Myth busting: Pesticide use in organic and conventional agriculture

Thomas R. DiGregori | November 8, 2015 | Genetic Literacy Project

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Landwirtschaft/ Ausbringung von Chemikalien auf Landwirtschaftliche Flächen

This is the first of a three part series

What is in a name? Plenty! The mere hint or even question suggesting that a pesticide might have any medicinal value would strike many as being ludicrous while to many others if not most others, it is beyond belief and therefore there is no need to continue reading. PESTICIDES ARE POISON! They are inherently evil and any attempt to define them in any other way makes one a member of a corporate cabal or a servant of them. For those brave souls still reading, let us begin with a few definitions or concepts – oversimplified but not incorrect.

Poison – disrupts a vital function or functions in a living organism or organisms that could lead to death but not necessarily so. There are many confounding factors including one's immune system and, most important in toxicology, the dose and which organism is attacked.

Toxin – essentially the same as poison, but with some exceptions largely refers to a substance created by a plant or micro-organism, most often for defensive purposes.

Dose – The well-established principle of toxicology is that: Dose makes the poison. Or as stated by Paracelsus (German speaking doctor, Swiss, Philippus Aureolus Theophrastus Bombastus von Hohenheim, 1493 – 1541) who is credited with the concept: All things are poison, and nothing is

without poison; only the dose permits something not to be poisonous (in Greman – Alle Ding' sind Gift, und nichts ohn' Gift; allein die Dosis macht, daß ein Ding kein Gift ist). The demand of many for "zero tolerance" violates this basic principle of toxicology and is theology or ideology masquerading as" science protecting the public." For vital nutrients for humans, there are amounts below which result in deficiencies and above which are toxic often with similar outcomes. Much the same is true for plants.

Medicine – For infectious diseases, medicine would largely be something that kills the living organism that causes the infection. In such instances, a medicine would be a form of poison. Medicine as an anti-biotic is simply the use of a toxin (poison) produced by another living organism – a fungus, bacteria or plant – to kill the living organism or organisms that have invaded the human body and are causing harm or possible death. In the last half of 19th century, with improved microscopes and aniline dyes, scientists could see into the cell and into the blood stream. Koch, Pasteur and others were able to identify the micro-organisms that caused some of the world's most deadly infections. With the dyes, not only could one identify the micro-organisms, but it was also clear that they responded differently to the dye than did the surrounding blood and tissue. Consequently, if a substance could be found that killed the micro-organism but not the human (or domesticated animal), it would be medicine.

NOTE – Dose makes the poison in medicine in more ways than one. Most everyone knows that not taking enough of a medicine might do more harm than good. For example – patients not completing a treatment for TB led to the emergence of more lethal drug resistant varieties of TB. Dose is also important in that the medicine can kill the infectious agent and also otherwise hurt the patient, known as side-effects. The choice often is between either letting the infectious agent kill you or allowing the medicine to harm you while saving your life.

(On a personal note – I had three of the deadliest infections known to humans. I gave up a leg to survive one of them. For the last of the three, I was being given antibiotics that damaged the kidneys – their more general use had been discontinued decades earlier because of that. The dosage was very carefully monitored as were my kidneys which were "badly" damaged up to the point but not beyond that would allow the kidneys to recover which to my good fortune, they did.) Medicine and poison are therefore relative terms both relative to the organism and as a balance between benefit and harm. Chemotherapy in cancer treatment would be an excellent example of the balance between benefit and harm. Ironically, one says it is a medicine if it is more likely to save you than kill you!

Pesticides – Poisons that could also be considered as plant medicines. (Are you still with me? Have I lost more of you?) In fact, in Indonesia where I worked, pesticides were known as obat – medicine – or obat pembunuh hama meaning medicine that kills disease. Designating a pesticide as medicine may seem preposterous or even insane to the urbanites in developed countries. It makes perfect sense to farmers in many developing countries. Their precious food crops (and other crops) have been regularly getting sick and dying for them and for those who came before

them. If they now have something that kills what kills or harms their food crops and allows the plants to return to health, it is medicine in every reasonable sense of that term.

