



The Vital Earth News

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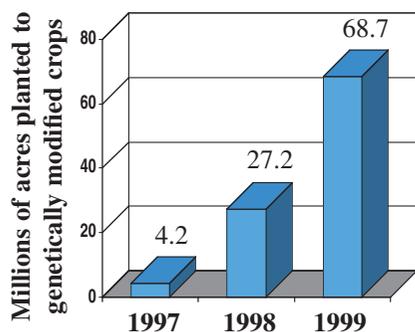
Winter 1999/2000

Terminator Genes for Seed Sterility *Traitor Technology*

by Paul W. Sylie, Ph.D.

A subtle new enemy has stealthily crept in amongst the farmer's most basic inputs. His seeds are being sabotaged. This sabotage is not of the ordinary kind that one can identify on-sight. It hits him at the most basic level: the seeds he grows ... and it also hits him hard in his pocketbook.

"Terminator genes" are being inserted into the DNA -- the basic inheritable material of all life -- of seeds which are



marketed by some of the seed giants of the Western world: Monsanto, Novartis,

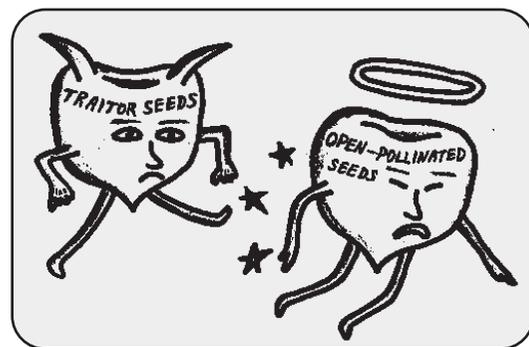
and Astra Zeneca. The planting of "transgenic" crops (those that are genetically altered) has skyrocketed the last four years, increasing from 4.2 million acres in 1996, to 27.2 million acres in 1997, to 68.7 million acres in 1998.

What Are They?

First of all, let us define what these transgenic crops with "terminator genes" really are. Genes are bits of inheritable material comprised of a helical deoxyribonucleic acid (DNA) "backbone" having four major "bases" (alkaline-reacting) chemicals attached to it in various sequences. The sequences are critical because the order in which they occur determines the sequence of amino acids that are generated in the proteins they fabricate.

Each cell has two full sets of genes -- one from the sperm and one from the egg -- that code for proteins made in all of the tissues and organs that the plant needs during its life cycle. However, only the genes that are needed to pro-

duce proteins for a particular cell are actually "turned on" for that cell. These active genes do the work for the cell, and the other genes are inactive ... though they are active in other cells somewhere



Open-pollinated seeds are under siege, but natural laws tell us they will eventually win.

else in the plant.

A typical gene is divided into segments. The first part -- called the **promoter** -- is a stretch of DNA that interacts with the cell or environment to initiate the actions of the next segment. The

See *Terminator Genes*, page 3

A Tribute to Sir Albert Howard

by Paul W. Sylie, Ph.D.

Those of us who are inescapably entwined in organic agriculture would do well to understand a bit of history regarding one of the major pioneers of the organic movement. That individual is Albert Howard, who has been called the first modern-day pioneer of the organic method.

The son of a Shropshire, England, farmer, he studied agriculture at Cambridge University before stepping into the practical world of on-farm



research and study in the West Indies, India, and England. In 1940 he published a book entitled *An Agricultural Testament*, which related his practical theories of agriculture and remained a landmark work on natural farming for nearly 30 years. In 1947 he published a second book, *The Soil and Health*, which related in strong terms the health of the soil to the health of plants and the people that consume them.

A generalist, Sir Albert shunned con-

See *Nature's Laws*, page 2

Nature's Laws Hold the Key to Success

ventional methods of agricultural research in favor of practical testing. He opposed teams of specialists conducting research on fragments of the whole, each contributing a splinter of knowledge.

He was a broad-scale thinker, asking the questions, "Can mankind regulate its affairs so that its chief possession -- the fertility of the soil -- is preserved? On the answer to this question the future of civilization lies." His answer to that question led directly toward the organic method. That method has been used throughout history within various societies, and whichever societies most closely approximated nature's methods were also those having the longest histories.

Sir Albert Howard's major work was conducted in India over a 25-year period, where on 75 acres he tested, observed, and concluded that composting of organic wastes -- using what he termed the "Indore Process" -- was an integral key to maximizing the efficiency, integrity, and health of the entire system.

