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Phosphorus ... the "Reluctant Nutrient"

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Phosphate has a triple negative charge, and that charge makes phosphate strong enough to stay put. It can attract itself to calcium—which has a positive charge—for which reason the two of them can be held in the soil. Phosphate has to be placed where it is needed. If placement is restricted to the top quarter inch of soil, it will not feed the plant once the soil dries out.

Most plants contain .2 to .4% phosphorus. Even though it is considered a major nutrient along with nitrogen and potassium, the amount is small. Out of every applied pound, there is only .2 or .4 pound—or not even half a pound—of phosphorus in 100 lbs of plant material. Phosphorus is the workhorse of plant nutrition because it has to be there for cell division and growth, for photosynthesis and for energy transfer from ADP to ATP. It is absorbed into the plant as orthophosphate ions. In other words, H_2PO_4, with a single negative charge, or HPO_4, with a double negative charge. This means phosphorus has to combine with hydrogen in order to get it into the plant, meaning enough hydrogen has to be on hand for phosphate to make the combinations necessary to get into the plant. The phosphorus and the hydrogen do not do it all by themselves. As my friend Zoell Colburn used to say when he taught agronomy courses, "The soil is the plant's stomach." That stomach for eight tons of alfalfa has to process 450 pounds of nitrogen as well as 95 pounds of phosphate. A 150 bushel corn harvest takes 85 pounds of phosphate. Soybeans require 55 pounds in terms of a 50 bushel crop. Wheat, at 60 bushels, takes up 55 pounds of phosphate. . . .

The ears of corn are from plants that were deficient in phosphorus. Plant growth was stunted, and silk emergence was delayed, the result being that some rows of kernels did not develop properly.

A reserve of phosphorus in the soil is always needed. In fact, it is always better to have more than the crop requires. When test figures reveal a phosphate deficiency, at least the minimum desired value for crops must be provided. You can get by with a little less on soybeans, but if you are raising 150 bushels of corn or more, you can't get by on the minimum, shown as the desired value on the test. You will actually limit your yield, especially in years when you

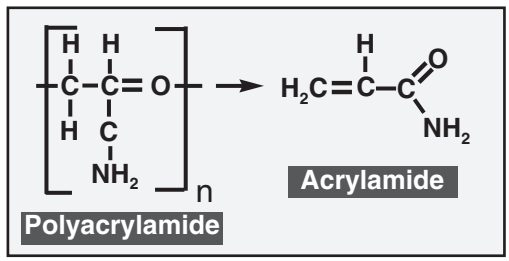
See 80 lb/acre Removed, page 2

The Roundup – Chip Connection

By Paul W. Syltie, Ph.D.

It may come as a surprise to many that the herbicide Roundup — and others like it — has been found to have a close connection to the chips you may eat ... not that the chips contain glyphosate, the active ingredient in Roundup, but that the "sticker" mixed with the Roundup can break down into the very same compound that is found in potato chips and other crisps. That compound is acrylamide, and it is highly toxic.

Does this chip-glyphosate connection sound far-fetched? Let us seek out the truth of the matter and see whether or not it really is. First, let's look at chips.



The compounds and reactions look simple and harmless, but acrylamide is highly toxic and dangerous.

Chips and Asparagine

In April of 2002 a Swedish study uncovered the fact that acrylamide, a compound that causes cancer in animals, is contained in crisps (chips of various sorts) and biscuits, but not in raw foods, at levels higher than the World Health Organization [WHO] recommends for drinking water.[1] The Swedish researchers discovered that, in over 100 foods purchased in Swedish stores and restaurants, "fried, oven-baked, and deep-fried potato and cereal products may contain high levels of acrylamide."

See Roundup Carries, page 6

80 lb/acre of P Removed By Corn

Continued from page 1

have cool, wet seasons.

