cluding iron. Efforts to combat iron deficiency, which affects about one-quarter of the earth's population, have included attempts to reduce the phytate concentration in corn. However, this strategy has met with limited success because phytate is important for proper seed germination and early plant vigor.

In the in the September–October 2015 issue of *Crop Science*, researchers report that recurrent selection breeding is an effective method to alter phytate concentration in corn populations. Moreover, populations selected for high- or low-phytate differed in their iron bioavailability as measured in a human cell culture model. At the same time, the high- and low-phytate populations did not differ significantly in seed quality measures.

This work establishes the feasibility of improving iron bioavailability while preserving seed quality in corn populations by using widely available plant breeding methods. This is a new application of a tried-and-true approach that complements biotechnology and mutation breeding in efforts to solve one of the world's most pressing nutritional problems.

Adapted from Beavers, A.W., A.S. Goggi, M.B. Reddy, A.M. Lauter, and M.P. Scott. 2015. Recurrent selection to alter grain phytic acid concentration and iron bioavailability. Crop Sci. 55(5). View the full article online at http://dx.doi.org/doi:10.2135/cropsci2014.12.0807

Standard Extraction Method Underestimates Nitrite in Soils

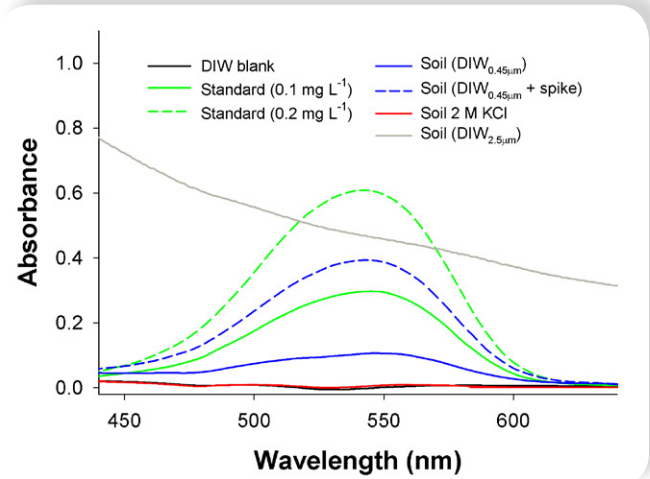
Nitrite is an intermediate in both nitrification and denitrification, and in soils it can react to form nitrous acid and other nitrogen gases that regulate atmospheric chemistry. However, nitrite is reactive and seldom detectable in soils, limiting our understanding of the linkages between soil N-cycling rates and atmospheric processes.

In the July–August 2015 issue of the *Soil Science Society of America Journal*, researchers report that nitrite's elusiveness in soils may not only be due to its reactivity, but also to inadequate analytical approaches. For over three decades, the standard analytical technique has been to extract soil with 2 M KCl; however, KCl also extracts soil acidity that destroys nitrite. The research team found, in fact, that KCl extraction can underestimate nitrite by 96%.

To improve soil nitrite analysis, they developed a water extraction that minimizes the release of acidity and nitrite destruction. The method also uses less soil compared to previous extractions: 4 grams versus 200 g.

Due to 2 M KCl's widespread use, underestimates of nitrite may be producing serious misunderstandings of processes in which nitrite plays an important role. Nitrite is both produced and consumed rapidly, meaning that even low concentrations can support substantial losses of reactive N gases. Being able to accurately measure nitrite concentrations will therefore help refine global soil N emission models.

Adapted from P.M. Homyak, K.T. Vasquez, J.O. Sickman, D.R. Parker, and J.P. Schimel. 2015. Improving nitrite analysis in soils: Drawbacks of the conventional 2 M KCl extraction. Soil Sci. Soc. Am. J. 79(4). View the full article online at http://dx.doi.org/doi:10.2136/sssaj2015.02.0061n



Nitrite absorbance spectrum for soils extracted in 2 M KCl (red line) and deionized water (DIW; passed through 2.5 or 0.45 µm filters); a two nitrite standards made in DIW; a nitrite spike added to DIW-extracted soil; and a DIW blank. Note the destruction of nitrite with the KCl extraction.

Changes in Soil Chemistry from Forest Liming Persist for 21 Years

In many areas of the Northeastern United States and Canada, long-term acidic deposition has depleted soils of base cations. Forest liming restores base cations in acidic soils, improving the crown health, growth, and seed production of species like sugar maple. However, it's uncertain how long the effects of liming persist in soil, or how deep in the soil profile lime-induced changes occur.