The key to the success of Sir Albert's views and conclusions was an open, unbiased eye towards the natural, God-created world. Also implicit within his work was a growing awareness that adherence to nature's

ways leads to the best results ... cause and effect. For example, his first successful research project in Wye, Kent, was to discover that the usual practice of eliminating all male hop plants from growers' fields was a distinct departure from nature, leading to a decreased growth rate and increased susceptibility to greenfly and mildew damage. By allowing male plants to liberally polli-

nate the fields -- as nature would have it -- yields and quality of hops rose consistently.

Sir Albert began to appreciate the incredible importance of the photosynthetic process in plant growth, and how leaves and roots must work together within a natural environment in which variety and stability are normal ... not

patient appears to make little progress, but is actually quietly replenishing nutrient reserves until suddenly normal activities are resumed.

He took an uncommon interest in mycorrhizal fungi, the symbiotic fungi associated with roots that have in recent years been shown to be of vital importance to plants. These fungi funnel the

vast majority of soil phosphorus, zinc, manganese, and other immobile elements to the roots of plants, and effectively expand the feeding volume of the root system by tens to hundreds of times. Soil microorganisms and organic matter were understood to be the heart of soil fertility, a contention that most knowledgeable soil scientists will also admit today. When properly supplied with organic materials through residue or compost return, then plants will be able to extract essential nutrients that encourage healthful plant growth, which in turn will deter soil pathogens and insect pests. Poor soil fertility produces suboptimal plants that contribute to unhealthy, malnourished people. He attributed the Black Death of 1348-49 in part to a population weakened by drought and diseases during previous years.

The seven basic laws of nature regarding land management which Sir Albert Howard considered critical for any permanent agricultural system are listed in the text box. They are the methods seen always operating in our forests and grasslands.

In virtually all of the civilizations that have passed from the earth these cardinal laws of nature have been severely abrogated. We are abrogating them just as severely today in Western agriculture as

See Sir Albert, page 7

1 Mixed farming is the rule.. Plants are always found with many species of plants and animals living together. There is never an attempt at monoculture.

2 The soil is always protected from the action of sun, rain, and wind. All of the sun's energy is used in the forest canopy and undergrowth, and much in the prairie ecosystem. Leaves break the force of raindrops to a mist or splatter, and roots and structural units bind the soil together.

3 Rainfall is carefully conserved. Much water is retained in the surface soil, and excess is gently transmitted downward through pores and cracks along structural units.

4 The forest and prairie manure themselves. A persistent rain of organic matter -- leaves or grass -- settles on the soil surface where scores of bacteria, fungi, and other organisms break it down to humus and plant nutrients.

5 Mineral matter needed by trees and grass is obtained from the subsoil. These minerals are also recycled through vegetation as it falls, and decomposes on the soil surface. No phosphate, potash, or other minerals need to be added to a properly functioning system.

6 Soils always carry a large fertility reserve. These reserves are contained in the humus of the surface horizons as well as in the native minerals of the soil mass.

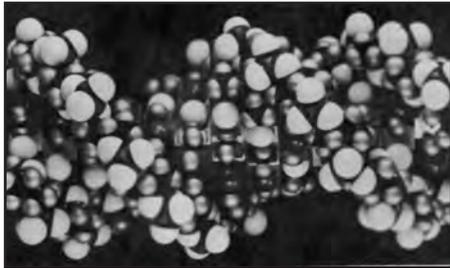
7 Crops and livestock look after themselves. No spray machine or vaccine is supplied in nature, only natural immunity to diseases and insects that will hold at bay the pests that are usually present. Nature's rule is "Live and let live".

factory uniformity and man-made paradigms unnaturally superimposed upon living processes. The omnipresent cycle of birth-growth-maturity-death-decay, and then back to birth forms the core of the fertility recycling so important to a long-term sustainable agriculture. He likened an abused soil to a sick patient, wherein the body lives off of its reserves for a period of time. During recovery the

Terminator Genes Kill the Germ!

Continued from page 1

second segment -- called the **coding sequence** -- contains the actual code for the order of amino acids to be constructed



DNA (deoxyribonucleic acid) constitutes the primary information storehouse of all cells.

in the proteins. When a gene is active the promoter directs the coding sequence to generate a specific protein needed by the cell.

