



**Memo n°8: Art DUNHAM**

**Veterinary**

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Arthur Grinnell Dunham DVM graduated from Iowa State University in 1974. He and his partner practice large animal medicine in a small community in northeast Iowa. Ryan Veterinary Service works with a mix of swine, dairy, cow-calf, and feedlot operations. He has always had a great interest in nutrition and does nutritional analysis. He is a member of the Iowa Veterinary Medical Association, the American Veterinary Medical Association, the American Association of Swine Veterinarians, and the American Association of Bovine Practitioners. He is also a member of Practical Farmers of Iowa. He started to develop concerns about the overuse and abuse of glyphosate based herbicides a few years after RR beans and RR corn were introduced. A good share of the practice has sandy soils that leach trace minerals more than black dirt. Many of these soils have a high ph that puts much of the manganese and other trace minerals in an oxidized- unavailable state. He contacted Dr. Don Huber in 2007 and has been working with him and a small diverse group. He appreciates the support of his wife, of his 4 children and their families, and that of his veterinary partner and office staff.

## **Animal Health Issues with Increased Risk Due to the Use of Glyphosate Based Herbicides**

I, Arthur Dunham DVM, am a partner in Ryan Veterinary Service, where I have practiced large animal veterinary medicine since graduating from Iowa State University in 1974. The practice is located in northeast Iowa, USA. The practice has a mix of swine, dairy, cow-calf, and feedlot. Because of my nutritional interest and its importance in health, I have done and do nutritional analysis with all four categories. Some of our clients never adopted Round-Up Ready technology while many did. Seeing differences between these operations after the approval of Round-Up Ready soybeans in 1996 and Round-Up Ready corn in 1998 as well as seeing improvements in operations cutting back on glyphosate since then, led to testifying here.

Anyone evaluating glyphosate should know about all 3 of its patents: 1964 as a general chelator or metal cation binder similar to EDTA, 1974 as an herbicide, and 2010 as a human antiparasitical and human antibiotic (1). All three of these patents depend on glyphosate's ability to bind with trace mineral cations that are necessary cofactors in biological enzyme systems. Glyphosate would chelate divalent cations in this order based on the log of chelate formation constants (K values):  $\text{Cu}^{++}11.93$   $\text{Zn}^{++} 8.74$   $\text{Ni}^{++} 8.10$   $\text{Cd}^{++} 7.29$   $\text{Co}^{++} 7.23$   $\text{Fe}^{++}6.87$   $\text{Mn}^{++}5.47$   $\text{Mg}^{++}3.31$   $\text{Ca}^{++}3.25$  (These constants are read in factors of 10 like ph numbers so going from 5 -6 is a factor of 10).

Industry wants everyone to ignore the first and last patent even though they are as accurate as the 1974 patent. Today's science recognizes the importance of the GI microbiome. That alone should curtail glyphosate's indiscriminant use as an antibiotic herbicide and prompt society to get glyphosate out of our food supply. Here are 8 clinical outcomes that have become more common with increased glyphosate use.

### 1) Manganese ( $\text{Mn}^{+2}$ ) deficiency

Manganese is the cofactor in the Shikimate pathway that plants and most bacteria have to make the aromatic amino acids and defense substances like lignin. This deficiency was seen in swine, dairy, and cow-calf herds in 2006 and since. It can result in non-cycling sows and cows that are in positive energy and protein balance. Cows have very small pea-sized ovaries on palpation and do not come into heat regularly. Calves born have poor immune function with many suffering from

recurring scours and some with navel ill. Some calves are born with chondrodysplasia---short legs and big joints---like a bull dog. (3) Cows have more stillborn calves that have very low Mn+2 liver levels when tissue is submitted to ISU. (4) The May 17-19 Minnesota Dairy Health Conference in 2011 discussed this problem and Dr. Jeremy Schefers blamed dry weather like the droughts in Australia where Mn++ deficiency was first documented and down played glyphosate use as a cause. (5) He said this more than likely so as not to offend agribusiness support to his university and thankfully some veterinarians in the audience found this amusing since the Midwest was drenched with heavy rains in the years he was discussing and collecting tissues.

