The Vital Earth News

Agricultural Edition

Volume VII, Number 1 **Vital Earth Resources • Gladewater, Texas** **Winter 2002**

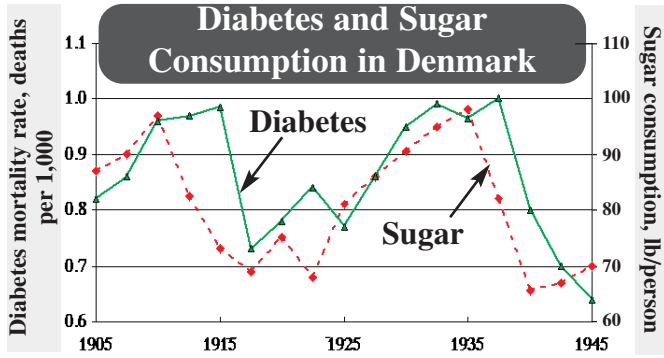
The Soil, Food Quality, and Your Mind

by Paul W. Syltie, Ph.D.

We live today in a bizarre world that, on the one hand, is making great strides in diagnosing and treating diseases related to diet. Those diseases include cancer, arthritis, heart disease, diabetes, endocrine imbalance, and even the common cold. We must not, of course, discount the part played in the genesis of disease by genetic factors, as well as improper thinking habits and attitudes like anger, hatred, jealousy, and despondency[1] ... or the lack of exercise, adequate fresh air and sunshine, and proper hygiene.

On the other hand, food fabricators and fast-food purveyors continue to churn out a plethora of foods having dubious value, which have been processed to the point that they contain few beneficial nutrients and oftentimes an abundance of "antinutrients" ... substances created during processing that are toxic to the body. It may come as a shock to many people that cancer and heart disease are nutritional disorders, but recent studies have estimated that about 80% of cancer cases are caused by inadequate nutrition.[2]

Heart and artery diseases have been tied to refined and processed foods like margarine, pasteurized-homogenized milk, refined flour, and other common foods of Western civilization.[3] Diabetes has long been known to result from a high refined sugar intake, and the accompanying reduced level of chromium and other vitamins and elements essential for proper sugar metabolism.[4] It may be said that, in general, a whole food contains within it the proper array of nutrients essential to metabolize it in the body, while a refined food has had certain components — elements, vitamins, or other nutrients — removed so that the body, to utilize it, must extract the lacking substances from its reserves.



Since many Americans eat so much "foodless food" it is a remarkable testimony to the resiliency of the body that we remain as healthy as we do ... though in many ways that health is counted we are not doing so well. While the lifespan of Americans is now 73 for men and 79 for women, the quality of that life is oftentimes far less than desirable. A large number of older folks — and many younger people, for that matter — consume drugs of some sort to treat various syndromes. These chemicals and depleted foods, however, cause both mind and body to suffer as will be shown later.

The Soil-Food Quality Link

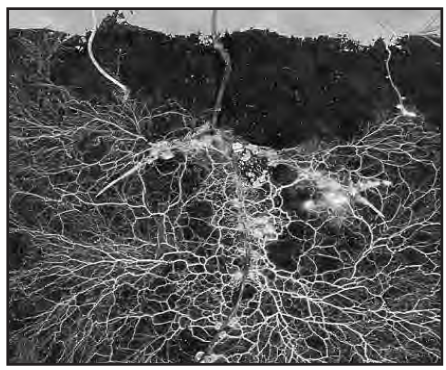
Amidst the dizzying array of factors affecting food quality (see the list on page 2), seldom do people appreciate the

See Food Quality Affects, page 2

How Plants Communicate Underground

by Paul W. Syltie, Ph.D.

Perhaps no other association of organisms within the plant-soil system is more profoundly illustrative of the Creator's character than the mutualism expressed in mycorrhizal connections among plant roots. Mycorrhizae not only greatly benefit the individual plants with which they are associated, but they can — and usually do — reach out to attach to the roots of other plants in the vicinity, feeding nutrients from the stronger plants to the weaker ones, boosting the overall health of the entire plant community in a direct and substantial way. This points to the "selflessness" of plants, as it were, or as we humans say, "Do unto others as you would have others do unto you ...".