A pesticide as medicine for plants operates with similar constraints as medicine for humans. A pesticide must kill or damage that which is bringing harm to a crop be it a micro-organism, an insect, rodent or another plant competing with the crop for nutrient including light. As with other medicine, a pesticide has to do no harm to the crop or at minimum less harm than that with which it is afflicted. A pesticide has any number of other constraints such as not harming non-target species such as other desired plants, beneficial insects and of course humans. In other words, pesticides must kill a targeted insect or weed without otherwise reducing a desired condition of biological diversity. Like antibiotics for humans, pesticide use must have a strategy of killing targeted micro-organisms, insects or weeds in a manner that minimizes their ability to develop resistance to it.

Are pesticides necessary in agriculture?

With or without pesticides, a farmer has to find ways of protecting her or his crop. The more successful agriculture is, the more it concentrates nutrient in an open field. (We will obviously neglect greenhouses and hydroponics for this note though they are not without problems including invading organisms.) Nutrient for humans is likely to be nutrient for a host of other creatures (but not all) including birds, rodents, other wild animals, insects, micro-organisms etc. and be grown in soil with nutrients that supports competitive plants. One way or another, the crop has to be protected. Farmers have been doing this for thousands of years and it has often been with arsenic and other toxins that afflict the target species but are also toxic to humans and a range of other creatures. Many like Michael Pollan seem to believe that the use of pesticides was an invention of modern agriculture (identified as industrial monoculture) which requires its use while agriculture as traditionally practiced did not.

It is naïve in the extreme to believe that organic farmers do not use pesticides as farmers always have. The USDA has "The National List of Allowed and Prohibited Substances" for organic agriculture which includes both "natural" and synthetic pesticides. Nor is there any evidence that natural pesticides are any safer or better than synthetic ones. A number of the pesticides used by organic farmers are also used by conventional farmers. In other words, natural pesticides have their uses but if they were superior in every way, there would be no need for synthetic pesticides either in organic or conventional modern agriculture.

Most important among the non-target organisms that should not be harmed by a crop protecting pesticide are of course the humans who will apply the pesticides, those who harvest and later handle it and of course the eventual consumers who eat it. There are more short and long term considerations of pesticide use than we can even begin to discuss here which not only complicates the issue but provides for an unending stream of discourse and debate. Rarely do we discuss the problems of not using pesticides beyond that of losing the crop.

Plants in the wild including those that were later domesticated by humans had to protect themselves. They did so by producing substances that are toxic to the organisms that threaten them. Plants were and remain chemical factories that produce a huge array of chemicals. The only choice for those who wish to avoid chemicals in their food had better stop eating. In the fall term, just before Thanksgiving, I circulate a Holiday Menu provided by The American Council on Science and Health listing some of the many chemicals in the foods that grace our table for the Thanksgiving and Christmas Holiday. (For nearly 30 years, I have served on various Boards for ACSH and am currently on the Board of Scientific Advisors.)

Humans through time in domesticating plants have selected through the centuries for matters like taste and yield. Many of these attributes selected for, particularly taste, tend to lessen a plant's ability to defend itself thus needing more defense from the farmer. Modern plant breeding including biotechnology has allowed for the creation of plants with improved defenses. Even so, plants remain chemical factories. Most plant toxins are secondary metabolites and are largely expressed when the plant is invaded. The greater the invasion, the greater will be the likely expression of toxins.

Nutrients in food: Organic vs. conventional

In recent years, it has been argued that organic produce has more nutrients than conventionally produced produce because they are less well protected. That notion is promoted by organic activist and journalist Michael Pollan; it places him on a slippery slope to a place where he does not want to go. First, most of the alleged increased nutrients are anti-oxidants for which there is no evidence of any benefit. In fact, there are a number of studies that show serious potential harm from too many anti-oxidants including one that shows increased risk of diabetes.

Even more, Pollan in effect concedes a toxin or a poison is not necessarily an absolute and that what is toxic to one organism may be a nutrient to another. Another trick used to allege greater nutritional value for organic food is to pick a nutrient in a food which is a poor source for that nutrient. Thus an otherwise insignificantly small increase in that nutrient can be presented as a large percentage increase. A plane with a safety record of one in a million fatalities is twice as risky as one with a safety record of one in two million but few of us would seriously disrupt our travel schedule just to get the "safer" plane. There are a number of factors that could explain small differences in nutrients other than the ones that those dredging the data are seeking to establish as the cause.