Researchers now report the 21-year results from a single application of dolomitic limestone at 22.4 Mg ha^{-1} in four forested sites in Potter County, PA, where soil, soil leachate, and sugar maple foliar chemistry have been measured. The findings appear in the July–August 2015 issue of the *Soil Science Society of America Journal*.

The team found that increases in exchangeable Ca and Mg, and pH, continued for 21 years (through 2006) and were detectable to depths of 35 to 45 cm in the mineral soil.

Sugar maple foliage chemistry also had elevated Ca and Mg in 2006, indicating the persistence of the lime treatment. However, comparisons of Ca/Al molar ratios showed inconsistent results when compared with published risk thresholds, suggesting species-specific thresholds should be developed.

Overall, the study suggests that forest liming can be used to remediate acidic soil conditions and provide long-term increases in base cations that maintain the health and growth of sugar maple.

Adapted from Long, R.P., S.W. Bailey, S.B. Horsley, T.J. Hall, B.R. Swistock, and D.R. DeWalle. 2015. Long-term effects of forest liming on soil, soil leachate, and foliage chemistry in northern Pennsylvania. Soil Sci. Soc. Am. J. 79 (4). View full article online at http://dx.doi.org/doi:10.2136/sssaj2014.11.0465

New research suggests that forest liming can be used to remediate acidic soil conditions and provide long-term increases in base cations that maintain the health and growth of sugar maple.

Sidedressing Anhydrous Ammonia Improves Nitrogen Use by Corn

High nitrate concentrations in lakes, rivers, and other surface waters are a recurring environmental and public health problem. The source of much of this nitrate is agricultural use of nitrogen fertilizers.

Thus, much interest exists in developing farming practices that reduce the off-site effects of fertilizer, while maintaining the economic viability of crop production. Despite this, the effects of application timing of N fertilizer on both crop yield and water quality have been little studied in the Midwest Corn Belt.

In the July–August 2015 issue of the *Soil Science Society of America Journal*, researchers applied anhydrous ammonia fertilizer at three different times: in the fall, in the spring before planting, or as an early season sidedress. They then measured corn yield and loss of nitrate in tile drainage from a production field.

Their results showed that sidedressing makes the greatest use of fertilizer N, maximizes crop yield, and minimizes nitrate leaching to tile drains compared with either fall or spring pre-plant applications. If widely adopted, replacing fall application of N fertilizer with sidedressing would improve N use efficiency, corn yield, and reduce nitrate loading of surface waters. However, further measures would still be needed to meet most nitrate reduction goals.

Adapted from Jaynes, D. 2015. Corn yield and nitrate loss in subsurface drainage affected by timing of anhydrous ammonia application. Soil Sci. Soc. Am. J. 79(4). View the full article online at doi:10.2136/sssaj2015.01.0033

Poultry Litter pH Buffering: Measurement and Applications

The pH value of poultry litter is affected by nitrification, mineralization, and the addition of acidifying chemicals, all acting on the pH buffering capacity. To better predict and reduce ammonia loss, the pH buffering capacity of litter must be accurately and quickly measured. However, no methods for doing so are currently available.

In the July–August 2015 issue of the *Journal of Environmental Quality*, researchers determined litter pH buffering capacity both through titration and near infrared spectroscopy (NIRS) techniques. Using the buffering capacity values, an empirical model was then created to predict the weight of alum needed to reach a target pH.

The authors determined that measuring litter pH buffering capacity by using acid/base titrations requires a 24-hour shake time and the addition of Ag_2SO_4 as a microbial inhibitor. Litter buffering capacity ranged from 187 to 537 mmol (pH unit)$^{-1}$ kg^{-1} dry litter and NIRS had coefficient of calibration of 0.90. The alum model performed well from pH 6.5 to 7, but under-predicted the alum needed to reach pH <6.

Better measurements and understanding of litter pH buffering capacity will aid in model predictions of ammonia loss and increase the precise use of alum in poultry houses and during litter storage. With further validation, NIRS shows promise in accurately and quickly measuring litter buffering capacity.