Genetic engineering manipulates the pattern of proteins in an organism by altering the genes that fabricate them. Genes are added or altered. Since all genes are similar, genes from a mouse or a corn plant can be added to a soybean plant ... or promoters can be removed and placed in front of another coding sequence to change when and where the protein is made. For instance, the coding sequence for human growth hormone (HGH) can be inserted into a cow, and the promoter for casein, a major milk protein, moved in front of the HGH sequence. HGH will then be made in the milk instead of casein.

Enter Terminator Technology

To produce terminator seeds the genes must produce a toxin that will kill the seed late in its development.

The way this is done is to take a promoter from a gene normally activated late in seed development -- in cotton, for example -- and fuse this promoter to the coding sequence for a toxic protein that will kill

the embryo late in seed development.

The means to do this, however, must be linked to some system that will allow an abundance of seed to be grown for farm sale. Using the above scenario alone would mean that the fruit seeds would die, and no large-scale production could occur. The job is accomplished through an ingenious series of genetic and chemical manipulations. Three engineered components are inserted into the cotton's DNA:

(1) A *toxic gene (as from Saponaria officinalis) controlled by a seed-specific promoter, but blocked by a piece of DNA between the promoter and the coding sequence.*

(2) A *repressor protein coding sequence with a promoter that is active*

can be overridden by the antibiotic tetracycline.

Terminator Gene Action

The transfer of genes into the plant is not a very precise operation, but can be accomplished by injecting genetically engineered DNA into the nucleus of a cell using a tiny needle, by soaking the seeds in altered DNA and then electrically shocking them, attaching the DNA to small metal fragments and shooting them into the nucleus, or adding the DNA to viruses or bacteria and infecting the cells with them. Only a few of the infected cells will have the correct incorporation of genetically-altered DNA. Whole plants must be generated from these cells, and then they are tested for the function of the new genes. A cotton line is developed

from these properly functioning terminator plants, and the seed is multiplied for farmer use.

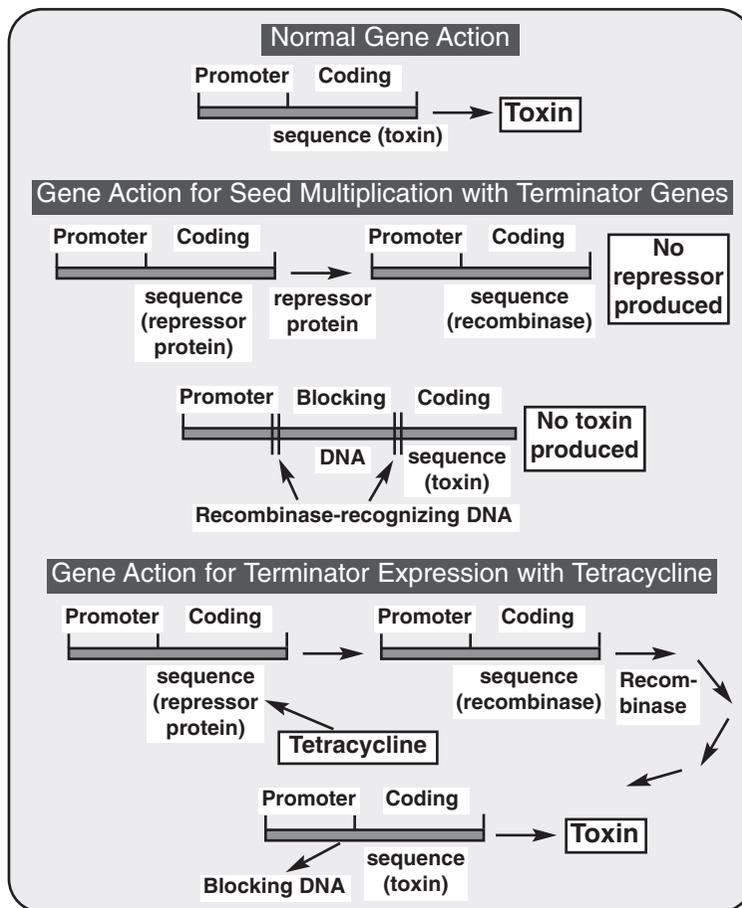
Why the Terminator?

The Terminator gene offers absolutely no agronomic advantage to the farmer. Its benefit is for the multinational seed companies who can use the technology to require farmers to repurchase seed from them every growing season. The Terminator is just one example of how a company can load genetic modifications of a number of commercial characteristics into a plant or animal, and then activate or deactivate them at the point of sale...like buying a tractor with "value-added" accessories. Together, these genes can be called Tractor Genes. "Gene Giant" companies want to tie these genetic modifications to their proprietary chemicals so that one is useless without

the other. However, there are a number of potentially serious consequences that may emanate from this Terminator technology.