Cherry picking nutrient increases because plants are less well protected ignores the other secondary metabolites also expressed that might not only be toxic to invasive organism but also to humans. As Bruce N. Ames and Lois Swirsky Gold have demonstrated in a number of peer-reviewed articles in major scientific journals, 99.9% of the chemicals that humans ingest are natural but the dosage is sufficiently small as not to be dangerous in most cases. The aptly named confirmation bias allows those convinced of a belief to find a nugget or two of evidence for their

convictions in a mountain of data. Ignored are the large scale meta-studies that find no significant difference in nutritional value between organic and conventionally grown food.

The two articles below discuss the nutritional quality of organic and conventional foods:

- "Nutritional quality of organic foods: a systematic review," The American Journal of Clinical Nutrition, vol. 90 no. 3, September 2009, pp. 680-685

- "Are Organic Foods Safer or Healthier Than Conventional Alternatives?: A Systematic Review, Annals of Internal Medicine", Vol. 157. No. 5, September 4, 2012

Results: *From a total of 52,471 articles, we identified 162 studies (137 crops and 25 livestock products); 55 were of satisfactory quality. In an analysis that included only satisfactory quality studies, conventionally produced crops had a significantly higher content of nitrogen, and organically produced crops had a significantly higher content of phosphorus and higher titratable acidity. No evidence of a difference was detected for the remaining 8 of 11 crop nutrient categories analyzed. Analysis of the more limited database on livestock products found no evidence of a difference in nutrient content between organically and conventionally produced livestock products.*

Conclusions: *On the basis of a systematic review of studies of satisfactory quality, there is no evidence of a difference in nutrient quality between organically and conventionally produced foodstuffs. The small differences in nutrient content detected are biologically plausible and mostly relate to differences in production methods".*

Safety: Organic vs. conventional foods

The other question is – are they safer. As we will attempt to show below, there is reason to believe that organic agriculture produces a less safe product.

The Bt. protein in transgenic Bt. corn is toxic to insects with a base digestive and receptors for the toxin but not necessarily to humans who eat the corn where the Bt. toxin, a protein is broken down to its constituent amino acids in our acid based digestive system. Certain proteins in tree nuts that can be fatal to some human beings are simply nutritious proteins to other human beings. There is considerable literal truth to the adage that one man's meat is another man's poison. There is ongoing international research on proteins that are allergenic to humans.

(See for example – Protein Allergenicity Technical Committee (PATC), ILSI Health and Environmental Sciences, Institute.)

Researchers encountering a novel protein can consult the descriptions of known allergens for similarities. And they can conduct allergenicity tests on it.

Gary P. Munkvold, Richard L. Hellmich, and Larry G. Rice, Plant Disease, Vol. 83, No. 2, February 1999, pp. 130-138):

Given that increasing yields has allowed more corn to be grown on less land there by leaving more land to return to forests or other vegetation, Bt. corn and other Bt. crops have provided an environmental benefit as has the overall land sparing ability of modern agriculture. Though there is not a scintilla of evidence for any harm from the Bt. corn crop to non-target insects, to the environment or to humans, there is considerable evidence that the crop product itself is safer.

When the corn borer works its way into the corn plant, it will carry a fungus, Fusarium ear rot into the plant. Simply the act of breaching the plant's outer defenses makes it more susceptible to disease invasion. The Fusarium ear rot express neurotoxins called fumonisins. The Bt. protection reduces considerably any fusarium infestation of the corn crop (Munkvold GP & Hellmich RL (1999) Comparison of fumonisin concentrations in kernels of transgenic Bt maize hybrids and nontransgenic hybrids."

Fumonisin is spit out by the mold. Fusarium as part of its chemical defense system. For decades, farmers and ranchers have known that animals can fall seriously ill if they eat corn that has been coated with Fusarium, even if the kernels later seem clean. People in parts of the world with high Fusarium growth, most notably the Transkei region of South Africa, have high rates of esophageal cancer. But it wasn't until 1988, when South African scientists first described fumonisin, that anyone knew exactly why the mold was dangerous.

Numerous reports and studies point to corn toxin playing a role in birth defects.