Because phosphate is not easily moved, the only way to lose it is via wind or water erosion. If you need it on top, then put it on top. If you need it down under, then try to put it on so that you can get it worked and mixed into the top six or seven inches of soil. I am not suggesting that you work it down 12 inches. Work it in as deep as the fencepost rots because that is how deep the microbes are going to work on it and keep it available. If you put it down deeper, chemical reactions in the soil take place, none of them necessarily beneficial to the crop. . . .

When the purple color comes into the leaf of that corn, you have missed 15 bushels of corn. . . . As a consequence, I always look to see that there is some reserve phosphate. When you are growing 150 bushels of corn, I am going to tell you that 240 pounds of phosphate is not enough. If you are above 300, then I will say if you don't work it wet that is enough. If you tell me you are going to work it wet, I will say you need to put a starter in there anyway — not very much, but a little bit! Phosphate availability in the soil is not affected by application time and method. If you put it on top, it is going to stay there and it is not going to be available except when there is moisture at the top. . . .

When the weather gets cool the plant can't pick phosphate up very well. When the soil temperature gets cool, the ADP conversion to ATP is slowed down or stopped. Finally, phosphate availability is affected by soil pH. With a pH of 6.5, phosphate availability is generally going to be as good as it can be. The other thing that affects it is calcium availability. Most phosphate contained in crop plants is in the fruit or the seed. In a 180 bushel corn crop there are 78 pounds of phosphorus in the grain and 30 pounds in the stalks. In 60 bushels of soybeans there are 48 pounds of phosphorus in the grain and 16 pounds in the stalks. Every time you harvest a 180 bushel corn crop, you are taking off roughly 78 pounds of phosphorus. In and around Charleston, Missouri, our corn yields run 170 to 175 bushels per acre. The old rule of thumb for our corn soils calls for maintenance of phosphorus at 70 pounds per acre. . . .

Now, what materials can one use to get phosphate? There are super-phosphoric acid and phosphoric acid for liquid. Basically, I talk about concentrated superphosphate, or triple-superphosphate, or 0-46-0. That is the common, lowest, cheapest priced phosphorus material on the market. Under that is diammonium phosphate, monoammonium phosphate which is 11-48-0 or 11-52-0, normal superphosphate which is 0-20-0, basic slag which has 6% phosphate in it as P_2O_5, and then rock phosphate which has roughly 35 total pounds P_2O_5. The rock phosphate is not broken down. It is sometimes called colloidal phosphate or soft rock phosphate. . . .

Phosphorus levels in an animal's diet directly affect health and vitality. This poor cow raised on a Texas ranch was able to subsist only on grass and forage that was deficient in phosphorus. Note her poor condition.

If you are going to apply phosphorus in the fall, use an ammoniated phosphate. Use diammonium phosphate, 18-46-0, monoammonium phosphate, 11-48-0, or polyphosphates if using liquids. If you use enough, polyphosphates will build just like the ammoniated phosphate. . . .

Why does a soil system tie up an 0-46-0, and why doesn't it tie up an 11-48-0? Triple-superphosphate has a pH of 4.4. When you put something that has a pH of 4.4 on a soil that has a pH of 5.5 or 6 or 6.5 or 7 or 7.5, how long do you think it is going to stay in the form that it is in? The answer is, "Not very long!" In a year with adverse conditions, it is not going to stay more than a month. In a very good year, it could last as long as two months. When you put on that pH 4.4 material, it will start to combine with calcium because phosphorus loves calcium and is drawn to it the way a southerner is drawn to black-eyed-peas. What you wind up with in four to eight weeks is tricalcium phosphate. Tricalcium phosphate is the parent material in hard rock phosphate. . . .

