Visual Assessment of Sulfate Reduction to Identify Hydric Soils

Wetlands are recognized as an important source of biodiversity, recreation, and ecosystem services. The protection and delineation of wetlands, which encompass hydric soils, wetland hydrology, and hydrophytic vegetation, is not only ecologically important, but is also mandated by federal law. Requirements for the identification of hydric soils mainly involve observable features generated as a result of oxidation-reduction reactions.

In a recent issue of the *Soil Science Society of America Journal*, researchers demonstrated the observation of sulfate reduction as black staining of FeS on Indicator of Reduction in Soil (IRIS) panels is a viable method for determining hydric soil status and ultimately performing wetland identification and delineations. The evidence of SO$_4^{2-}$ reduction (FeS precipitation) on IRIS surfaces proves highly reducing conditions and could be used in lieu of the requirements for Fe removal from IRIS surfaces.

The researchers found that when IRIS panels showed at least 2% FeS precipitation (black staining), 100% of the panels met the National Technical Committee for Hydric Soil criteria for anaerobic conditions and ultimately performing wetland identification and delineations. Using the observance of 2% FeS precipitation on the IRIS panels as an indicator of anaerobic conditions will allow practitioners and researchers to quickly visually analyze IRIS tubes and panels in the field.


Fertilizer Microdosing Increased Maize Yields in Humid Tropics

Increasing soil productivity includes optimizing fertilizer use, but prevailing fertilizer recommendations are high and beyond the reach of most smallholder farmers. Fertilizer microdosing provides lower, more efficient, and cost-effective fertilizer recommendations for smallholder farmers.

Despite being promoted as an appropriate technology for increased cereal production in the Sahelian Drylands of Western and Southern Africa, little is known about the impact of fertilizer microdosing to cereals in the humid forest agro-ecological zone. More so, studies on fertilizer microdosing have been limited to the sole cereal base cropping system with limited information on the dose and type of fertilizer required in rotation cropping in which a legume N input may substitute or increase fertilizer N supply.

In a recent article published in the *Soil Science Society of America Journal*, researchers report yield and economic effects of varying microdose rates of N-P-K fertilizer to maize in rotation with cowpea and in sole cropping on Gleyic Plinthic Acrisol and Plinthic Acrisol soils in the semi-deciduous rainforest zone of Ghana. Maize grain yields increased by 33 to 99%, and net returns were optimal with N$_{20}$P$_{40}$K$_{20}$ and N$_{0}$P$_{40}$K$_{20}$ microdoses in the sole and rotation cropping systems, respectively. While maize grain and stover yields and N, P, and K use efficiency were higher in rotation than in sole cropping, grain yield increase was higher on the Gleyic Plinthic Acrisol than on the Plinthic Acrisol.

The aforementioned fertilizer microdoses could be considered appropriate for increasing maize yield and income of smallholder farmers in the humid forest zone. Nonetheless, further trials on the soil types will be valuable for smallholder maize farmers.

Deep Vadose Zone Respiration Contributions to CO₂ Fluxes from a Semi-arid Floodplain

Most of the carbon dioxide (CO₂) fluxes leaving the soil surface originate from the shallow subsurface soil layer. These fluxes come from root and microbial respiration. However, recent work has shown that there exist contributions to this CO₂ flux from the deeper subsurface. It has been estimated that there is as much organic carbon at depths greater than 1 m compared with the surface to 1-m depth. However there have been only a few measurements of CO₂ flux measurements from deeper locations. In the case of floodplains, there have been numerous studies that have demonstrated the carbon fluxes to river systems. Groundwater recharge is often a slow process, and this provides ample opportunity for microbes to break down organic carbon and hence release CO₂.

Authors of a recent article in Vadose Zone Journal set up their observational study in semiarid western Colorado—at the Rifle floodplain along the Colorado River. The surface soil extends to about 1.5 m deep and is underlain by floodplain alluvium with coarse alluvium extending to 6 to 7 m, and the water table is at around 3 to 4 m deep. The major annual infiltration from snowmelt and late spring rainfall occurs in the months of April through June. In later months (July to early fall), evapotranspiration dominates the hydrological cycle with little or no recharge through the vadose zone.