It has been discovered that the extensive mycorrhizal network associated with plants roots also interconnects nearby plants, thereby promoting the sharing of nutrients among them.

The mycorrhizal fungi, through their power to connect plants through their vast mycelial network, fulfill the selfless functions we associate with a well-functioning community.

Radioactive Isotope Studies

Studies by Simard and others[1] in Canada have shown that different species of plants can be compatible with the same species of mycorrhizal fungi. Their studies show that the transfer of carbon compounds was in both direc-

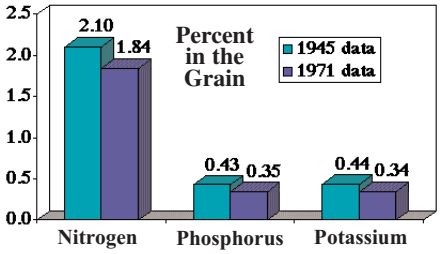
See Plant Roots Share Food!, page 6

Food Quality Affects Your Mind!

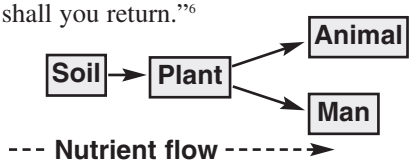
Continued from page 1

effect that the soil has on that quality. The soil is truly the premier causal agent of food quality ... not to deny the genetic effects of various plant varieties. Indeed, plant hybridization has reduced the mineral and vitamin levels of many

Changes in Wheat Composition in 25 years[5]



crops considerably over the past decades, and genetically engineered plants will likely change those levels even more. Plants fabricate soil minerals into their structural and storage organs, which farmers then harvest for food. It is this soil-plant connection that serves as the foremost link that mankind has to the earth: "... you shall eat the herb of the field ... for dust you are, and unto dust shall you return."[6]



All functions of the body — circulation, respiration, excretion, skeletal support, and others — are directly tied to the nutrients contained in the food one eats. So are the nervous system and mind tied directly to the body. Abundant evidence exists to show this body-mind connection.[7] We know that mood swings are intimately tied to blood sugar levels: as blood sugar content falls below about 50 mg/100 ml, headaches, depression, and weakness are likely. The zeal to accomplish is greatly dampened.[8] High blood sugar levels of diabetes have a similar effect on the mind and body, sapping energy and reducing vitality.

To illustrate the effect of dietary deficiencies on health and energy let's briefly consider two case histories.

Bob, the College Dropout[9]

Bob, a bright and aspiring student, had attended graduate school working on his doctorate in mathematics, but his work was interrupted by Army service. After returning home he had no ambition to return to school and complete his degree; he had no goals, seldom went anywhere, and forgot all about math. By chance he met a doctor who understood the importance of nutrition in mental health, who advised the pathetic young fellow to take 100 mg per day of pantothenic acid (Vitamin B12). Bob began taking the supplement, and about ten days later, while window shopping, caught sight of an expensive German camera and decided to pursue photography as a hobby, if not as a career.

Amazed by his own growth in interest in life, he wisely attributed this energy to the Vitamin B12, so out of curiosity tripled the dose. This dose he continued for several months, until five months after the first dose he applied for readmission to his former university. In two years he had a Ph.D. in mathematics.

This marvelous transformation of Bob by taking just a single vitamin is remarkable. His energy output increased radically such that his "real personality" could be expressed. According to Watson in *Nutrition and Your Mind*,[10] "Since all behavior depends on the production of energy in the tissues, one's 'personality'— what one thinks, feels, and does — changes when one's energy output changes."