I had a good client up near Gibson, Illinois. He called me during a drought year. He said, "I have rented 160 acres next door to me, $125 an acre. I want you to analyze the soils." His neighbor had been farming it for years and he didn't have any idea what the fertility levels were. I analyzed that soil. It was extremely deficient. In fact, there was a 150-plus phosphate deficiency. He had 200 to 300 pounds potash deficiency. Percentage wise, the potash was below 2%. His dilemma was self evident. "I have already rented it," he said, "and next year the owner's son-in-law hopes to farm it. I probably won't get it again. How can I build these levels up without spending a huge amount of money that I am not going to be able to get back?" I asked him to find out if the landlord had ever used a product such as 9-18-9 or 10-20-10. The answer came back: he never had. I told the farmer, "You can grow a fine crop as long as you put either product two inches beside and below the seed, and put plenty of nitrogen as far as the corn is concerned. He bought the material and he put it on all of his corn. He applied the nitrogen that was required. He made an application on the beans until he got to his last tank. He saw he wasn't going to finish the field. So he stopped and went to the far side of the field to finish up. After harvest the farmer said, "Neal, where I came in and applied that small amount of liquid fertilizer like you said, I made 16 bushels more soybeans to the

See P: Hard to Keep Available, page 3

Genetically Modified Crops:
An Economic and Nutritional Disaster

By Paul W. Syltie, Ph.D.

The adoption of genetically modified (GM) crops within the agricultural sector of the United States and other countries has proven to be a bad policy. In a recently published book entitled *Seeds of Doubt: Experiences of North American Farmers of Genetically Modified Crops* by the Soil Association in England, the assault of GM crops on the economies of North America has been carefully portrayed. The cost of engineered corn, soybeans, and canola since 1999 has been at least $12 billion due to farm subsidies, lower crop prices, product recalls, and the loss of major export markets. Moreover, farmers are not achieving the higher profits promised by the biotechnology companies touting the new seeds, since markets for the crops in Europe, Asia, and Africa have all but dried up.

This report is the most comprehensive to date from a non-biotechnology-industry source to review the serious consequences of the push by Monsanto and other biotech firms to capture the hard-pressed farmer's business. Widespread impacts of these GM crops on the food and farming industry have been noted in North America, where 75% of the world's GM food is grown.

Problems with GM crops have pressed more than 200 farm and organic groups in the United States and Canada to call for a moratorium on the introduction of GM wheat, the next step in the progression of major seed companies to pollute virtually all of the major seed stocks around the country with unnaturally introduced genes. According to the Soil Association's director, Peter Melchett, "GM was introduced to the United States when farmers were financially vulnerable. The biotechnology industry's claims that their products would bring benefits were widely accepted, but GM crops have now proved to be a financial liability."

New Evidence of Nutritional Problems

A 17-year-old Dutch student at University College in Utrecht recently performed a simple animal feeding experiment that compared genetically modified food to unmodified types (*The Ecologist*, June, 2002). His results have shocked both laymen and scientists ... and should put purveyors of GM foods on the defensive.

Hinze Hogendoorn obtained 30 female six-week-old mice and turned them loose in big cages having two bowls of food: one GM (corn and soybeans) and the other non-GM (Kellogg's and Quaker cereals and oatmeal). The mice quickly devoured the bowls of non-GM food but would not touch the GM food.

Then Hogendoorn provided only GM food to more mice, keeping a control group eating the non-GM foods. One mouse that ate the GM food died, and the others, though initially appearing to be heavier than the non-GM batch, actually lost weight during the study. The control group eating non-GM food ate less and continued to gain weight during the study.

Intriguingly, Hogendoorn noticed that the GM-fed mice seemed less active and acted rather listless, distressed, and discontented. At times, however, "Many were running round and round the basket, scrabbling desperately in the sawdust, and even frantically jumping up the sides...."

Without having thoroughly investigated the long-term health effects of genetically altered crops, it is unconscionable to allow such foods into the grocery stores of America and the world. We are what we eat, and if our food is altered to provide less than optimal nutrition it ought not be eaten. □

P: Hard to Keep Available

Continued from page 2

acre over where I didn't. That was a situation where I was trying to get by for one year."

I put rock phosphate in two classifications—hard and soft rock. . . . Once the pH gets above 6.5, hard rock phosphate gets harder and harder to make available. Microbes and acids in the soil literally face a meltdown-proof stone wall. For this reason and for these several reasons, hard rock phosphate has gotten a bad reputation. . . .