In this field site, boreholes were instrumented at five locations along the groundwater flow direction to investigate vadose zone to a depth of around 3.5 m. The hydraulic head measurements were obtained using tensiometers and piezometers, and the diffusion coefficients for CO₂ were also obtained. In addition to the site monitoring, the soil water retention curves and gas diffusion coefficients were determined for soil and sediments in the laboratory. The surface CO₂ flux was measured for a period of one year during the morning and the late afternoon—evening time period. Soil gas samples were also collected. In order to independently determine the effect of the deeper subsurface on CO₂ fluxes at the surface, the respiration rates were measured on the deeper sediments.

It was observed that the CO₂ flux measurements in the field vary from a low during winter to a high during summer. This is related to the warming of the shallow layer of the subsurface. In addition, the daytime CO₂ fluxes are higher than the daily averaged fluxes. In the deep unsaturated zone, the CO₂ concentration was higher, indicating that this is a source of CO₂ for the flux to the atmosphere as well as diffusion to the groundwater with the larger gradient being towards the soil surface. As there are few or no roots deeper than 1.5 m, most of the deeper CO₂ production comes from the native organic carbon in the deeper layer and seasonally by advection from the overlying soil or groundwater. The higher respiration rates at certain depths are consistent with the profiles of CO₂ and the diffusion coefficients. Finally, the respiration contribution from the soil deeper than 2 m is about 17% of the total soil surface CO₂ fluxes.

Grass–Legume Intercrops Offer Greater Stability and Same Yield as Grasses Alone

Extreme weather events are predicted to increase in frequency in the U.S. Northeast. Annual intercrops are an agroecological strategy that farmers can implement to reduce the risk of crop failure and build resilience. Alternative species not often grown in the Northeast were selected for their heat and drought tolerance in an effort to explore the multi-functionality of cover crops as forages. Grass and legume intercrops can be grown after a small-grain harvest and produce necessary forage while building a more complex crop rotation.

In the September–October 2016 issue of *Crop Science*, researchers report on biomass production, competition metrics, and stability of crop performance of monocultures and three- and four-species mixtures from three different locations across the Northeast and found that intercrops had more steady growth across the nine site-years and produced the same amount of biomass as the grass monocultures. By visualizing the partial land equivalent ratios with radar plots, the researchers were able to identify patterns of competitive advantages of species in the intercrops across site-years. Overall, species selected for annual intercrops should have similar monoculture growth rates to minimize asymmetric competition.


Interaction of Genetic Mechanisms Regulating Methionine Concentration in Maize Grain

Methionine is an essential component of poultry diets. Normally, it is provided as a supplement that adds to the cost of the diet. An alternative approach is to base a diet on corn that is bred to contain elevated methionine levels. This approach simplifies diet formulation and eliminates the cost of supplementation. High-methionine corn has been developed using several different approaches that take advantage of different genetic mechanisms.

In the September–October 2016 issue of *Crop Science*, researchers tested different combinations of high-methionine corn varieties to identify the combinations with the best performance. In the varieties tested, some genetic mechanisms conferring high methionine work better in combination with other types, suggesting that it is possible to capture synergism between genetic mechanisms to obtain hybrids with high-methionine concentration.

The results suggest that when developing high-methionine hybrids, breeders should consider combining high-methionine inbred lines containing different genetic mechanisms for increasing methionine levels. This information can be used by plant breeders to develop new hybrids with elevated methionine levels, which will allow poultry producers to formulate healthy diets for less cost, resulting in higher profits for poultry producers and/or lower costs to consumers of poultry products such as eggs and meat.


Plots of pearl millet, sorghum sudangrass, cowpea, and sunn hemp in late September 2013 (~50 days after planting) in Willsboro, NY—one of the three locations for an intercropped experiment exploring functional diversity. *Photo by Chris Pelzer.*
Phosphorus Uptake by Potato from Fertilizers Recovered from Anaerobic Digestion

Of the major plant nutrients, world resources of P are the smallest, and peak P is predicted to occur globally by 2030. Because of potential shortfalls in P availability, P should be used as efficiently as possible to conserve the resource base and maintain agricultural productivity. A variety of promising P-enriched products recovered from anaerobic digesters (AD) on U.S. confined animal feeding operations (CAFOs) are emerging as commercially viable. These include traditional products such as digested liquid manure and biosolids and newer products such as recovered P-enriched fine solids and struvite.