Factors Affecting Food Quality

Genetic factors: crop variety

Environmental factors:

- *Soil:* minerals, available nutrients, organic matter, porosity, texture, water holding capacity, slope position, internal drainage
- *Climate:* rainfall (amount, intensity, distribution(, temperature (average, extremes, seasonability), storms, wind, solar radiation (intensity, day length)
- *Management:* tillage methods, weed control, chemical applications, compaction

Processing factors:

- *Harvest:* stage of crop maturity, method of harvest, time in storage
- *Synthesis:* saponification (margarine)
- *Fractionation:* grain milling
- *Chemical additives:* sugar, synthetic sweeteners, synthetic vitamins, emulsifiers, coloring agents, conditioners, flavoring agents, salt, preservatives, smoking
- *Storage and preservation:* storage time, chemical agents, cooling, freezing, fermentation, drying, irradiation, distillation, heating, homogenization

Final preparation factors: Length of storage, heating (temperature, time), microwaving, pressure cooking, boiling, additives (salt, spices, herbs, chemicals), time until eaten

Agatha, the Reclusive Housewife[11]

Agatha was a delicate, shy, and sensitive young married lady who was a friend of a doctor specializing in treating psychological disorders. Agatha was afraid of nearly everything and everyone, refusing to ride on freeways — she would become terrified — and avoided contact with anyone but her husband and family. Agatha, a fast metabolizer, was used to eating quick-energy foods like honey, fruit juice, bread, and potatoes, which gave her quick energy but led to its rapid depletion. After consenting to try a higher protein, whole grain diet, she soon became a highly motivated, confident, successful person with many interests, many friends, and a whole new existence in the outside world from which she had been hiding all her life. She became a secretary for a law firm, and remained an extrovert as long as she adhered to the proper diet. According to Watson,[12]

Poor tooth and dental arch development are symptoms of poor nutrition. The brain and mind are also affected.

"In explaining the reason behind her 'new personality' , I told [Agatha] I had seen many an alleged 'introvert' turned into an 'extrovert'. An introvert 'looks in' only because he's not creating sufficient energy in his nervous system to 'look out' — to be an extrovert."

Experiments with rats and Vitamin A — amongst many vitamin and mineral studies — have shown that their "per-

See Organic Foods Have, page 3

Organic Foods Have the Highest Quality

Continued from page 2

sonalities" changed by becoming much more "vital" and "active" with more of the vitamin.[13] Minimum daily requirements of the government are not a reliable guide for optimum body-mind functioning when studies prove that much more of a nutrient is usually better. Note the figure below that contrasts one's personality to nutritional level.[14]