## 2) Cobalt (Co+2) deficiency

Dr. Mike Sheridan, swine consultant from Steinbach, Manitoba, saw “squatter” hogs in a large farrow to finish operation feeding small grains to sows and their offspring. Spinal cord tissue sent to 2 veterinary diagnostic labs and to a human lab all confirmed demyelination of the spinal cord due to B12 deficiency. Increasing folate and Vitamin B12 in the rations for sows and their pigs did not stop the problem (went from about 3% to 2%). Switching grain sources seemed to be part of the fix. Was this new grain spray dried with glyphosate? (6). Internationally known dairy veterinarian and consultant Dr. Earl Aalseth had dairies give 7.5 cc of 1000mcg/cc B12 to all fresh cows twice a day for 2 to 3 weeks post freshening to gain about 5#/milk/cow/day through the lactation on lower feed intake with better reproductive and overall health.(7) Fiber digesters in the rumen have a high Cobalt requirement and glyphosate likes this trace mineral better than Manganese. There are up to 4 chelation sites per glyphosate molecule and our USA Federal Register now says it is legal to have up to 30ppm glyphosate in our bread and cereal which comes about because of the permitted spray drying of wheat as a harvest aid. The pig is a model for B12 (cyanocobalamin) in humans where both a 150 # pig or human require 15ppb B12 daily where cobalt makes up less than 5% of that mass. If we do not want B12 deficiency and demyelination of nerves, why do we allow this chelator in our diet at over 1000X the level recommended for cobalt? We supplement folate in the human diet in the USA, so now demyelination of nerves instead of pernicious anemia becomes the first symptom of B12 deficiency. Nurse Sally Pacholok is not the only one that thinks that 40% of Americans are now low in B12. (8)

### 3) Toxicoinfectious botulism:

I have witnessed four cases of toxicoinfectious or visceral botulism in our own practice as well as provided phone consultation on many more. In the USA, we lack a way to confirm this disease in the lab since the bioassay test we do uses lab mice and they are not as sensitive to the botulinum neurotoxins as the horses, cattle, and pigs we are checking. With this form of the disease you do not have preformed toxin in the pit silage from a ground-up dead animal where many cows die all at once, but the toxin is elaborated right in the intestinal tract of the animal. Two factors are required to trigger this form of the disease. First you need to make some small grain silage or haylage too wet and then you need an antibiotic like glyphosate in the diet through Round-Up Ready corn silage, earlage, or corn grain. The glyphosate in those feeds knocks down bacteria such as *Enterococcus faecium* and *faecalis* that hold the *Clostridium* in check and keep it from forming neurotoxin. (9) In many herds the cows die fast with few signs or they drink like cats and do not consume enough water because of motor nerve paralysis and an inability to swallow normally. (10) You occasionally see a cow like the one pictured (paralyzed tongue hanging out of her mouth) that goes from giving over 100# of milk/day to near death in a few days. (11)

### 4) Altered microbiome and changes in the environment resulting in more listeriosis and other pathogenic infections:

The Diagnostic Labs at both the University of Minnesota and at Iowa State University admit they are culturing more listeria in mastitis cases. (12) Listeriosis used to be associated with poorly made corn silage but now we are seeing cases with cattle on dry hay and Round-Up Ready corn. (13) A recent KSU study showed that pigs with a more diverse microbiome have lower morbidity and mortality from PRRS (porcine reproductive and respiratory syndrome virus) and Circa virus than those with a microbiome that is less diverse. (14) Farrowing clients that have switched to no corn grain with glyphosate have avoided the 20-40% of all farrowing operations in the USA that break or rebreak with PRRS yearly according to an ISU veterinarian. (15) My partner, Don Cook DVM, and I have seen more cases of nursing beef calves on pasture breaking with *Mycoplasma bovis* if the cows and calves are supplemented with RR corn silage or if the calves are given creep feed with Round-Up Ready products. Shiva Ayyadurai's metabolic model for human metabolism predicts less glutathione (part of the vitamin E system) and more formaldehyde with glyphosate in the diet. (16)

