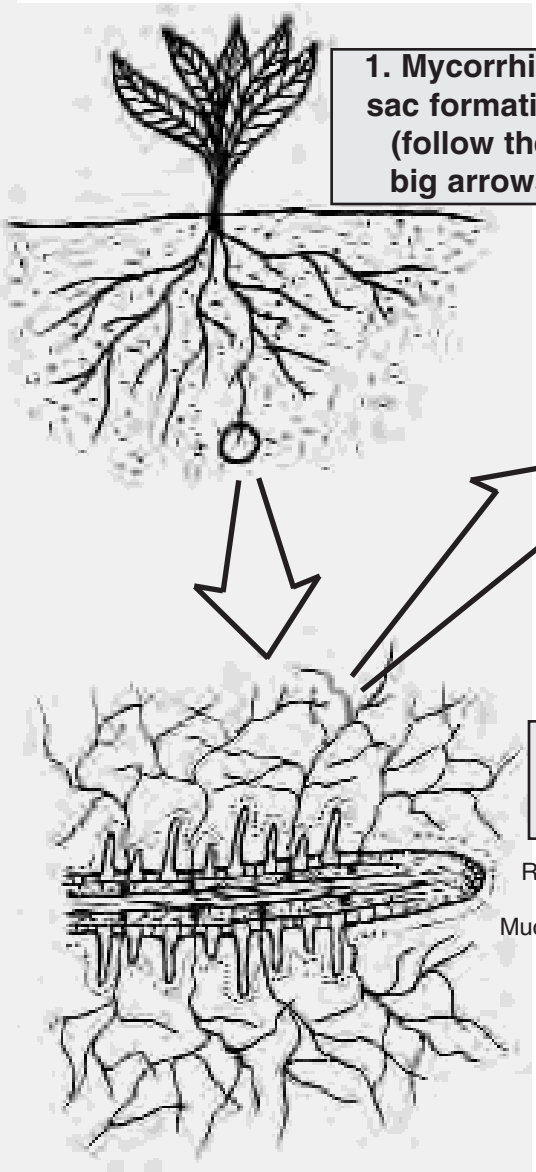
5. The energy powering the structure building process comes from the leaves aboveground. T or F

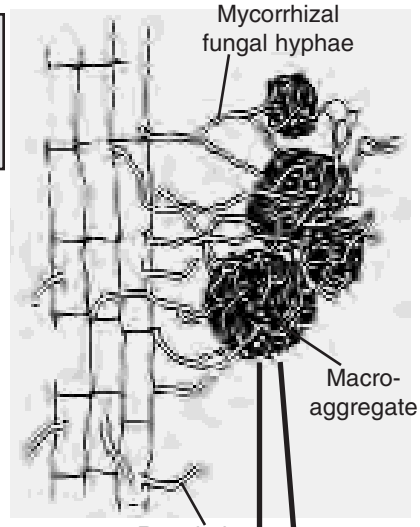
6. The "bricks" of the soil structure fabric are the _____, formed by bacteria binding sand, silt, and clay.

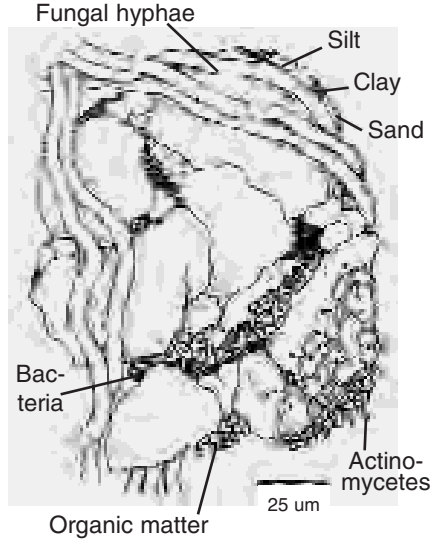
7. Huge amounts of polysaccharide glue and certain other mucilages are needed in the soil to affect soil structure. T or F

Answers: 1. d; 2. glomalin; 3. T; 4. a,b,c; 5. T; 6. microaggregates; 7. F.

Soil Structure Creation Strategies of Plant Roots







[From *How Soils Work* by Paul W. Syltie, Xulon Press, 2002]

Polysaccharide and Aliphatic Glues

Continued from page 1

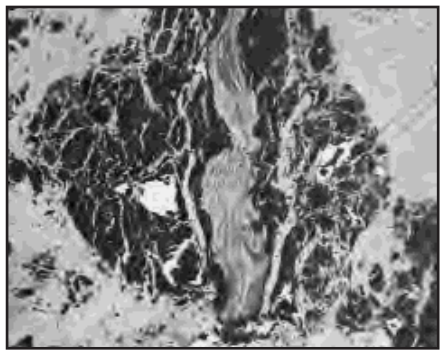
particles together are primarily of two types: *polysaccharides* and *long-chain aliphatics*. Polysaccharides have been studied the most, and are long chains (polymers) of various sugar molecules. They are derived from the microbial breakdown of plant tops and roots, which themselves are comprised of 50 to 80% by dry weight of carbohydrates.[1] Carbohydrates in turn comprise about 5 to 10 % of soil organic matter and are highly important in maintaining aggregate stability, ion-exchange properties of soils, and the nutrition of heterotrophic soil organisms ... those that feed on decaying organic matter. Soil organisms consume plant carbohydrates and secrete slimy materials, a part of which is an array of polysaccharides.

