The curveball of PFAS

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AT A GLANCE

Soil is the primary source of PFAS on-farm, and municipal or industrial waste sludge is the primary way they get there, but regulations are coming – and understanding what they are and how they impact you is important.

Hold on to your hats, folks: There's another thing we need to be worried about. Per- and polyfluoroalkyl substances (PFAS) are one of the more recent environmental concerns to crop up in agriculture. Unlike nitrogen, phosphorus or many of the other environmental considerations that need to be managed on-farm, PFAS are not a direct result of agricultural practices per se, but are a side effect of living in the world we live in and our addiction to convenient products. Moreover, PFAS are unique in that they are a concern for human health rather than the environment. Agriculture merely serves as a vector that brings these compounds into the food and water supply.

What PFAS mean for agriculture

This will not be a detailed breakdown of what PFAS are or how they're used in society. Rather, this article will be a brief look at how agriculture is exposed to them, how to test for them and how exposure could be mitigated. For the purposes of this discussion, it's only important to know that PFAS have been around since the 1940s, they are in thousands of common household and industrial products, and their impact on human health has only recently become a serious concern. The work on PFAS is yet so immature that there isn't enough information to form hardline regulations regarding acceptable levels within food and water. However, the EPA has set a health advisory level of 70 parts per trillion (ppt) in drinking water.

A brief refresher on the concept of bioaccumulation is prudent at this point to help facilitate a better understanding of how agriculture fits into the story. Merriam-Webster defines bioaccumulation as "the accumulation over time of a substance and especially a contaminant (such as a pesticide or heavy metal) in a living organism." The classic example of this is mercury contamination in fish, and the ocean food chain offers a great way to visualize the process. When the smallest creatures feed on the ocean sediment, they take up mercury and don't excrete it. The mercury concentration builds up in their bodies, which are in turn eaten by a bigger fish, who takes up the concentrated mercury and further concentrates it for the next bigger fish, and so on. This is how small amounts of mercury in ocean sediment can be concentrated to toxic levels in the meat of the fish we eat.

While forage production has little to do with ocean ecology, the jury is in and there is no question that when PFAS are present in the soil, they are taken up by plants.

PFAS are not going away. One day soon, they will be a normal part of the danger lexicon, just like lead or asbestos. That means regulation is coming and will most likely start with the end product: milk. When that happens, those producers who have already investigated PFAS on farm will be ready and will know exactly where they stand.

The plants are eaten by livestock, which bioaccumulate the PFAS and pass them into the resulting milk and meat. A small 2012 survey conducted by the Center for Food Safety and Applied Nutrition, a branch of the FDA, looked at 49 milk samples from across the U.S. and found one sample had PFAS levels higher than the 70 ppt EPA advisory level. There was something special about the ground that fed the cows which made that milk: Municipal sludge was applied as a soil amendment.

Where are PFAS?

Soil is the primary source of PFAS on-farm, and municipal or industrial waste sludge is the primary way they get there. Of course, there are exceptions, such as a field near an airport where fire suppression was practiced using firefighting foam. That would dump a huge load of PFAS into the soil and down into the groundwater. Outside of a special case like that, if mitigation is the aim, then soil management is the strategy. The strategy is simple – it begins and ends with the avoidance of sludge applications. In fact, the application of any waste material other than manure really should be avoided for a variety of reasons outside the scope of this discussion. While these products offer an up-front financial advantage, the hidden costs invariably show up down the road and can be significant. Given the current outlook on fertilizer prices, land application of sludge is likely to look more and more enticing.

First steps for PFAS

Testing is the second key factor in management. As the old cliché says, "You cannot manage what you do not measure." Most forage producers already work closely with an agricultural testing lab for routine soil fertility or forage analysis. Some of the more progressive growers may even have their labs on speed dial. Unfortunately, PFAS testing is in the realm of environmental testing, and most agricultural labs will not have the capabilities to perform the test. They should, however, be able to refer you to a lab that can perform the test.

Because the levels of concern are so low (parts per trillion) and PFAS are everywhere, the sample collection process is different from that of collecting a standard livestock water or forage sample. A well-respected environmental lab with international reach has put together a guide that outlines the proper precautions for collecting samples. Some of them are surprising, such as not wearing clothing that has fabric softener and not to use cosmetics the day of sampling.

TABLE 1

FIELD SAMPLING GUIDE

MATRIX	CONTAINER	PRESERVATIVE	METHOD	NOTES
Drinking water	2 x 250 ml HDPE or PP	Trizma	EPA Method 537.1	Trizma is a buffer and removes free chlorine.
Non-potable water	2 x 250 ml HDPE or PP	None	PFAS by isotope dilution (ID)	
Effluent	2 x 250 ml HDPE or PP	Trizma	PFAS by isotope dilution (ID)	Finished samples may require Trizma.
Soil, sediment, bio-solids	1 x 250 ml (or 4 ounce) HDPE or PP	None	PFAS by isotope dilution (ID)	

Holding time for treated drinking water is 14/28: sample extraction = 14 days, sample analysis = 28 days, all other holding times are 28/28 or 28/30.

DO USE	DO NOT USE
Sample container items	
• HDPE or polypropylene (PP) • Lined or unlined HDPE or polypropylene caps	• Glass or LDPE container • Teflon-lined cap
Field equipment	
• High-density polyethylene (HDPE) or polypropylene materials • Silicon tubing • Loose paper (non-water resistant) • Aluminum field clipboards or Masonite • Sharpies, pens • Regular ice	• Teflon containing materials • Teflon tubing • Waterproof field books • Plastic clipboards, binders, or spiral notebooks • Post-it notes • Chemical (blue) ice packs
Field clothing and personal protection equipment	
• Well-laundered clothing, defined as clothing that has been washed six or more times after purchase, made of synthetic or natural fibers; cotton clothing preferred. • No fabric softener • Boots made with polyurethane and polyvinyl chloride (PVC) • Sunscreen that is all natural and/or organic • Insect repellents that are all natural and/or organic	• New clothing or water-resistant, waterproof or stain-treated clothing; no clothing containing Gore-Tex • Clothing laundered using fabric softener • Tyvek • Boots containing Gore-Tex • Cosmetics, moisturizers, hand cream or related products as part of personal hygiene and/or showering routine the day of sampling
Field equipment decontamination items	
• Alconox and/or Liquinox	• Decon 90
Food Items	
• Bottled water and hydration drinks (i.e., Gatorade and Powerade) to be brought and consumed only in the staging area.	• Food and drink other than the exceptions listed at left

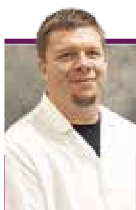
Source: Pace Analytical, pacelabs.com

A full list of precautions can be seen in **Table 1**.

PFAS testing

Testing for PFAS is expensive, likely in the hundreds of dollars per sample, so taking a sample properly is of extreme importance to anybody who doesn't like to waste money. More important than losing money on a poor sample is the rabbit hole one may go down trying to trace the source of a false positive. When a lab is looking for levels in the single-digit parts per trillion, even the smallest contamination will show up, and that false positive test result could lead to spending a lot of money looking for the source of PFAS on-farm, only to learn that there is none.

Though we may want them to, PFAS are not going away. One day soon, they will be a normal part of the danger lexicon, just like lead or asbestos. That means regulation is coming and will most likely start with the end product: milk. When that happens, those producers who have already investigated PFAS on-farm will be ready and will know exactly where they stand. Those who have not will find out quickly whether or not PFAS are a problem on their farms. Hold on to your hats.



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