Soft rock has a lot of goodies that break down over a longer period of time. I have clients who use soft rock. They simply figure that on a good soil it is going to be five, eight, or maybe ten years before they have to make an application again. Crops need phosphate for rapid seedling development. If you want to get a crop started, you have to have plenty of phosphorus, not only for winter heartiness, but also for disease resistance, efficient water use, early maturity and maximum yields. . . .

The test that I use for phosphate is a water soluble, acid soluble test. The reason I use this is that I want to see what is the phosphate availability for the entire growing season. This is a P_2 test.

If pH is above 7.5, I want a second phosphate test, namely the Olsen test. Relying on the Olsen test, if your calcium is correct and your other levels are there, 80 pounds per acre is enough. If you have 120 pounds, it is enough no matter what. . . . I like to see phosphate levels [both acid and water soluble] in the 500 to 750 range. □ [*For a sample copy of Acres USA call (800)350-5313.]*

What you spend years building may be destroyed overnight.
Build anyway.
The good you do today may not be remembered tomorrow.
Do good anyway.
Honesty and frankness may make you vulnerable to attack.
Be honest anyway.
People who need help can be confused and distressed, and they may attack you when you try to help them.
Help them anyway.
People can be unreasonable, illogical, and self-centered.
Try to love them anyway.
If you are successful you may win false friends and true enemies.
Succeed anyway!

[*Soundings,* March 19, 1991.]

15-Minute Soils Course

Lesson 16:

Soils: What Are They?

It would seem that something as basic and essential to life as soil would not be hard to define, but the task is not as easy as it may seem. Definitions vary depending upon who defines it: farmers, homeowners, engineers, or sociologists.

Farmers: a habitat for plants

Homeowners: the base material for a lawn, garden, and home foundation

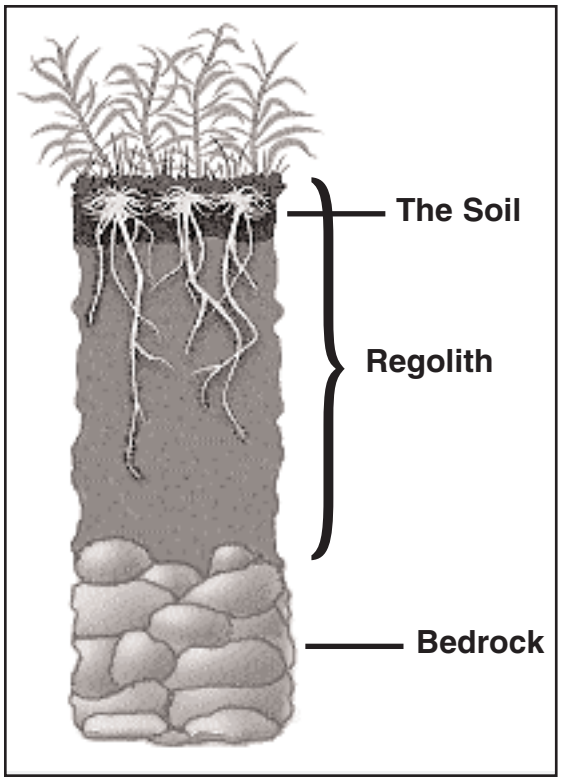
Mining engineers: the debris covering rocks and minerals

Highway engineers: the material on which a roadbed is placed

Sociologists: the top layer of the earth's crust upon which societies depend

Soil, a "Static" View

A person can examine a soil profile up close and identify its typical characteristics. Note the characteristics of the soil profile shown below.



By looking at the soils microscopically, and by using chemical or other analyses, one can further identify the details of the soil. It has the following qualities:

- Mineralogical content (quartz, feldspar, clay minerals, calcite, gypsum, etc.)
- Pore space and size
- Particle sizes (texture): sand, silt, clay, rocks, pebbles, etc.
- Organic matter: age and quality variations
- Catin exchange capacity
- Compaction and bulk density
- Water and gas content
- Micro and macroorganism species and populations (bacteria, fungi, algae, earthworms, moles, etc.)
- Plant and tree roots
- Color

The regolith may be very shallow or very deep, even hundreds of feet deep. It may have been weathered in place from rock or been transported by water, ice, or wind. The soil has developed from the regolith (parent material) by climate, topography, vegetation, and microbes working over time.