[Continued in Part II] **This blog, the first of three parts, appeared originally in Butterflies and Wheels with the title "A Pesticide as Medicine? Medicine as Poison? Or What is in a Name?" and can be seen in its original form here.**

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GENETIC LITERACY PROJECT
SCIENCE TRUMPS IDEOLOGY

Myth busting: Pesticide use in organic and conventional agriculture- Part II

Thomas DiGregori | November 9, 2015 | Genetic Literacy Project

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This is the second of a three part series by Thomas DeGregori, PhD, University of Houston

Bacillus thuringiensis (called "*Bt*") that has been used for decades by organic farmers to control crop-eating insects and by the World Health Organization to kill mosquitoes without using more toxic chemical pesticides. It's also been engineered into some crops to naturally repel insects — which has sparked condemnation from anti-GMO activists.

The concern over the the use of Bt proteins is a subset of the obsession over GMOS. It is easier to scare people than educate them.

Ironically, in recent years, it has been conventionally bred varieties of crops such as celery, potatoes and zucchini that have been removed from the market because they were expressing large amounts of their naturally occurring toxins. Celery contains psoralens that increase sensitivity to sunlight that can lead to dermatitis or chloracne and being a mutagen, can lead to skin cancer. Celery also contains goitrogenic compounds that interfere with the uptake of iodine into the thyroid. Potatoes contain highly *toxic* compounds known as glycoalkaloids, of which the most prevalent are solanine and chaconine. *Zucchini* may occasionally contain a group of natural toxins known as cucurbitacins.

In 2002 in New Zealand, highly toxic zucchini led to sickness and hospitalization for those who ate it. I was in New Zealand later that year and discussed this with the scientists who investigated it and have written on it. However, the following account is worth quoting at length because of the many issues important that it raises.

The most recent episode was an outbreak of "killer zucchini" which produced the "only food scare in recent history in New Zealand" and interestingly it "stemmed from the farming methods of organic farmers and others who use unconventional farming practices" (LSN 2003). In February 2003, Zucchini with "high levels of natural toxins" was sold on the vegetable market and resulted in "several recorded cases of people suffering food poisoning" (LSN 2003). We often worry about the toxicity resulting from spraying crops but rarely are we as concerned about those from not spraying them.

An examination of common factors shows the levels of toxin apparently increased among zucchini growers who did not spray their crops. Unusual climatic conditions meant there were huge numbers of aphids about in January and insect predation is sometimes associated with increased levels of toxins in plants.

In this case, there was a "clear link between increased toxin levels and older open-pollinating varieties of seeds" (LSN 2003). It is another of the "inferior is superior" views that there is something inherently virtuous in farmers planting their own saved seeds but it is "likely zucchini grown from saved seed will therefore be more vulnerable to toxin build-up".

The scientists who reviewed the "killer zucchini" case were very clear that the "most likely cause of the build-up of toxins is a genetic weakness in older varieties." However worthy the farmer's intentions may have been, "the growers' decision to use older varieties and to save seeds is likely to have resulted in a health risk for consumers – something which has never happened with crops derived from genetic modification".

In virtually every country in Asia and elsewhere in areas that benefited from the Green Revolution increases in wheat and rice and the increased yields from hybrid corn, the percent of land under cultivation to primary grains has actually been decreasing while the percent of land globally under cultivation to fruits and vegetables has increased substantially (more than tripled

since 1980 by my calculations, closer to doubling by others). From 1980 to 2004, fruit production increased 3.6 percent per year and vegetable production increase 5.5 percent per year. Only 4 percent of this increase occurred in developed countries.

The worldwide supply of fruits and vegetables per capita has increased continuously since 1961." page 5, "Between 1970 and 2000, annual growth rates in vegetable yields have been impressive in South Asia (1.8 percent), Latin America and the Caribbean (1.7 percent) and East and Southeast Asia (1.6 percent). Twenty-five percent increase in fresh fruit and vegetable consumption in the USA between 1977 and 1999,

"Dangerous" chemicals in food?

I try in a small way to immunize my students against scare tactics by having a one class period devoted to some of the things that are in your food about which you would prefer not to know when you are eating it. Finding a list of 10 or 15 or 20 of the supposed grossest things in your food is easy. Using a search engine will bring up more lists than you need or want. Most all the lists have a sub-text on the evils of modern food production.