#### 5) More Fusarium mycotoxins in the feed and bedding for livestock :

Dr. Bob Kremer, recently retired ARS scientist from Columbia, Missouri, has described how glyphosate use favors the Fusarium mold family. (17) The 4 most common families of Fusarium toxins are: vomitoxin, fumonisin, zearalenone, and T2. Nivalenol is another important Fusarium tricothecene mycotoxin. Advisory levels from our USA CVM (Center for Veterinary Medicine) and USDA are to feed no more than 1.6ppb nivalenol to pigs and no more than 4.6ppb to cattle in the total diet. One of our clients had more trouble with fertility and milking when sows were bedded with Round-Up Ready cornstalks in the winter versus no bedding in the summer. (18a). Many gilt pigs get swollen vulvas from the estrogenic zearalenone they are getting in their feed. One of our dairy clients with no hail damage in 2009 got 275 bushel to the acre RoundUp-Ready corn. He sprayed it with the fungicide Headline as advised and still had zearalenone high enough to cause many virgin heifers to udder up and squirt milk. (18b) He had T2 in dry grain over 200ppb. We have had receiving pellets from big companies using byproduct grains with too much T2 so the pigs do not eat enough and go backwards (19). We have had to occasionally empty hog feeders because of high vomitoxin levels and replace the feed with feed ground from a different source of grain (20). We have also seen the wet corn gluten commonly fed to fat cattle with high levels of Fusarium mycotoxins hurting performance and leading to some death loss (21). Fumonisin in the feed along with circa virus caused high mortality in big hogs in some herds (22).

#### 6) Glyphosate-phytase issues:

BASF, with their phytase called Nutriphos, were the first to stabilize phytase after 2006 so that it could take the heat of pelleting. Their chemist did not think about what would happen if this phytase kept working in the pit and in the field. Phytate, which phytase breaks down, is the part of organic matter that keeps phosphorus from leaching without soil loss like nitrogen does. The soluble phosphate released desorbs glyphosate bound to cations in the soil and frees it up to be an active chelator-antibiotic again. Both this dissolved reactive phosphorus and the glyphosate heads to our streams and lakes and creates algae bloom (23). Too many of our hog clients know that their soil soluble phosphorus levels should not be clear down to 5ppm and less and they remember that before 2006 they were getting in trouble with the DNR for having very high phosphorus numbers and of being accused of using too much hog manure. At least the manure was of much more value then and most of the phosphorus was staying on the farm where it could be used.

## 7) Antimicrobial resistance issue:

Swine veterinarians, including my partner and I, occasionally run into *Clostridium difficile* scours in baby piglets. This usually occurs after sows or pigs are treated aggressively with antibiotics for another disease causing dysbiosis or in other words a severe alteration in the normal gut microbiome of the pigs. A similar situation is causing this infection to flourish in people on extended or aggressive antibiotic treatment and many times fecal transplants are the only and best therapy. We can now use genomics to identify gut bugs and we will never be able to culture over 80% of them since they are so interrelated and dependent on each other. Glyphosate causes a dysbiosis. We have seen an increase in feedyard bloats when calves are weaned and put on dry pelleted feed with soyhulls in the pellets (24). The soyhulls helped bring the total glyphosate level of the grain part of the diet to over 8 ppm when .1ppm in the bowel will kill some beneficials (25) and when the antibiotic patent says most generally a dose of 1-2ppm is adequate (26). Monika Krueger got hired by the breweries in Germany before she ever did any of her animal studies. They hired her when they had trouble brewing beer brought on by their barley providers spray drying their grain with glyphosate preharvest and not telling the breweries of their change in management. This is proof that the 7771736 antibiotic patent for glyphosate is accurate.