The Serious Downside of Terminator: Junkie Genes?

See *Addict Seeds*, page 6



all of the time.

(3) A *recombinase coding sequence, controlled by a promoter that is active at all times except when repressed by a special repressor protein...which protein*

15-Minute Soils Course

Lesson 10: Secrets of Clay

Clay comprises a major part of many soils. The term **clay** has a dual connotation in soils:

1. A *texture designation* (particles less than 0.002 mm in diameter)
2. A *mineral type*

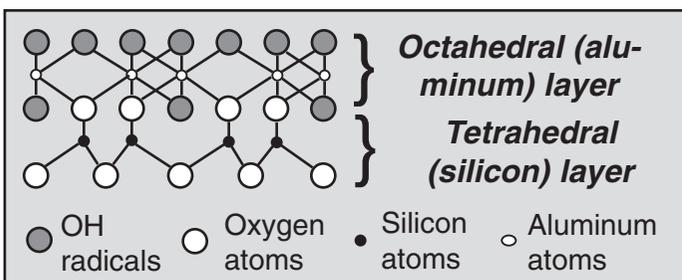
We have discussed clays at various times in past lessons, especially in Lesson 4. Yet, one cannot overemphasize clays because they contribute so much to the soil's cation exchange capacity ... and thus its ability to hold nutrients in the soil. This ability is due in large part to its

	Diameter (microns)	Number of particles	Surface area (cm ²)
Clay	<2	>90 billion	8 million
Silt	2 to 50	5.5 million	454
Sand (coarse)	500 to 2,000	90	11

tremendous surface area.

A lump of clay weighing one pound can have as much total surface area as 50 football fields! Its surfaces and edges are negatively charged, so they can hold an abundance of positively charged ions (cations).

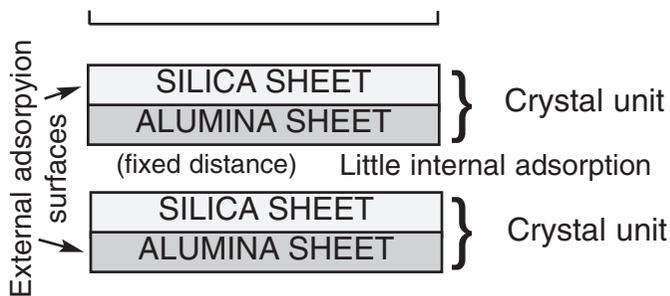
Clays are thought to be formed from the breakdown and recrystallization of elements from primary minerals like orthoclase, mica, or hornblende. These minerals are high in silicon, aluminum, and other elements such as magnesium, potassium, iron, calcium, and sodium. Clay minerals form two-layered or three-layered units comprised of silica tetrahedral and alu-



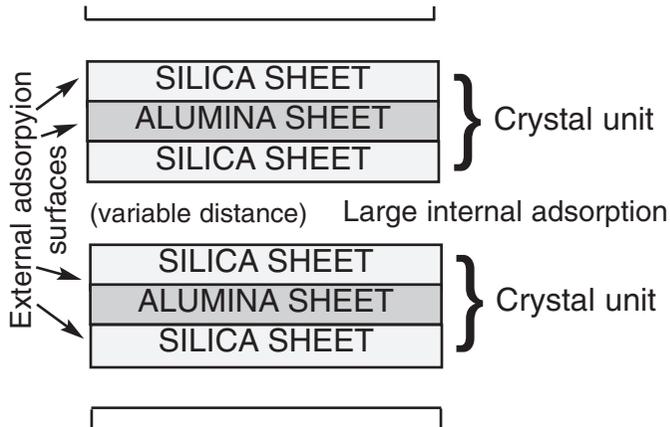
minum octahedral layers.

The mineral on the lower left (Kaolinite) is a 1:1 clay, since it contains one Al and one Si layer) It has a low negative charge and low cation exchange capacity. A 2:1 clay (montmorillonite, vermiculite, or illite) has two Si layers with an Al layer between. The 2:1 types are generally expandable, and can hold water and ions between the layers. They have a high negative charge and high cation exchange capacity

Kaolinite, a 1:1 clay



Montmorillonite, a 2:1 clay



Negative charges result from the replacement of some Si with Al in the tetrahedral layer (Si=+4 and Al=+3, a net -1 charge), and Al with Mg in the octahedral layer (Al=+3 and Mg=+2, a net -1 charge). Broken edges also exposed hydroxyl groups, which are negatively charged.