Beware the rhetorical question from activists that is designed for you to give the answer that the questioner is seeking. I have a couple of my own. How about: Do you want rat poison in your children's milk? Well, yes, if it is a calciferol that provides vitamin D 2 (ergocalciferol) and vitamin D-3 (cholecaciferol) both of which are constituents of many rodenticides. The synthesis of this "rat poison" in the 1920s was one of the important medical advances of the time as it contributed to preventing rickets which was all too common at that time. It also allowed along with electric lighting for domesticated chickens to lay eggs all year long and was an essential element in raising egg production from an annual average of 83 per chicken in 1900 to the over 300 annual average today. We have all eaten dog poison, namely chocolate. Most of us if asked know that chocolate is lethal to our beloved pets but do not think of it in that way when we eat it.

What about ethyl butyrate in our orange juice or martinis? Now that is a chemical and it is used as a solvent in a number of products (nail polish remover) and also as a plasticizer in cellulose. In fact.the ethyl butyrate in your reconstituted orange was originally a natural constituent of the oranges themselves.

It is fun to send the students looking for what foods that they eat that have castoreum or cochineal in them. Castoreum comes from beaver's castor sac (often called an anal gland because of its proximity to the posterior) and is secreted (or an exudate) in the urine to mark a trail for the beaver. What could be more natural? Cochineal is a scale insect that is cultivated on cactus in Mexico and has been ground up and used as a food coloring for centuries by the Mayans.

Many food and chemical scare lists are from websites or groups that criticize modern food production for its alleged waste yet also criticize it for finding uses for the entire animal, finding ways to use parts that are not found appetizing in our culture. Some of these ingredients are constituents of what are prized in other cultures such as haggis among the Scots and blood sausages for the Argentinians. Being raised in New Mexico, I remember Rocky Mountain oysters with great affection. Or how about what has been identified as the roe or the "fully ripe internal egg masses in the ovaries, or the released external egg masses" of sturgeon — what that most of us know as caviar.

One activist site even criticized "cheese makers" for using "rennet derived from the mucosa of a veal calf's fourth stomach to create the beloved, versatile dairy product" a process used for making certain types of cheeses for several thousand years. Note that modern biotechnology has provided us with GM chymosin enzyme for rennet cheese which passes muster for vegetarians if they are not ideologically opposed to GMOs.

Processed food has become a code word for modern food evil. Could we not consider wine to be processed grapes and fine cheeses and yogurts and other delicacies as being processed milk?

One of the silliest complaints found spiraling through cyber space is the disdain for having chicken feathers or duck feathers or even human hair or cow horns in our bread and a variety of other products. What many are getting excited about is the extraction of L-cysteine from these for various food and other uses. L-cysteine is an amino acid and therefore a nutrient. For infants and children and even some adults, it is an essential amino acid.

If the critics would calm their hysteria and think about it a minute, they would have to consider this one a challenged to hated "industrial agriculture." Scientists have taken what would otherwise be a waste product (except maybe for stuffing pillows) and extracted a nutrient from it and added it to the food that we eat. Maybe the organizations and websites promoting these fears don't want their followers to think about it. Ironically, some of those most vociferous about the "right to know what they are eating" are among the most ignorant of what is in their food or at least its significance.

Does industrial agriculture increase or reduce waste and food dangers?

One of the true achievements of modern science and agriculture is that it finds uses for so much of what is grown and thereby reduces waste. Waste such as not picking crops because they do not have an appearance that is saleable is a separate matter and is deplorable and is rightly condemned. Waste because in our affluence we overstock our refrigerators and then dispose of the inevitable spoilage is also deplorable particularly when there are still so many in hunger. But fuller utilization of what we produce is commendable.

Critics of biotechnology with zero knowledge or experience in agriculture often argue that we should attack world hunger by reducing waste rather than advancing new agricultural technologies. Some of us prefer to use all means at hand both by reducing waste, by increasing output and by seeing that those in need get their fair share. I actually had the good fortune of having someone make the reducing waste argument to me. He was blissfully unaware of the basic fact that farmers and others have been working on reducing post-harvest food loses everywhere and for as long as we have had agriculture.