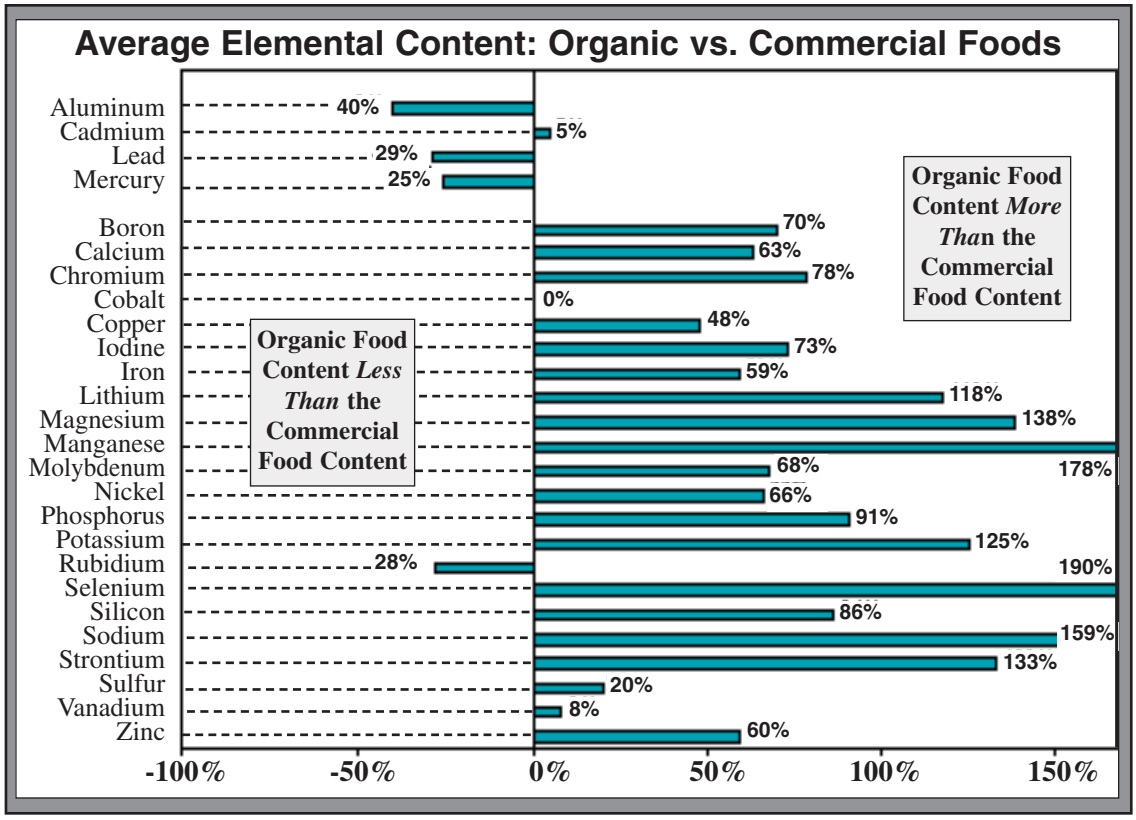
The Soil – Mind Connection

Now the connection between soil fertility and the mind becomes clearer. Low or imbalanced levels of nutrients in crops that are raised using hybrids and genetically engineered varieties, with high levels of commercial nitrogen on soils depleted of organic matter and minerals from improper management, leads to deficient levels of nutrients in the foods grown. Deficiencies in the foods in turn lead to depressed functioning of both body and mind, which relates to many of the diseases of the mind and body in today's undernourished but overfed population.

A study performed by Smith[15] (below) compared organically produced versus conventionally produced foods purchased in Chicago-area supermarkets. In this study organic pears, apples, potatoes, and wheat had, on the average, over 90% more of the nutritional elements than similar commercial food ... and if sweet corn levels are included the average difference was over 250%! See the graph below, and note especially differences in microelements.

These values of fresh foods do not take into account the harsh toll that food processing and long-term storage have on many foods in our supermarkets. Properly grown and fresh foods should comprise most of our diet, for processing can negate much of the good that excellent productive practices deliver.

The link between food quality and health of mind and body is real ... and soil quality, as has been shown, is closely tied to this state of health. We should heed the call to adjust our agricultural practices to produce the highest quality of food possible, not only for the sake of disease prevention but also for generating optimum energy and vitality amongst our people. ❐



Bibliography

1. McMillan, S. 1963. *None of These Diseases*. Fleming H. Revell Co., Old Tappan, New Jersey.
2. Simone, B. 1983. *Cancer and Nutrition*. McGraw-Hill, NY.
3,4. Burkitt, D., and Trowell, H. 1975. *Refined Carbohydrate Foods and Disease*. Academic Press, New York.
5. Morrison, F. 1945. *Feeds and Feeding*. The Morrison Publishing Company, Ithaca, New York; National Academy of Sciences. 1971. *Atlas of Nutritional Data in United States and Canadian Feeds.* NAS, Washington, D.C.
6. Genesis 3:18-19.
7. Cheraskin, E., Ringsdorf, Jr., W., Brecher, A. 1974. *Psychodietetics*. Stein and Day, New York.
8. Martin, C. 1971. *Low Blood Sugar: The Hidden Menace of Hypoglycemia*. ARC Books, Inc., NY.
9. Watson, G. 1972. *Nutrition and Your Mind, the Psycho chemical Response*. Harper and Row, Publications, New York.
10, 11, 12, 13, 14. See 9.
15. Smith, B. 1993. Organic foods vs. supermarket foods : elemental levels. *The Journal of Applied Nutrition* 45(1).

Personality One — *Inferior nutrition* —	**Personality Two** — *Optimum nutrition* —
• Settles for security out of lack of self-confidence • Hates to admit mistakes: the other fellow is to blame • Mainly interested in himself and his own comfort; responds to almost everything else with indifference	• Sets high but realistic goals and has the confidence to take required risks • Admits mistakes and takes the blame for his own mistakes • Has many interests beyond himself and generally has activities planned to look forward to

If you are patient in one moment of anger, you will escape a hundred days of sorrow.

Chinese proverb. *Bits and Pieces*, Volume T, Number 15, 1998,

15-Minute Soils Course

Lesson 14:

Those Wonderful Earthworms!

