De-sexing the water

Erik Ness

Hormone disruption can be very difficult to measure and decipher, but innovations in green chemistry are finally showing some potential for breaking down the pollutants that cause it. In June, Nancy Shappell, an animal physiologist with the Agricultural Research Service (Fargo, ND) reported to the American Chemical Society on her work using Fe-TAML and hydrogen peroxide to degrade the estrogenic compounds estradiol and ethinylestradiol.

Fe-TAML stands for iron tetraamido macrocyclic ligand, a family of designer catalysts developed by the Carnegie Mellon University's Institute for Green Oxidation Chemistry. The catalysts work by binding to an oxygen atom in hydrogen peroxide, creating an intermediate compound that oxidizes pollutants and renders them harmless. The complexity of the chemistry depends on the target molecule, but in the past 3 years Fe-TAML has shown promise in breaking down a wide variety of compounds, including agents of biological warfare, nitrophenols, organophosphorus pesticides, and chlorination byproducts.

Ethinylestradiol, the active ingredient in birth control pills taken by nearly 12 million American woman, is particularly resistant to natural degradation. However, a cocktail of Fe-TAML and hydrogen peroxide at room temperature can break it down to undetectable levels. Three other naturally occurring compounds with estrogen activity are also destroyed by TAML. The results are so promising that Fe-TAML will leave the comfort of the bench for a South Carolina hog facility – and some real world testing

Shappell's research on contamination around Fargo found that hormone levels in poultry litter and hog effluent are higher than those found in undisturbed wetlands, but that natural processes can often break them down. Problems can be intermittent – for example, hormone levels are higher during cold weather, when natural systems are less active. Proving human health impacts remains problematic. "We're not going to detect [these effects] for decades", she says, adding that fish and wildlife present a more immediate concern. "If you don't have a reproductively functional male, then the species is toast."

Shappell believes the evidence warrants developing a testing and remediation strategy. "As more people use hormonally active compounds, it's going to be more of an issue in the future." ■

Scanning soil health

Virginia Gewin

Scientists at the World Agroforestry Centre (ICRAF) in Nairobi, Kenya, have adapted an infrared (IR) scanning tool to screen the health of African soils. Used widely in the food and pharmaceutical industries, IR technology provides a cheap method to analyze thousands of samples .

To date, only a sketchy and fragmented database of African soil conditions exists, and inadequate baseline data have hampered effective intervention strategies. Compounding the problem, soils are being degraded as a result of population growth and unsustainable management following land conversion for agriculture.

"The future isn't about conventional soil tests, the future is developing whole new approaches to diagnostics", says ICRAF scientist Keith Shepherd. Using spectral signatures, Shepherd plans to provide integrated measures of soil properties that determine functions such as water infiltration and carbon sequestration. In doing so, he will bypass the need to relate such functions as crop response to nutrients or soil erosion to conventional soil tests.

Courtesy of W van Opzeeland

Scientists rapidly assess soil quality based on spectral signature.

Shepherd points out that conventional soil tests also require predictive models of soil functions, as well as local calibration. "The interpretation of traditional soil tests is largely based on expert opinion", he explains. Also, African farmers can rarely afford the time-consuming sampling and expensive conventional wet chemistry methods, so traditional labs are closing because testing is not profitable. Shepherd therefore wants to seize the opportunity to move towards an evidence-based approach.

"This is potentially a useful tool, but it needs to be tested and validated against ground-truthed data", explains Rattan Lal, soil scientist at Ohio State University (Columbus, Ohio) and president-elect of the Soil Science Society of America. "Anything that reduces the time required for detailed field sampling is a step in the right direction", he adds.

According to Lal, the recent understanding that soil can be both a source as well as a storehouse for carbon – and the promulgation of markets for carbon trading – has helped emphasize the need to determine soil carbon and quality.

Shepherd believes the IR approach is useful in US or European systems, given the increased interest in data-intensive precision agriculture techniques designed to place fertilizer only where needed. In fact, similar techniques are currently being developed in US laboratories. The plans for an IR machine in each region of Africa will facilitate a comprehensive assessment of land degradation on the continent. "Land degradation is very much underestimated as a development problem", he concludes. ■