Due to its extremely large surface area and crystal character, clays become very hard when dry, and types used for pottery will form a firm

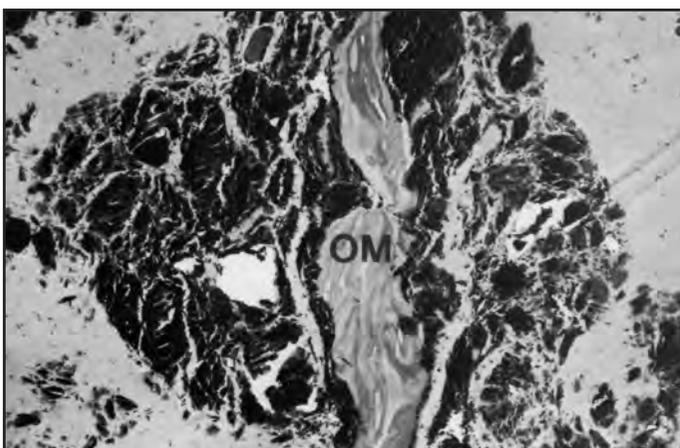
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15-Minute Soils Course

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structure when heated. If wetted moderately the lattices will become plastic in character and “ribbon out” between the fingers. Wetted even more, the spaces between lattices increase to form a gel that will flow rather freely, resulting in mud slides and slumps along slopes.

In most soils, clay provides a valuable matrix for creating soil structure and is the source of a large portion of cation exchange capacity. Note in the picture below how clay lattices surround and protect organic matter, preserving it in soils.



Energy and Health

Clay also displays some rather bizarre qualities, such as the ability to store energy and information. In one study, hitting a lump of clay with a hammer resulted in the emission of ultraviolet light for months. The clay lattice may even replicate itself like DNA does in a cell, thus accounting for the synthesis of clay minerals from broken down parent materials in soils.

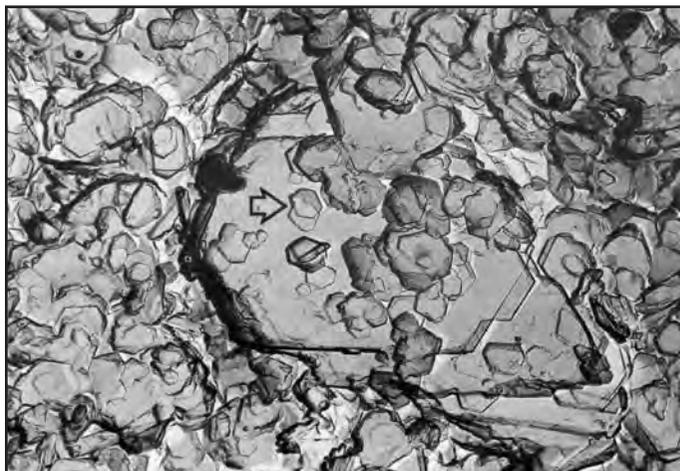
Clay is a catalyst, and was the first mineral used to refine oil. Wounds are healed faster with clay applications as poisons tend to be extracted from tissues by its enormous surface area and negative charge. Taking certain clays internally likewise helps absorb and deactivate toxic compounds in the body, helping the body to heal.

Notice the crystalline structure of kaolinite, a 1:1 clay mineral, to the right.

See How Much You Learned

1. Clay minerals are very important as contributors to cation exchange capacity. T or F.
2. The two major components of clay lattices are...
 - a. Mica layers
 - b. Octahedral layers
 - c. Vermiculite complex
 - d. Tetrahedral layers
3. Clay is known for its ability to aid in human health. T or F.
4. Clay minerals are categorized as the smallest particles in the soil, having diameters of...
 - a. 2 to 40 microns
 - b. less than 2 microns
 - c. 500 to 2,000 microns
5. Besides oxygen and hydrogen, the tetrahedral layers of clay is populated by _____, and the octahedral layers by _____.
6. Soil flow or slumping in very wet clayey soils is due to clay's tendency to form a _____ when wet.
7. **Challenge question:** A common 1:1 clay mineral is _____, and a common 2:1 clay mineral is _____.

miculite.
gel; 7. kaolinite; montmorillonite or illite or ver-
1. T; 2. b, d; 3. T; 4. b; 5. silicon, aluminum; 6.