Soil, a "Dynamic" View

In reality, nothing in nature that is living is static, and soils that support life of any sort are assuredly in a dynamic, living state. This includes the following types of activities:

- Activity of microorganisms feeding upon fresh or aged organic matter, fabricating nutrients, humic substances, polysaccharides, etc.
- Activity of larger organisms (worms, gophers, etc.) burrowing through the soil
- Weathering of soil minerals through microbial/root activity, utilizing their acids and powerful chemicals
- Movement of rainwater into and through the soil mass, and upwards via capillarity
- Exchange of soil and atmospheric gases
- Mass action of nutrients upon the clay and organic colloid exchange sites
- Growth and activity of plant roots, especially rhizosphere activity

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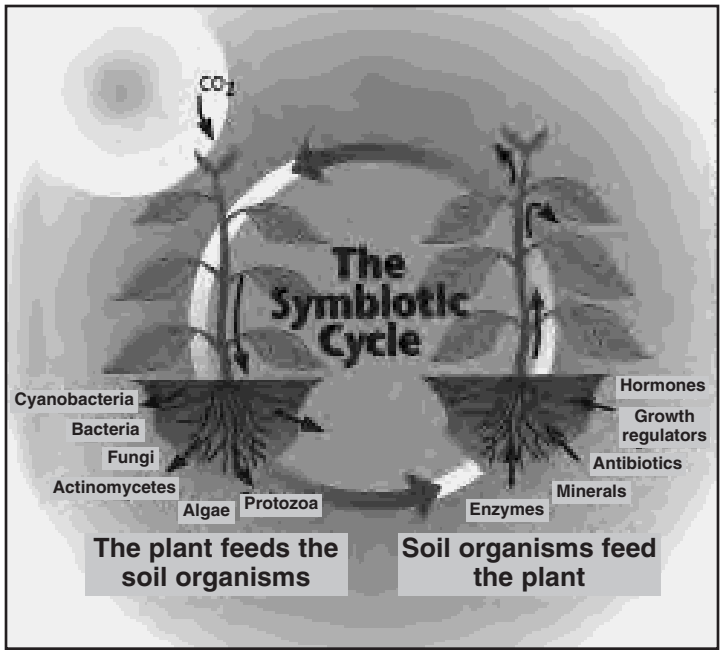
15-Minute Soils Course

Especially important concerning the dynamic view of soil is the concept of "the Symbiotic Cycle", as shown in the accompanying figure.



The plant feeds the soil organisms, and the soil organisms in turn feed the plant. This figure is greatly simplified from the multitude of complex reactions, growth patterns, and interrelationships amongst organisms and minerals and organic matter that cause this system to work. The Symbiotic Cycle is the core of soil functions.

A Synthesis of Views

The "static" view of soils is similar to what is called the *pedological* view, which says the plant is purely a natural body, with minor emphasis on its practical use. The "dynamic" view, similar to the *edaphological* view, emphasizes soil as the growth medium for plants, along with the many intricate reactions that occur. To define soil as a farmer, homeowner, or soil scientist perhaps ought to define it, the following is suggested:

"The soil is a natural body, synthesized in profile form from a variable mixture of broken and weathered minerals and decaying organic matter, which covers the earth in a thin layer and which supplies mechanical support and, in part, nutritional maintenance for plants."

Definitions are important to us in that they orient our thinking as to how we will treat or manage something. For example, if we define our children as creations of God we will want to train them in ways that will please the God who made them.

If we define the soil as the source of our food, feed, and fiber — and thus our very existence on earth — we will be apt to treat it with the utmost respect, not only for the present generation but for future generations as well. We all want to live in health and prosperity, so if we know that the very soil beneath our feet is the source of both, then there will be no question concerning our desire to seek the very best forms of management for the substance out of which our own bodies are fabricated.