Modern science and technology have in fact transformed the environment and converted waste into nutrients; it has transformed that which has harmed us into food stuff or medicine. The fungi claviceps purpurea produces a toxic, ergot, which infested grains such as rye and maize and has caused enormous pain called St. Anthony's fire throughout human history. My wife and many others have taken ergot for relief from migraines. This is one of a number of cases where we have taken a poison and used it for medicine or a pain killer or anesthesia.

There are a whole raft of other truly disgusting things in the foods that we eat but you will not find them (with a very few exceptions) on the disgusting food lists because their being in our foods does not serve an anti-modern food production agenda. Rat feces or even bits of a rat itself in your cereal or toast or cookies are not pleasant thoughts when eating ones breakfast. One must not forget the multitude of insects and micro-organisms that "contaminate" the food that we eat. These and many more can be found in the USDA/FDA publication "Defect Levels Handbook: Levels of Natural or Unavoidable Defects in Foods that Present no Health Hazards for Humans**".**

The phrase "Unavoidable Defects in Foods that Present no Health Hazards for Humans" says it all. They have been part of the food that we humans have eaten for as long as we have been eating. Some of the micro-organisms in our foods produce highly harmful toxins if the dosage is high enough. The dirty little secret that our foodie activists ignore is that modern food production, storage, transporting and processing have reduced these harmful products to extremely small (but not to zero) manageable levels.

This has not always been the case as our progenitors often suffered mightily from them and as with the cases above with the fumonisins, many poor people today still suffer from them. When you discard a food item because it has become infested with a fungus, think of the poor subsistence family that has a choice of eating something similar or not eating at all. A quick search will turn up numerous articles in medical journals of the severe organ damage that can target those who eat contaminated food. Contrast with tolerance level measured in parts per billion in many foods of "industrial agriculture" that we are privileged to eat.

Food scares and GMOs

An ongoing myth is that the manufacturing of L-tryptophan,using a genetically-modified bacteria, was responsible for an epidemic of Eosinophilia-Myalgia in the United States in the

1980s. This enduring legend remains one of the enduring factoids of the anti-GM movement in spite of massive evidence to the contrary. To the believers, no explanation is required as to how the manufacturing transformed the L-tryptophan and what pathway or action in the human body would result in the condition of Eosinophilia-Myalgia. When presented with peer reviewed data in an email that demonstrated the pathway to Eosinophilia-Myalgia from overdosing on L-tryptophan, a guru of the anti-GMO movement responded that nothing in the article altered his opinion.

Most vitamins are either harvested from soybeans which are likely transgenic using hexane a potent solvent or manufactured by bacteria in huge vats in Japanese chemical companies, shipped to the U.S. in huge containers to factories where they are put in pill form in a bottle labeled all natural for a stand-alone vitamin that we mostly get as part of complex protei*ns.*

What about glyphosate?

A news article in Nature News once explored the possibility that pesticide glyphosate could possibly be used to treat malaria; in other words could it be a medicine? “Could malaria be killed by what is now used as a garden weed killer?” was the headline of the Hellen Phillips piece in Nature. The answer is “yes”, it is possible. Glyphosate might also be able to treat other diseases.

The researchers have also found other shikimate-pathway enzymes in T. gondii and P. falciparum, each one a potential target for new drugs, and plan to try other new combinations of treatment. They have worked out the genetic sequences of a gene that produces one of these enzymes, which may turn out to be a powerful tool in the hunt for a ‘designer’ drug.

One real advantage of this approach to treatment will be for AIDS patients. Because the immune system of these patients is suppressed they often suffer from multiple opportunistic infections, including pneumonia and tuberculosis, as well as some of the apicomplexan infections. As all of these organisms also have the shikimate pathway, the researchers say “there is now the exciting possibility that compounds with broad-spectrum activity could be useful against several opportunistic pathogens” (Could malaria be killed by a garden weedkiller?

How could that be possible? Glyphosate works by disrupting the shikimate pathway in plants causing them to die. A plant’s metabolic process takes energy from the sun and uses it along with the plant nutrient to create among other things amino acids. The shikimate pathway is used by the plant for the biosynthesis of the aromatic amino acids including tryptophan which we discussed above. The shikimate pathway is also used by bacteria, fungi and algae but not animals. We humans and other animals get our amino acids from plants and other animals. Since we do not have to manufacture our amino acids (though we do transform them), it saves our energy for other uses. Plant photosynthesis using energy from the sun is the ultimate source of both our nutrients and the energy to use them.