Addict Seeds with Junkie Genes!

Continued from page 3

Many patents have been applied for related to genetic plant alteration, not just for the Terminator but for herbicide tolerance as well. Some patents propose that the Terminator gene sequence in seeds can be triggered by herbicides or even fertilizers, but the individual promoter strategy would weaken the plant's natural resistance to diseases and pests. These seed giants, of course, manufacture the chemicals to combat these weaknesses it manufactures into crops. Thus, farmers would be sold "addict seeds" with "junkie

... farmers are sold "addict seeds with junkie genes" that will not perform well without these chemicals!

genes", as it were, that will not perform well without these chemicals!

For Western farmers, the cost of seeds will increase with Terminator and other GMO technologies. The share of farm inputs increased by 86% in the United States the past ten years, and will rise much faster with genetically modified seeds. Also, farmers using genetically modified seeds will find themselves locked into expensive chemical purchases

just to keep their weaker crops healthy. For Third World and subsistence farmers, it is possible that governments will legislate the use of Terminator and Traitor technologies as a requirement for credit or marketing ... as has been the case with planting certain rice varieties in Southeast Asia. Further, destitute farmers might accept well-intentioned food aid and try to plant them for their next crop ... only to realize zero germination and famine staring them in the face.

In the Third World, traditional seed saving and the germ plasm pool for the affected crops will collapse if Terminator technology takes hold. Community plant breeding would cease to exist when farmers cannot save their seeds. In India, 100 million farmers would be at risk to join the burgeoning populations of giant cities.

More Trouble

Terminator genes will also lower the nutritional quality of the seeds. After all, the seeds are dead. Dead seeds will deteriorate more quickly, and the oils and vitamins will degenerate more quickly. The toxins may also induce allergic reactions in people who eat the oils, cereals, or bread products containing them.

Moreover, the Terminator gene can spread to other fields of the same variety and affect quality and germination of the crop. Tetracycline applied to the seeds will reach the soil and cause unknown interactions with organisms, and the antibiotic will likely reach water sources.

Terminator seed technology is another step in the loss of economic independence for farmers worldwide. Farmers would



Hearty and nutritious open-pollinated corn such as this will become much more difficult to find if Terminator technology is ever widely used.

be wise to avoid using these seeds, and instead follow natural laws that dictate the use of open-pollinated varieties.

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Crouch, M.L. 1998. How the terminator terminates. The Edmonds Institute, Edmonds, Washington.

The RAFI Institute. 1999. Traitor technology; the Terminator's wider implications. *RAFI Communique*, Jan.-Feb. ■

More Fallout from Genetic Engineering ... This Time with Potatoes

Researchers at the Scottish Crop Research Institute fed ladybugs aphids that had fed on potatoes engineered to produce lectin, which suppresses aphid feeding. The fecundity of the ladybugs suffered: almost three times as many fertilized eggs failed to hatch, compared with egg hatching in ladybugs fed on aphids raised on nonengineered potatoes. When male ladybugs were fed on aphids from the engineered potatoes and mated with normal females, four times the number of eggs were unfertilized compared with eggs fertilized by males consuming nonengineered potatoes. The female ladybugs that fed for 14 days on aphids that ate engineered potatoes lived only half as long as female ladybugs fed on aphids eating nonengineered potatoes. The researchers stated, "Strategies for the safe release of transgenic crops must be devised and validated under field or closely simulated conditions." ■ *Maine Organic Farmer & Gardener, March-May, 1998.*

Complacency is a blight that saps energy, dulls attitudes, and causes a drain on the brain.

The first symptom is satisfaction with things as they are. The second is rejection of things as they might be. "Good enough" becomes today's watchword and tomorrow's standard.

Complacency makes people fear the unknown, mistrust the untried, and abhor the new.

Like water, the man who is complacent follows the easiest course -- downhill. He draws fake strength from looking back.

Bits & Pieces, June, 1973.

Sir Albert

Continued from page 2

they ever were in Rome, Greece, or Babylon ... perhaps even more so. On the other hand, a permanent agriculture has been established in China for thousands of years using the return of animal and human wastes to the soil (see King's *Farmers of Forty Centuries*).