Amongst the thousands of soil organisms helping to maintain soil quality, none is more valuable than the lowly earthworm. The common cultivated field species are *Lumbricus terrestris* and *Allolobophora caliginosa*, but hundreds of others exist worldwide in most soils. Though hardly comparable to bacteria, fungi, actinomycetes, and protozoa in number (up to millions per gram of soil), they make up for numbers in their size. Various species may measure from an inch (2.5 cm) to 10 inches (25 cm) long, and weigh from 50 mg to 7 grams.

Populations of earthworms have been recorded up to 6 million per hectare (2.47 acres), with weights of 2,400 kg/hectare (2,200 lb/acre). The numbers fluctuate a lot, depending on the moisture conditions to a large degree; thus, numbers are highest in the warm and moist spring and early summer. Populations depend a lot on how much vegetative matter, manure, and nitrogen are returned to the soil. A high application of manure or the return of crop residues provide excellent food for earthworms, which come to the surface and feed directly on the organic matter, or oftentimes carry it into their burrows. This activity of burying organic matter is a major means by which organics are incorporated into soils.

Soil Consumption by worms in England

Situation	Number	Weight	Castings	Excreted soil underground	Total soil
	thousands/ha	Kg/ha	tons/ha	tons/ha	tons/ha
Old pasture	1,920	990	62	30	89
Field of leys	895	740	5	52	57
Cultivated	395	130	7	5	12

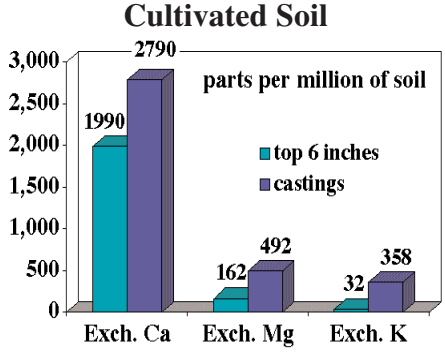
From E.W. Russell, *Soil Conditions and Plant Growth,* 10th Ed., Longman, London, 1973.

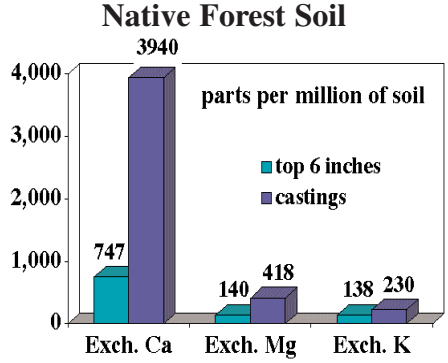
Earthworms burrow into the soil, of course, eating soil along the way and digesting it and organic materials with their powerful intestinal enzymes. Their castings may be left on the soil surface in a clump, or more frequently in the burrow itself. In a year's time these castings may total 26,000 to 60,000 lb/acre (30 to 70 tons/hectare)! Since most of this activity occurs within the top 15 cm (6 inches) of the soil, the effect over many years is for the finer soil particles and organic materials to be deposited on the surface, leaving a stony soil relatively stone-free on the top. Even Charles Darwin, an avid observer of earthworms who wrote the treatise *The Formation of Vegetable Mould Through the Action of Worms* in 1881, supposed that in 30 years some English pastures could have a new layer of topsoil 18 cm (7 inches) thick from worm castings.

Earthworm castings are seen on the surfaces of most soils, and are more fertile that the surrounding soil

Worms Increase Nutrients

Earthworms increase the available nutrients in the soil by a considerable degree. This is true for both cultivated and native soils, such as shown in the accompanying graphs. Note that every parameter is greatly improved (Russell, 1973). Besides the figures





Continued on the next page

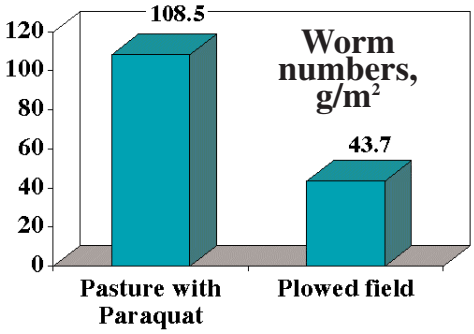
15-Minute Soils Course

for Ca, Mg, and K shown here, nitrogen was 43% higher in the castings for cultivated soil, and 91% higher for the forest soil. The pH in both situations was raised, from 6.4 to 7.0 for the cultivated soil, and from 4.6 to 5.3 for the forest soil. Soil phosphorous was also elevated in the castings. One researcher calculated that in England, only one earthworm species in a woodland soil produced 100 kg/ha (90 lb/acre) of N per year, double that of the return from the leaf litter.