In other words, what makes glyphosate toxic to plants and micro-organisms does not make it toxic to humans. One life forms poison may be another life forms nutrient or at least be neither. That does not mean that there might not be other toxic side effects for humans but that is an open question and not settled as many fervently believe. But it does mean that glyphosate has the potential of being medicine for the same reason it is a pesticide – it kills or retards the development of what harms the plants that we are trying to grow or kills or retards the growth of that which harms us.

The number of articles in reputable peer reviewed scientific journals strongly suggests that it may not be toxic to humans or at least not sufficiently toxic to offset possible benefits for disrupting the shikimate pathway of invasive organisms that harm. This is in line with the long standing ranking of the toxicity of glyphosate as being Group III: Unclassifiable as to carcinogenicity in humans, with Group I as posting the most risk).

[Read Part I here. To be continued in Part III] This blog, the second of three parts, appeared originally in Butterflies and Wheels with the title "A Pesticide as Medicine? Medicine as Poison? Or What is in a Name?" and can be seen in its original form here.

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GENETIC LITERACY PROJECT
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Pesticides Part III: Comparing pesticide use in agroecological and conventional agriculture

Thomas DeGregori | November 10, 2015 | Genetic Literacy Project

This is the third of a three part series by Thomas DeGregori, PhD, University of Houston. [Review Part I andPart II]

Last March, International Agency for Research on Cancer (IARC) – the branch of the UN's World Health Organization that studies the relationship between environmental and lifestyle hazard factors and cancer – focused on pesticides. Among its decisions, the committee concluded that glyphosate, a component of Roundup, Monsanto's widely used weedkiller, which has been in common household and agricultural use for decades, was being classified as a carcinogen in the category 2A: Probably carcinogenic to humans. That puts it in the same category as red meat and frying, among other agents or actions.

The conclusion focused on hazard and not risk, which measure the actual danger someone faces from normal usages. The decision conflicted sharply with every major science oversight agency that had previously evaluated the herbicide, known for its comparative mildness. Responsible agencies and agricultural universities continued to recommend the use of glyphosate for weed control. Protestors began demanding policy actions. There was no acknowledgement of the more toxic pesticides that were replaced by glyphosate or the resulting significant improvement in

the Environmental Impact Quotient (EIQ – "The EIQ impact assessment is based on the three principal components of agricultural production systems: a farm worker component, a consumer component, and an ecological component") that resulted when farmers switched to glyphosate from other products.

As would be expected, those who leaped on the initial report either did not read beyond the headlines or simply over-interpreted it to suit their ideological needs. The initial brief on glyphosate clearly distinguished between consumer use where there was no change from the previous conclusion of not being a hazard at the dosages encountered and occupational use, primarily in agriculture where there was a potential hazard but a risk factor was not given. It is important to note, that there were no new studies or data, just a re-evaluation of existing studies. It is understandable then that a number of regulatory agencies in U.S. and Europe quickly re-affirmed, in some case strongly re-affirmed their previous determination as to the safety of glyphosate.

One of the worst distortions of the report was on VICE an HBO presentationthat fashioned itself as a balanced look at GMOs. (Unfortunately, the full program is available only to subscribers.) The host of the program, Isobel Yeung, gave opportunities to harsh critics of GMOs to make their case with no pushback while aggressively questioning a distinguished scientist, who happened to be a Monsanto vice-president, on a rather esoteric point that she did not seem to understand. The program was unbalanced throughout.

Towards the end of the program, there are two brief snippets from an interview with John McLaughlin, a Canadian scientist and member of the IARC committee, that summarized the committee's work re-assessing the toxicity of glyphosate and other chemicals. The interview made him sound like he was ringing warning bells about glyphosate. The snippets were either a case of creative editing – the video equivalent of cherry-picking – or extreme cleverness in asking questions designed to only get the answers the interviewer sought.