We owe a debt to Sir Albert Howard for not only standing up for natural agricultural methods which he saw functioning under his own research eye, but for leaving us a legacy of hope through his written words. If you have been touched by the philosophies of J.I. Rodale, Louis Bromfield, Eric Eweson, Russell Lord, Paul Sears, or others from the early to mid-30's era, you have been touched by Sir Albert Howard ... for he rubbed shoulders with them all. That era was a time when people were more closely attached to the land, and when more common sense and long-term thinking reigned. Sir Albert was truly a visionary of that era whose influences have lasted far beyond his lifetime. Natural laws continually return to teach us. For Albert Howard they were life itself. ■

Knowledge has to be improved, challenged, and increased constantly or it vanishes.
Peter Drucker

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.

To Save Soil, Use No-Till

Reduced or zero tillage was predicted to overtake a major portion of farmland across North America by the early 21st Century. To a great extent that prediction is coming true, for in 1997 the three common conservation tillage systems were used on 111 million acres (about 37%) of U.S. farmland. Conventional deep plowing was used on 106 million acres, while reduced tillage was utilized on 77 million acres. Truly, the revolution to reduce tillage is well under way.



Chisel plowing is one system of minimum tillage. Many others exist.

This change has many benefits:

- 1. Less runoff and erosion due to more residue left on the soil surface**
- 2. Improved moisture content for crop growth**
- 3. Increased soil organic matter content with less oxidation caused by tillage**
- 4. Reduced compaction, and better crop growth, due to fewer trips over the field**

There are some negatives within modern agronomic systems, such as the requirement to use herbicides with many

crops, and the tendency of the soil to warm slower in the spring because of the insulating effect of residues. However, yields have proven to be as high or higher with reduced or zero tillage compared to plowing.

The elimination of machine tillage is a back-to-nature movement that is bound to reap dividends, since any way we can more closely emulate natural systems will bring automatic rewards. Nature has its own tillers -- ants, earthworms, and other small creatures -- and requires minimal disturbance of the soil in order that the vitally important structural units are left intact. As a result, air and water can easily move through the soil rather than face impenetrable barriers from compaction.

One Illinois farmer commented, "Farmers are still infatuated with tilling, but they are kind of living in the past. The soil plays out. You can only do that for so long."

A Pennsylvania farmer put things more bluntly: "Tillage is a disaster for the soil. It's like a hurricane coming through. I'm going to leave this soil in better condition than when I found it."*

No-till farming also saves on fuel and machinery. Because of fewer trips and better tilth -- requiring less power -- about 5 gallons of fuel and \$17 in machinery wear and maintenance can be saved for every acre farmed in this way.

*Anderson, C. 1998. Chiao, plow. *The Toronto Star*, March 21. ■

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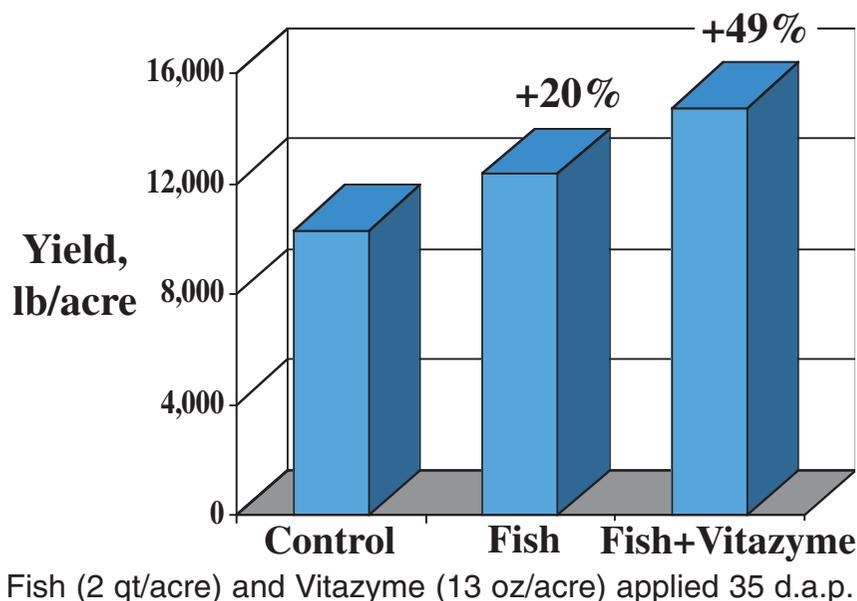
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