Who says earthworms cannot resemble snakes? This whopper was found in an Ecuadorian cloud forest.

Besides producing so many more plant nutrients, earthworms also greatly improve soil structure, and thus aid air and water movement. Their burrows, lined with a cohesive mucilage, help form stable aggregates. Roots, water, and air can move easily down the channels, to perhaps 6 feet for some species. The castings themselves contain aggregate-enhancing polysaccharides. Since worms mix the surface organic residues into the topsoil, porosity is also improved by these additions. Thus, water infiltration and percolation are enhanced – and erosion reduced – by earthworms, especially when plenty of organic materials are present.

Some conditions deter earthworms, such as a low soil pH (generally below 4.5), and a sudden, severe freeze if the soil surface is not protected by insulating vegetation or residue. Pesticides and herbicides can kill them as well, including those used in zero and minimum tillage systems, although such tillage systems that utilize herbicides still allow for high populations.



Tillage greatly disrupts earthworm ecology and populations. See the graph in the lower left-hand corner.

Build Up Worm Populations!

It is highly important to build and maintain high earthworm populations by providing plenty of returned crop residues and manures, retaining a good plant or residue cover, and restricting or eliminating tillage. They improve the all-important soil structure and water-air relations, and increase nutrient availability, all of which lead to higher crop yields. As Buckman and Brady in *The Nature and Properties of Soils* (Macmillan, 7th Ed., 1969) have said, "It has long been known that earthworms have a favorable effect in soil productivity."

Encourage earthworms in your soil and you will reap great benefits.

See How Much You Learned

1. Which of these factors encourage earthworm populations?
   a. Soil cover b. Manure applications
   c. Reduced tillage d. All of these factors

2. Most earthworm activity occurs within the top 6 to 8 inches of soil. T or F

3. Earthworm _____ contain elevated levels of available nutrients such as Ca, Mg, K, and N.

4. A soil pH below about _____ is detrimental to earthworm activity.

5. A total of 30,000 lb/acre per year of earthworm castings on a good soil is normal. T or F

6. Abundant earthworm activity can substantially improve which of the following:
   a. Water infiltration b. Soil Structure,
   c. Hardpan production d. Higher yields

7. _____is a well-known researcher who in 1881 published a noted book on earthworms.

1. d; 2. T; 3. castings; 4. 4.5; 5. T; 6. a,b,d; 7. Charles Darwin.

Roundup Ready Soybean Troubles

Many farmers enjoy the ease of planting genetically modified "Roundup Ready" soybeans that allow the farmer to spray glyphosate herbicide over the crop to kill all of the weeds in one pass. In 2000 about two-thirds of all soybeans planted in the U.S. were Roundup Ready. The system is handy and usually cost-effective for farmers wanting to save trips over the field, this in spite of a hefty $6.50 "technology fee" for each 50-pound sack of seed and a contract that prevents replanting of any seed the following year.

However, all is not good with this widely adopted system. During very hot weather the biotech soybean stems become brittle and will split. University of Georgia and University of Arkansas researchers think that genetic changes may have effected the plants' metabolism in some adverse way, or soil bacteria, which help the plant extract nutrients, may be damaged by the glyphosate, leading to changes in stalk development.

According to Robert Kremer, a soil scientist for the USDA, a four-year study using Roundup herbicide to spray over biotech soybeans showed that the glyphosate touched off a wild proliferation of certain fungi in the soil, some of which can be fatal to the soybeans. Kremer is not so much concerned about the short-term crop damage that results from this fungal explosion as he is the long-term shifts in soil ecology. It is likely that the fungi are active in breaking down the glyphosate, which is a chemical foreign to the soil ecosystem.