The effect of these polysaccharides is far beyond what would be expected from such small amounts added. Some of the secreted bacterial, fungal, and algal polysaccharides become attached to the clay fraction of the soil. Though normally susceptible to further degradation by hungry bacteria, these compounds are protected from microbial attack by residing between thin clay layers which are too closely spaced for bacteria to enter. Bacteria are usually over 0.3 um in diameter, and the polysaccharide resides within crevices smaller than this.[2] Only by repeated mechanical action of machinery will the clay platelets be opened enough to allow exposure of the polysaccharide for microbial consumption. During soil drying the clay platelets with their polysaccharide contents will collapse and bond strongly, giving rise to strong, box-like card house structures that are resistant to dispersion or collapse, especially if the polysaccharides become irreversibly denatured when dried.[3] Great numbers of individual threads of these polysaccharides produced by soil microbes will capture large volumes of clay platelets and other soil particles. In this manner only 0.02 to 0.2% of added microbial carbohydrate can markedly stabilize clay aggregates.[4]

Only 0.02 to 0.2% of added microbial carbohydrate can markedly stabilize clay aggregates.

Enter the Aliphatics

Long-chain aliphatic compounds have been found to have a strong effect on soil structure. The decomposition of soil organic matter yields increasing proportions of these lipids (fatty compound), while polysaccharides decrease.[5] According to Dinel,[6] "Soil lipids are heterogeneous, polyfunctional compounds of different reactivity." Certain fractions of these lipids, termed "hydrophobic", contribute to water stability of soil aggregates while the more reactive lipids are involved in the more permanent stability of aggregation.[7] These long-chain aliphatics comprise a surprising 20 to 60% of humic and fulvic acids isolated from mineral and organic soils.



A soil "ped" is formed from clay units bound together by microbial glues.

The conclusions of a major study by Dinel showed a close relationship between microbial activity, bound organic matter of an aphotic nature, and soil aggregate stability.[8] The decomposition of these lipids with their polymethylene chains, and ketone and alcohol functional groups, is a result of a great increase in microbial activity. These functional groups, the aliphatic chains, and their breakdown products all conspire to bind soil particles and stabilize soil structural units.[9]

Other mucilages and glues produced by soil microbes include polyuronides and other natural polymers that attach soil particles together, and are preserved within the crevices and cracks of clay particles and lattices. The values of these natural glues is incalculable, since they help develop the structure of soils essential to maintaining soil porosity, and thus are essential for air and water movement. Without them the soil would become compacted, devoid of the all-important *macropores* — spaces between structural units that allow for the free movement of air and water.

The problems caused by compaction are many: reduced root penetration with consequential decreased fertilizer utilization, anaerobic soil conditions that lead to the generation of toxic compounds, root death, denitrification, a greater incidence of root diseases, greater soil erosion, and increased pressure from undesirable weeds. All of these lead, of course, to reduced profits for the farmer. For instance, a study on corn in Minnesota found that machine compaction reduced yields by 9 to 30% on a Webster soil. This yield loss was up to 12% the second year,[10] showing how the effects of compaction are removed quite slowly.

Once again we are led to the conclusions that returning crop residues to the soil, optimizing soil microbiological activity, and avoiding tillage when wet — a disaster for structural units — are so critical for maintaining productive soils. Plants need air, not just above-ground but below as well, and water must flow easily within the profile. The glues that bind soil structural units are thus shown to be major keys in bringing those essential profitable yields at harvest. □

Bibliography

1, 2. Foster, R.C. 1981. Polysaccharides in soil fabrics. *Science* 214: 665-667.

3. Smart, P. 1975. *Soil Science* 119: 385.

4. Foster, R.C. 1978. In *Modification of Soil Structure*, edited by W. Emerson, R. Bond, and A. Dexter. Wiley and Sons, New York, New York, p. 103.

5. Preston C., Shipitalo, S., Dudley, R., Fyfe, C., Mathur, S., and Levesque, M. 1987. Comparison of ^{13}C-CPMAS NMR and chemical techniques for measuring the degree of decomposition in virgin and cultivated peat profiles. *Canadian Journal of Soil Science* 67: 187-198.