See How Much You Learned

1. There is only one definition for "soil" that fits all situations. T or F

2. Soils can be viewed from a _____ view or a _____ view.

3. Pore space, organic matter content, and bulk density are characteristics of what may be termed the . . .
a. static view of soils.
b. the dynamic view of soils.
c. both a and b.

4. The action of plants interacting with soils within the dynamic view of soils may be termed the _____ cycle.

5. The material from which the soil profile develops is called the regolith. T or F

6. The pedological view of soils is similar to the _____ view, and the edaphological view is similar to the _____ view.

7. For super achievers: Remember the definition of a soil in this lesson, and write it down from memory.

Answers: 1. F; 2. static, dynamic; 3. a; 4. symbiotic; 5. T; 6. static, dynamic; 7. see the article.

Roundup Carries Acrylamide!

The U.S. Environmental Protection Agency describes acrylamide as white, odorless, flake-like crystals that are used mainly to treat drinking water and for industrial purposes, and can cause cancer in people if they are exposed to it over time.[2] The Swedish investigators found that an ordinary bag of potato crisps may contain up to 500 times more acrylamide than the highest level that is allowed by the WHO!

An attractive, weed-free field requiring no cultivation can result from Roundup use, but are the side effects of toxic by-products worth its use?

Acrylamide is produced in heated starchy foods by the Maillard reaction, a reaction wherein high temperatures break down proteins in the presence of sugars to give a more flavorful, golden brown product. This reaction also produces acrylamide when the amino acid asparagine is heated with sugar at 185°C or higher.[3] Other amino acids also change their structure during heating and combine with sugars to produce acrylamide.[4] The higher the temperatures, and the longer the heating continues, the more acrylamide that is formed. Boiling does not form the compound, likely due to the lower temperature involved.

Add Roundup to the Mix

How does Roundup herbicide relate to the acrylamide issue? The connection is direct, profound, and heretofore unresearched. Roundup contains in its mix 25% *polyacrylamide*, which serves as a surfactant, an agent that enables the chemical to cling to the leaves of sprayed plants. This chemical as a polymer is not especially problematic, but when it breaks down in the environment it produces acrylamide.

Polyacrylamide is also used extensively as a soil conditioner, a "binding agent" that is applied to soils which are low in organic matter and natural structural binding agents and microbial activity. Soil organic matter and microbes are the major contributors to a strong soil structure, but soils that have been depleted of these components by tillage, high commercial nitrogen applications, and pesticide applications for years lose many of their organic and microbial components, necessitating some treatments to aggregate the soil and reduce erosion. Polyacrymalide serves as an "artificial glue" to bind soil particles together instead of the natural polysaccharide glues generated by soil microbes. The polymer is sprayed at 10 parts per million through irrigation water several times throughout the growing season, lacing the leaves of plants with the chemical besides the targeted soils.[5]

Thus, through herbicide and surfactant application, and through soil conditioner application, polyacrylamide is deposited on the leaves of many of our food and fiber crops. Manufacturers of this polymer claim that the chemical is non-toxic and environmentally friendly. However, in nature the polymer is depolymerized — broken down to the individual acrylamide units — in five