Many soybean growers are also resigned to the fact that, sooner or later, the weeds will "outsmart" the herbicide and mutate so they will withstand its application. Already some Roundup Ready crops are experiencing competition from certain weeds that formerly were not a problem, and some usual weeds are developing resistance to glyphosate. Once weed resistance to Roundup becomes widespread, farmers will be forced to turn to more toxic herbicides unless they opt for mechanical cultivation or other non-chemical options.

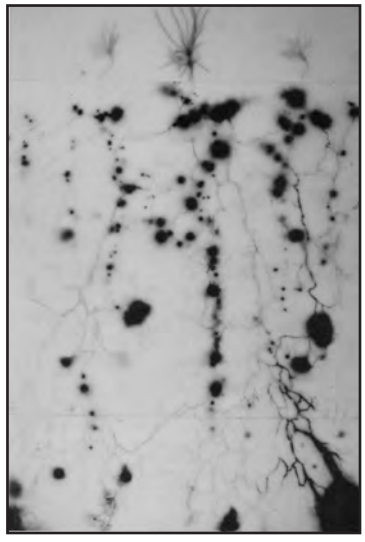
Not usually addressed by farmers, or by Monsanto, is the direct toxic effect of Roundup on applicators and farmers. The chemical also can leach into underground water supplies or be washed into streams and lakes. Its effects on humans by entering the food supply is another more serious issue that has hardly been touched upon, but will surely in time become the most serious problem of all regarding the cultivation of these genetically modified soybeans. Farmers need to rethink the wisdom of planting biotech seeds of any type to avoid the many dangers that they pose to themselves, the consumer population, and the soils that sustain us. ❐

Plant Roots Share Food!

Continued from page 1

tions, between *Betula papyrifera* and *Pseudotsuga menziesii*, but the transfer was mostly towards *P. menziesii*, especially when *P. menziesii* was shaded. This transfer of energy by the mycorrhizae greatly assisted *P. menziesii* in its trouble.

Notice the marked transfer of radioactive phosphorus from the source area in the lower right of this growth container on the right.[2] The radioactivity shows up as dark patches along the root and mycelial network, moving up from the source and along the mycelia and to various resource-rich patches that interconnect plants. Even the leaves of the pine seedlings show up in the autoradiograph. Studies like this show that in ectomycorrhizal plants such as pines, it is the mycorrhizal mycelium rather than the roots that are primarily responsible for the absorption and transport of nutrients amongst interconnected plants.



Radioactive labeled phosphorus, added in the lower right-hand corner, has been moved by the mycorrhizae to all of the pine seedlings.

When radioactive carbon ($^{14}CO_2$) is fed directly to a "donor plant" in an array of several plants, it has been discovered, through autoradiography, that the carbon becomes distributed throughout the root systems and mycelia of all of the plants that are interconnected by the mycorrhizae.[3]

The implications of mycorrhizal links and interplant carbon and nutrient transfer for ecosystem structure and dynamics are numerous. Some researchers argue that the nutrient pathway — hyphal versus soil — is irrelevant from practical and economic view points, but at the same time say that understanding these mycorrhizal pathways is important for plant management.[4] Some of the important implications of mycorrhizal links amongst plants are given below.

1 Mycorrhizal associations assist seedling establishment near mature plants by allowing the seedlings to become infected more rapidly, or to tap into an established common mycorrhizal network supported by other plants. These plants incorporate into what have been called "guilds", with all of the associated plants interconnected by a common mycorrhizal fungus.

2 Mycorrhizal associations assist the recovery of species following disturbance of the soil or of the plant stand.[5]

3 Mycorrhizal associations reduce competitive demands of one species, and promote the diversity of species within an ecosystem by allowing carbon and nutrients to flow directly through the mycelial network from well-suited to deficient plants nearby. The strong literally assist the weak and poor individuals.