In the September–October 2016 issue of the Agronomy Journal, researchers report on a multi-year study conducted in the Columbia Basin of Washington to determine the availability and uptake efficiency of P recovered from AD dairy and poultry manures in potato production.

The team found that among the AD-recovered P materials and P rates applied, tuber yields were not significantly different from commercial mono-ammonium phosphate (MAP), with P recovery efficiencies averaging 42% at 56 kg P ha⁻¹.

All recovered AD-P materials evaluated provided adequate P to potatoes when equal rates of P were applied and the method of application was comparable, indicating AD-recovered P can be used effectively as a substitute for commercial P fertilizers.

Increasing Nutritional Status and Yield of Corn by Optimizing Plant Spacing

In order to supply the food needed for the growing world population in the next decades without additional impact on natural resources, cropping systems must be redesigned. It is well known that uniform within-row plant spacing is a key crop management strategy to obtain high corn (Zea Mays L.) yields. However, at the field scale, uniform plant spacing is not frequently achieved. A new concept of precision planting is emerging based on the use of modern devices on planters that can overcome uneven plant space distribution across the field.

In the September–October issue of Agronomy Journal, researchers show that in order to achieve a high level of corn yields, a new high standard of uniform-row plant spacing is required. Optimizing the within-row plant spacing also results in higher crop sensor readings, suggesting an improvement in the efficiency of plant nutrition in well-fertilized soils. Based on the average of two site-years, the planter equipped with a vSet (Precision Planting, Tremont, IL) vacuum meter system improved the uniformity of plant spacing (CV = 22.5%) compared with a traditional planter with a mechanical horizontal plate metering system (CV = 38.7%). This optimization of within-row plant spacing increased the corn yields by 10.7% (Fig. 1). Although the modern devices for planters have decreased the error in plant distribution, no planter that has been investigated has attained the optimum plant spacing uniformity (CV < 10%) required to achieve the maximum corn yield, suggesting that additional planter improvement will be necessary.


Drainage Phosphorus Loss Proves Tricky to ‘MANAGE’

As the 2014 Lake Erie toxic algal bloom and other phosphorus (P)-driven blooms around the world continue to generate headlines and stir regulatory interest, associated human and environmental health concerns have resulted in a need to revisit the potential contribution of P transported through tile drains to these water impairments.

In the September–October issue of the Journal of Environmental Quality, researchers compiled water quality and cropping information from 50 years of drainage studies into the MANAGE (Measured Annual Nutrient loads from Agricultural Environments) database to evaluate the impact of in-field management practices and uncontrollable site-specific factors on the amount of P lost in tile drainage.

Across the database, less than 2% of P applied in a given year was lost in drainage water, illustrating the challenge of managing tile P loss for water quality when these losses may not have a significant annual economic impact in field. Reduced tillage showed increased drainage dissolved P loads although this finding must be weighed carefully as conservation tillage provides numerous other benefits.

This study reveals that the scarcity of information on drainage P loss and management, particularly relative to nitrogen, is a critical gap in scientific understanding.


Education Levels are Declining in Young Male Farmers

Environmental decisions made by farmers often depend on their age, gender, and formal education. Changes in these demographic variables are therefore important for designing long-term environmental policies. However, studies on the effect of demographic variables on environmental behavior often show conflicting results.

A study recently published in Agricultural & Environmental Letters used mail survey data (n = 3069) to determine whether education levels of landowners in rural southwestern Ontario, Canada varied with age, gender, and occupation (“farmer” or “non-farmer”). Education level was shown to increase with decreasing age in all landowners with the exception of male farmers where the opposite trend was observed. This striking result highlights the importance of taking into account interactions among demographic variables.

The unexpected decrease in education level in young male farmers is cause for concern and may need to be taken into consideration by policymakers in the design and implementation of agri-environmental programming.


Across the database evaluated in this study, less than 2% of P applied in a given year was lost in drainage water. Photo by K. King/USDA ARS.

Agricultural landscape near Seebach’s Hill, Perth County, ON, Canada. Photo courtesy of Jeff Brick.

doi:10.2134/csa2016-61-10-3