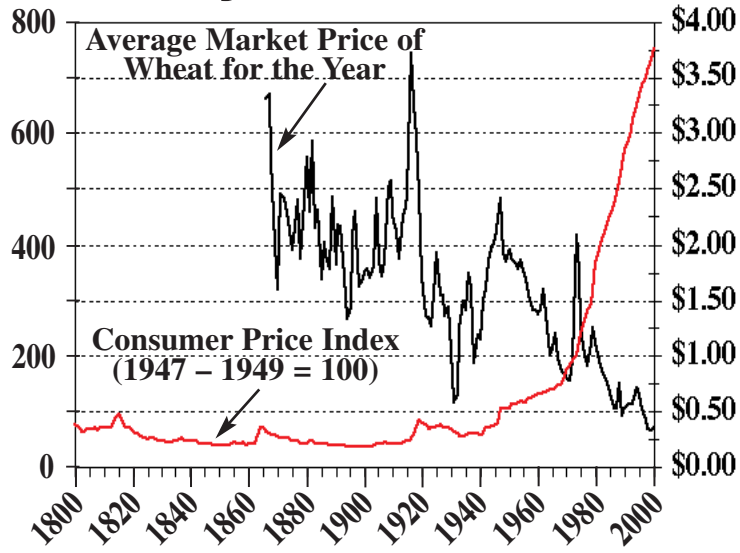
See Roundup Potent As, page 7

See How the Buying Power of Wheat Has Changed in 200 years!

Do you wonder why it is hard to make ends meet on the farm ... why costs of production are so high compared to the value of the crop in the marketplace? Notice the graph on the right which charts the consumer price index (the relative value of money compared to a certain time period) and the purchasing power of wheat (a fairly stable commodity in terms of value) from 1800 to 2000. Therein lies the answer to this question, though the reasons for these fluctuations are another major issue not discussed here.□

Purchasing power of one bushel of wheat (in terms of 1947 – 49 dollars)

1867	—	$3.36
1917	—	$3.73
1949	—	$1.85
1971	—	$0.77
1973	—	$2.08
2000	—	$0.35



Source: National Organization for Raw Materials, 2002

Roundup Potent As the Maillard Rx

Continued from page 6

years![6] Not only does the polyacrylamide cease to act as a permanent binding agent for soils, but the polymer breaks down to its toxic subunits and enters the food chain. Also, the units can be inhaled in dust or be readily absorbed through the skin.

Cooking or Herbicides More Important?

According to Dr. Joe Cummins, a Canadian scientist, the Maillard reaction as a creator of acrylamide in heated foods may be second in importance to the residual acrylamide deposited on leaves and soil in the field. This researcher claims that frying foods containing polyacrylamide would likely increase the concentration of acrylamide even more in processed foods.[7] Moreover, animals would get large doses of the chemical in their feed through the crops sprayed with Roundup, especially through residues of the hebicide's surfactant on soybean hulls and other soy and corn-based feeds they consume. It is likely that the action of digestive enzymes and intestinal microflora can depolymorize the polymer to acrylamide. It is also probable that plants themselves may take up acrylamide to add to the chemical load within the stems, leaves, and fruit once the chemical has been broken down in the soil.

"Polyacrylamide is the crutch that holds up the entire edifice of industrial farming. It's toxic, it's everywhere, and the agbiz system can't replace it."[8]

Having, then, plant products like soybeans, corn, canola, and others liberally laced with polyacrylamide, is it any wonder that the potential exists for high concentrations of acrylamide to occur in food products? With that comes the risk of diseases caused by this toxin.

Is it worth the risk of Monsanto and other manufacturers to continue selling a herbicide laced with a surfactant which is causing such great harm to humans and animals, and the environment? Perhaps the fact that one agribusiness giant earned around 50 or 60% of its multibillion dollar profits in 2001 from the sale of glyphosate laced with polyacrylamide has something to do with its view of this question.

We live in an age wherein scientific knowledge has led us to replace labor on the farm with herbicides that can "miraculously" kill weeds while not greatly harming the genetically modified crop. That science has also revealed the several dangers to health posed by the introduction of such toxins, and the need to limit our exposure to them. Will common sense, oftentimes so rare nowadays, prevail in deciding which route science will take? □

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When Conflict Comes, Try These.

- Talk with the person to find the cause, and try to correct it.
- If the problem involves overlapping responsibilities, emphasize the necessity to cooperate, and work out a clearer relationship.
- Try to eliminate head-to-head competition and rivalries, and instead devise joint goals.
- If the conflict is personal, kindly explain the problem and seek understanding.
- Realize that each person's value depends not just on talents, but on the ability to get along with others.

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