4 Mycorrhizal associations reduce nutrient losses from ecosystems by keeping more nutrients in the biomass, thereby increasing overall productivity. This loss reduction is especially evident

Continued on the next page

Plant Communities Encourage Diversity

Continued from page 6

when nutrients are cycled from dying to living plants.[6]

5 Mycorrhizal associations increase the productivity, stability, and sustainability of ecosystems, an inferred effect that has never been investigated experimentally.[7]

Due to the many positive impacts of mycorrhizal hyphal connections among plants to create a more stable, efficient, healthy, and diverse total ecosystem, the implications of activities such as tillage and pesticide applications (herbicides, insecticides, fungicides, etc.) on overall health of the ecosystem are great. Massive fracturing and mixing of the soil by plowing from the perspective of hyphal interplant connections is highly deleterious to plant and soil health. These community sensitivities are a warning flag to the need to treat soils with care, and protect the established habits and structure of interplant organisms with respect. Even as one should not destroy the contacts between citizens of a town without expecting serious upheavals in its function, so one should not disrupt the contacts among plant root systems by rupturing the multitudes of interconnecting fungal hyphae.

Other Forces and Organisms

The plant community communicates in other ways than by mycorrhizal ... both above and below-ground. For years it has been understood that leaves of trees which are damaged by tearing send some sort of airborne cue to surrounding trees, telling them to prepare for an insect or pathogen attack. Other studies show that individual cells act as both receivers and transmitters, and cells, tissues, and entire organisms each carry specific frequencies of some type of energy.[8] Plants are indeed more complex than we can imagine, and so are the communities they create. ❒

Bibliography

1. Simard, W., Perry, D., Jones, M., Myvold, D., Durall, D., and Molina, R. 1997. Net transfer of carbon between ectomycorrhizal tree species in the field. *Nature* 338 (7 August): 579-582.
2. Read, D. Mycorrhizal fungi in natural and semi-natural plant communities. In Ecophysiology of Ectomycorrhizae of Forest Trees: *The Marcus Wallenburg Foundation Symposia Proceedings 7* (September 27). The Marcus Wallenburg Foundation, Falun, Sweden.
3. See 2.
4. Simard, S., Jones, M., and Durall, D. 2001. Carbon and nutrient fluxes within and between mycorrhizal plants. In *Mycorrhizal Ecology*, ed. by M. van der Heijden and I. Sanders. Springer-Verlag.
5, 6, and 7. See 4.
8. Kiessling, L., and Gestwicki, J. 2002. Bacteria mimic cell phone system to communicate. *Nature*, Jan. 3, 2002. In www.rense.com, Jan.3, 2002.

One freezing Chicago night in 1914 the cry of "Fire!" rang out in Thomas Edison's movie and record production plant. Sales from those items were all that was keeping Edison solvent as he experimented with storage batteries, phonographs, and many other inventions. Within minutes all of the celluloid for records and films had gone up in flames, and fire companies from eight surrounding towns could not quell the flames. Everything was destroyed.

How to Handle Discouragement

Edison, at age 67, came running to the plant shouting to his son, "Where's Mom? Go get her son, Tell her to hurry up and bring her friends! They'll never see a fire like this again!"

Early the next morning, long before dawn, Edison called his employees together and announced, "We're rebuilding!" He told one man to lease all the machine shops in the area, and another to obtain a wrecking crane from the Erie Railroad Company. Then, almost as an afterthought, he added, "Oh, by the way, anybody know where we can get some money?"

Later he explained, "We can always make capital out of disaster. We've just cleared out a bunch of old rubbish. We'll build bigger and better on the ruins." Shortly after that he yawned, rolled up his coat for a pillow, curled up on a table, and immediately fell asleep.

From *The Electric Thomas Edison,*Charles Edison, in *Great Lives, Great Deeds*, Readers Digest Assoc. 1964.

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 Horticultural Edition* (two issues per year)
- ❑ Carl Pool water soluble fertilizers
- ❑ Potting soils, mulches, and compost
- ❑ Please have a sales representative call
- ❑ 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 boosts root zone microbes to assist plant growth. In 2001, studies showed Vitazyme ...

- ❒ **Increased total fungal biomass by 412 %.**
- ❒ **Boosted active bacterial biomass by 178%.**
- ❒ **Increased nitrogen fixers by 441%.**

Vitazyme can increase crop growth in your fields like with this corn, using just two 13 oz/acre applications.

Vital Earth Resources

Carl Pool®

P.O. BOX 1148 · Gladewater, Texas 75647