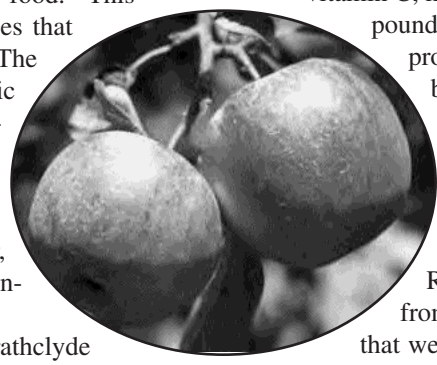
6, 7, 8, 9. Dinel, H., Levesque, P., Jambae, P., and Right, D. 1992. Microbial activity and long-chain aliphatics in the formation of stable soil aggregates. *Soil Science Society of America Journal* 56: 1455-1463.

10. Voorhees, W., Johnson, J., Randall, G., and Nelson, W. 1989. Corn growth and yield as affected by surface and subsurface compaction. *Agronomy Journal* 8: 294-303.

"Organically Grown" Is Better

by Paul W. Syltie, Ph.D.

An article in the *Journal of Alternative and Complementary Medicine* (Volume 7, Number 2, 2002), entitled "Nutritional Quality of Organic Versus Conventional Fruits, Vegetables, and Grains," strongly supports what many of us already suspect: organically grown food is more nutritious than conventionally grown food. This article surveys 41 separate worldwide studies that compare organic and conventional crops. The results of the comparison show that organic crops have more vitamin C, iron, magnesium, and phosphorus, but fewer undesirable nitrates than conventionally grown crops. Moreover, the protein quality was better, nutritionally significant minerals were higher, and some heavy metals were reduced in concentration.



Recent research at the University of Strathclyde and the Dumphries and Royal Galloway Infirmary revealed that the salicylic acid levels of organic vegetable soups was almost six times higher than non-organic vegetable soups. Salicylic acid helps combat atherosclerosis and bowel cancer.

Further, nutritionist Shane Heaton in a review entitled *Organic Farming, Food Quality, and Human Health* concluded that "Unless you eat organic, one item in three in your fridge or kitchen cupboard is likely to contain chemical residues which often occur in potentially dangerous combinations." In the U.K., government tests revealed that nine out of 10 non-organic oranges contained residues of more than one pesticide. In lettuce as many as seven different pesticides were found. Levels of vitamin C, minerals, and phytonutrients (anti-cancer compounds) were also higher in the organically grown produce, while animal feeding trails revealed better reproductive health, better growth, and improved recovery from illness resulting from organic foods.

In 2002 a Swiss study revealed that organic apples were superior in taste and quality versus conventional apples. Researchers compared Golden Delicious fruit from five pairs of organic and conventional farms that were less than a kilometer from each other, and that had similar microclimates, soils, and cultural systems. The organic orchards produced fruit that was significantly firmer (+14%), had better flavor (+15%), more phosphorus (+31%), and more phenols (+19%). Organically grown foods are indeed being shown to be superior to the standard fare produced today by agrichemical methods. ☐

It is not the critic who counts, not the man who points out how the strong man stumbled or where the doer of deeds could have done better.

The credit belongs to the man who is actually in the arena; whose face is marred by dust and sweat and blood; who strives valiantly; who errs and comes short again and again; who knows the great enthusiasms, the great devotions, and spends himself in a worthy cause; who, at the best knows in the end the triumph of high achievement; and who, at the worst, if he fails, at least fails while daring greatly, so that his place shall never be with those cold and timid souls who know neither victory nor defeat. ***Theodore Roosevelt*** *Bits and Pieces*, June, 1983

Weed Resistance Is Real

Continued from page 3

moderate course. He suggested that farmers rotate their Roundup Ready crops with conventional varieties.

"My gut reaction is that we do need to limit the use of glyphosate-resistant crops," VanGessel said. "That doesn't necessarily mean we don't develop them or don't use them altogether, but instead use a planned approach so to not use the glyphosate-resistant crops year in and year out."

Monsanto Co., which markets the Roundup Ready crops in addition to the herbicide, said the problem is not nearly that severe. ☐

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. If you would like to receive future issues of this newsletter or product information, simply fill out the form on the right and mail it to us.

Yes! Send me a subscription to _The Vital Earth News_ and/or product information!

- ❑ *The Vital Earth News Agricultural Edition* (two issues per year)
- ❑ Carl Pool water soluble fertilizers
- ❑ Potting soils, mulches, and compost
- ❑ Vitazyme, Aqua-Min, and Odor-X
- ❑ I am an ( ) individual, ( ) retailer, ( ) grower.

Name _____

Address _____

City/State/Zip _____

Telephone and/or fax (optional) _____

Mail to: **Vital Earth Resources, P.O. Box 1148, Gladewater, Texas 75647**

Vitazyme speeds the germination of treated seeds in many cases. Treated soybeans in Kentucky germinated in only four days despite cold soil conditions in May, and yielded 56.8 bu/acre in an very dry year. Other crops will respond equally well to seed treatment.

The beans on the left had Vitazyme applied directly on the seeds in the row, and are bigger, leafier, and darker green. Yield increases with Vitazyme were substantial.

Vital Earth/Carl Pool logo and return address