Adapted from Cassity-Duffey, K., Cabrera, M.L., Mowrer, J., and Kissel, D.E. 2015. Titration and spectroscopic measurements of poultry litter pH buffering capacity. J. Environ. Qual. 44. View the full article online at http://dx.doi.org/doi:10.2134/jeq2014.11.0463

Reassessing the Carbon Footprint of a Hydroelectric Reservoir

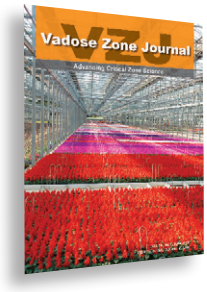
The carbon footprint of energy sources is becoming an important concern in climate change mitigation, as well as a strategic matter in the North American energy market. Hydropower in boreal regions is generally considered the energy source that emits the least amount of greenhouse gas during its life cycle. However, knowing that construction of a hydroelectric reservoir causes a land-use change—deforestation and flooding—it's advisable to evaluate the possible loss of a forest carbon sink, and how this contributes to the net carbon footprint of the reservoir.

To address this, a study assessed the relative impact of land-use change—the flooding of forested territories—on modifications to carbon sinks and sources associated with the creation of a hydroelectric reservoir in Quebec's boreal forest. The results were published in the July–August 2015 issue of the *Journal of Environmental Quality*

The authors' carbon flux estimates—made using a detailed and sensitive methodology—showed overall net emissions of carbon. However, they were very small (4 ± 2 g CO_2e kWh^{-1}), making the contribution of land-use change to the carbon footprint considerably less than in recently published calculations. Consequently, this study reveals how negligible (3%) the relative contribution of land-use change to the total net carbon footprint of a boreal hydroelectric reservoir can be.

Adapted from Dessureault, P-L, Boucher, J-F, Tremblay, P., Bouchard, S., and Villeneuve, C. 2015. Uncovering the minor contribution of land-cover change in upland forests to the net carbon footprint of a boreal hydroelectric reservoir. J. Environ. Qual. 44. View the full article online at http://dx.doi.org/doi:10.2134/jeq2015.02.0071

View of Eastmain-1 spillway, dam, and reservoir. *Photo by Hydro-Quebec.*



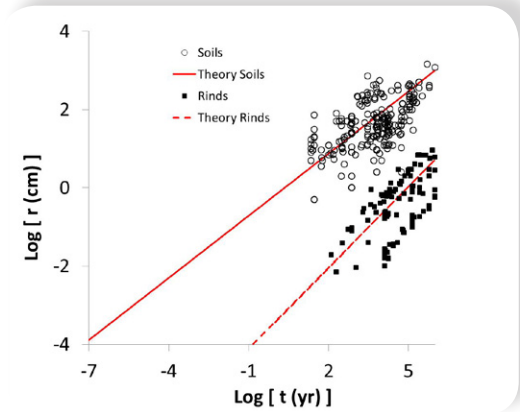
Study Offers Insight into Slowed Weathering Over Time

Why do rates of soil development and rock weathering slow over time? A study in the July 2015 issue of *Vadose Zone Journal* answers this question in terms of slowed solute transport, explaining the role of transport limitations on weathering. In the research, the depth of the chemically weathered layer (weathering rind) on basalt surfaces was found using three known parameters: a fundamental length scale, equal to a pore size; a fundamental time scale (the time for water to flow through such a pore); and an exponent, which depends on the typical saturation conditions.

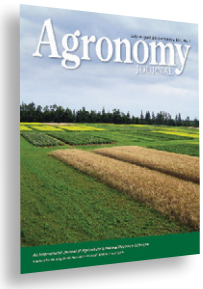
The results of the modeling agreed with observations in 16 studies performed on thousands of stones with ages from decades to a million years. An analysis using the same length scale, but a much smaller time scale appropriate for the much larger hydraulic conductivity of typical soils, also gave the time dependent depths of 14 of the world's soils, as well as rates of soil production at another 5 sites, under varied climatic conditions.

Prediction of weathering rates for silicate minerals in consolidated and unconsolidated media is key to quantifying dominant global carbon fluxes on millennial scales and up and in understanding past climate change and extinction events in the geologic record. Predicting soil production is also important for understanding landscape evolution.

Adapted from Hunt, A.G. 2015. Predicting rates of weathering rind formation. Vadose Zone J. 14(7). View the full article online at http://dx.doi.org/doi:10.2136/vzj2014.09.0123



Simultaneous prediction of weathering rind thickness and soil depth. The same 1-μm pore size was used for both, but the hydraulic conductivity in typical soils is about six orders of magnitude larger than for basalt. The exponent applied is the known value for the inverse of the fractal dimensionality of the percolation backbone, implying unsaturated conditions for surface rocks, saturated for soils.