Doctors tell us not to put any unused human antibiotics down the drain if not used to avoid environmental contamination. Why worry about following this advice when in the USA we are using 3X more of this antibiotic than all other antibiotics put together under all uses on livestock? This herbicide antibiotic works on malaria and gonorrhea where we are running low on effective therapies (27). If ag is causing issues with human antimicrobial resistance then environmental contamination should be a main area of interest and leaving this herbicide out of the discussion is not science. I attended the second annual meeting on antimicrobial resistance of the National Institute of Animal Agriculture in Columbus, Ohio, with an agronomist in 2012. The whole meeting was devoted to environmental contamination and even had science that showed contamination with copper compounds could change resistance patterns (28). The 2 of us spent the whole meeting trying to inform the speakers of glyphosate's patent 7771736.

## 8) More early term pregnancy loss:

A Hoard's Dairyman article as well as an article in Beef Magazine talk about only 85% of USA beef cows and heifers exposed to artificial insemination and bulls ever



have a calf and that this is worse than in the 1990s (29&30). One of our clients with a 150 cow herd has had only one year in the 43 we have worked for him where we had fewer breeders and fat cattle sold than the number of cows and heifers exposed to artificial insemination and bulls. That year was the only year that he fed Round-Up Ready grain and silage to his cows. Hopefully in the very near future I will be able to talk about the probable cause of this fertility decline.

This part depends on whether proteonomics gets done in time.

Our small group has worked with the veterinary researcher that found an EM agent that he determined was the cause of mare infertility syndrome. Dr. Don Huber wrote a letter to the USA Secretary of Agriculture asking for funds and help to research this agent. This letter got leaked and was circulated widely. I sent edematous swine placenta and cattle amniotic fluid samples to this researcher where we had early abortion and I split the samples so that the ISU Veterinary Diagnostic lab got samples of the same tissues. The researcher found his vascular damaging agent and ISU came up with no cause. The researcher put the agent he got from my tissues and others into chicken embryos and other experimental animals and caused a percentage of them to abort. The agent was also isolated from Goss's wilt corn tissue samples and from Sudden Death Syndrome soybean tissues. Anthony Samsel and Steffani Seneff have a very plausible at least partial description of this agent in their last paper when they discuss the substitution of glyphosate for glycine resulting in a peptoid. Monsanto described this peptoid in 1972 when they used C-14 labeled glyphosate and saw that some ended up in the protein of the marrow and brain etc. and that not all was excreted in the urine and feces. (31)

## **Conclusion:**

Glyphosate use has been sold to the public as an environmental savior and of paramount importance for no-till or "conservation" agriculture. As others will testify, glyphosate is anything but good for the soil. Many have shown (e.g. Gabe Brown of North Dakota) that glyphosate is not necessary for minimum and no till and no one is advocating going to continuous corn with all mold board plowing and that is usually what glyphosate proponents are comparing its use too. Honesty and true science should not let the widespread adoption of this herbicide, no matter how convenient, result in society ignoring the other two glyphosate patents entirely. This is especially true when the science of those patents seems to at least partially explain the increases of many chronic disease issues in the USA that modern medicine is struggling with.

As a veterinary clinician of 43 years, I look for science that backs my clinical observations rather than discounting observations and blindly accepting the ag business funded papers that are often guilty of not looking at the whole picture. Now that we have mapped our genome as well as that of plants and now that we realize we share 40% of our genome with plants, we should not blindly think that herbicides are non-toxic and recommend combinations for resistant weed control when we do not even know modes of action. 32) We need more agroecology rather than more agro chemistry. We need specialists that have some general knowledge. We need less scientific reductionism and we need regulators that are known- something generalists. Substantial Equivalence has always been based on PR (Public Relations) rather than good science. In geometry, if the first step in a theorem is false than everything that follows is wrong as well. Too much faith in industry financed science along with failure to provide enough public funding has helped get us in this dilemma.

Art Dunham DVM

**Link to access the foot notes (1) to (31):**

**<https://drive.google.com/drive/folders/0B0QQ2fgcr1mMWGcySFQwekVFeGs>**