Fortunately, McLaughlin subsequently appeared on a different program — The Agenda with Steve Paikin: The Last Roundup Debate — where is words were not cleverly manipulated. He distinguished between hazard and risk and indicated that as a hazard review, the new assessment was a worst case scenario that did not take into account real world exposure. It was not a measure of risk — the likelihood that someone faced actual dangers from exposure. and not a risk factor. It certainly did not suggest those eating food faced any dangers at all. Even for agricultural workers, the major potential occupational hazard, McLaughlin said that if the glyphosate is used according to instructions given by Health Canada, it is not a health risk.

Are there safer, more productive alternatives to conventional agriculture?

Agroecology is currently the rage among activists in developed countries, bolstered by supporters' claims that the practice simultaneously increases yields and protects the crop against

pests of all kinds. That's a false divide, suggesting that sustainability is best achieved by one particular farming method. It needs to be stated that all agriculturalists are agroecologists in that they recognize the agriculture takes place in differing environments which must be understood if one is to be successful in producing a crop and sustaining production through time. It is not a perspective invented by and unique to urban activists in developed countries who have never in out in the field and had to deal with real problems of producing a crop.

It is easy for Jean Halloran from Consumer's Union, while on a panel in Manhattan, to proclaim, "We favor a knowledge-based approach rather than a chemical-based approach to increasing production," without having to identify and implement these "knowledge-based" solutions. Walter De Jong, a Cornell University agriculturalist on the same panel:

was shocked at how people who don't live near farms feel entitled to advise farmers, especially on environmental matters…. There is a romantic notion of environmentalism, and then there is actual environmentalism. …farmers are very conscious of the environment. They want to hand off their operation to their kids and their kids' kids, so they maintain the land the best they can while doing what they need to do in order to sell their harvest.

No one would deny that an intensive study of agroecology as a scientific inquiry and discipline could yield many insights and make a substantive contribution to agricultural development throughout the world. The problem is that it has become a religion and not a science and is being offered in exclusion to other approach and not complementary to them. The larger problem is that as such, they don't work except in the minds of urban activists mentally and physically divorced from the realities of agriculture.

Grist reporter Nathanael Johnson asked the question: "Why aren't agroecological techniques farming spreading faster among poor farmers?" Johnson proceeded to list the many virtues of agroecology. Children in school and in 4H clubs are taught agroecology and organic methods. This has been going on for decades yet when they become adults and actually farm, they use pesticides. In his piece, entitled "Even this organic advocate thinks African farmers need herbicide," Johnson concluded, "It could be that organic methods just aren't working for poor farmers."

Other farmers and scientists have reached similar conclusions. Don Lotter,celebrated in the agroecology community, shocked his adherents earlier this year with a nuanced analysis of the limits of organic agriculture when he wrote "Facing food insecurity in Africa: Why, after 30 years of work in organic agriculture, I am promoting the use of synthetic fertilizers and herbicides in small-scale staple crop production," a discussion piece in*Agriculture and Human Values*.

Food insecurity and the loss of soil nutrients and productive capacity in Africa are serious problems in light of the rapidly growing African population. In semi-arid central Tanzania

currently practiced traditional crop production systems are no longer adaptive. Organic crop production methods alone, while having the capacity to enable food security, are not feasible for these small-scale farmers because of the extra land, skill, resources, and five to seven years needed to benefit from them — particularly for maize.

Conservation Agriculture (CA) in Africa has two main categories — organic and herbicide-mediated. The organic version of CA, despite years of promotion, has had a low rate of adoption. Herbicide-mediated zero tillage CA via backpack sprayer can substantially increase conventional maize yields while at the same time nearly eliminating erosion and increasing rainwater capture up to fivefold.

The pesticide that he advocates? Glyphosate, which he described as a herbicide "which is a non-proprietary product produced in Africa and approved for small farm use. The systemic nature of glyphosate allows the killing of perennial grasses that would otherwise need deep plowing to kill. The rooted weed residues protect the soil from erosion. The risks of glyphosate use are substantially outweighed by the benefits of increased food security and crop system sustainability."

[Review Part I and Part II] This blog, the third of three parts, appeared originally in Butterflies and Wheels with the title "A Pesticide as Medicine? Medicine as Poison? Or What is in a Name?" and can be seen in its original form here.

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