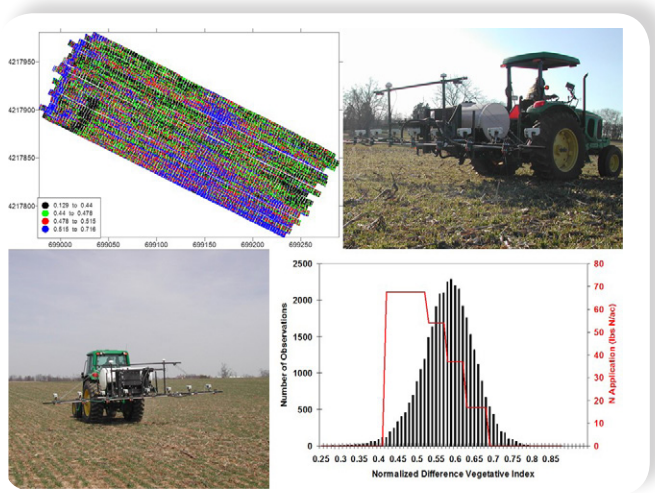
Individual Sensors in Arrays May Yield Different Nitrogen Rates

Many sensors depend on algorithms to translate signals into selected soil and crop properties and determine management outcomes, such as nitrogen (N) fertilization rates. One question about sensor arrays is how variation in individual sensor performance may influence the N prescription when the usual discontinuous, "stair-step," algorithms are used to interpret output data.

To understand this, a study published in the September–October 2015 issue of *Agronomy Journal* used an eight-sensor GreenSeeker array to measure NDVI (normalized difference vegetation index) at growth stage Feekes 6 in four wheat fields, and evaluate two algorithms, A and B, for converting these data into N rates.

The researchers found that while trends in individual sensor behavior were consistent *across* fields, N prescription rates *within* fields did vary. They attribute these in-field differences to the interaction between NDVI data from individual sensors, and the algorithm used to convert the NDVI values to fertilizer N rates. Sensor and algorithm differences generated a narrower range of N rates for algorithm A (coefficient of variation values: 5.1-9.9%) than B (CV values: 4.3-26.2%). Another key finding was that one sensor prescribed 18 to 21% less N than other sensors with algorithm A, and 27 to 56 % less N with algorithm B.

Overall, this study suggests that individual sensor performance and its interaction with data interpretational algorithms should be understood before sensor arrays are used to characterize soil and crop properties.



Assessing individual sensors in an array (clockwise from upper left): wheat field NDVI map; N rate delivery to no-till wheat; stepwise N rate algorithm and NDVI data population; and NDVI sensors in the array.

Adapted from Pena-Yewtukhiw, E.M., J.H. Grove, and G.J. Schwab. 2015. Fertilizer N rate prescription, interpretational algorithms and individual sensor performance in an array. Agron. J. 107(5). View the full article online at http://dx.doi.org/doi:10.2134/agronj14.0573

Proper Organic Fertilizer Rates for Corn

Yield increases are evident from applications of cattle manure and swine effluent, which are attributed to improvements in soil chemistry and structure. On the other hand, over-application of manure can result in higher salt levels, cause soil surface crusting, and decrease absorption of soil water.

The benefits of proper application and possible negative impacts of over-application suggest it's important to use targeted rates of application. However, long term studies of the proper application rates of cattle manure and swine effluent in corn are limited.

In the September–October 2015 issue of *Agronomy Journal*, a 10-yr field study in Kansas compared three levels each of cattle manure, swine effluent, inorganic fertilizer, and a control, on corn yield, grain nutrient content, and water productivity.

Results of this long term study showed that mean corn grain yield from the cattle manure, swine effluent, and inorganic nitrogen treatments were about 2X, 1.8X, and 1.9X greater than the untreated control, respectively. Grain nutrient content and water productivity were consistently higher for the cattle manure treatments and inorganic N treatments.

Since grain yield and nutrient uptake did not differ among rates of cattle manure and swine effluent application, the researchers concluded that the lower end of the N- or phosphorus-based application rates used in this study is sufficient to achieve optimal crop yield and water productivity.

Adapted from Schlegel, A.J., Assefa, Y., Bond, H.D., Wetter, S.M., and Stone, L.R. 2015. Corn response to long-term applications of cattle manure, swine effluent, and inorganic nitrogen fertilizer. Agron. J. 107. View the full article online at http://dx.doi.org/doi:10.2134/agronj14.0632

Plastic Mulching Shows Benefits in High-Altitude, Dryland Areas of China

Crop yields have increased significantly with the use of plastic-film mulching in dryland areas of China at low- to mid-altitudes. However, the potential benefit of this technology at high altitude remains unknown.

In the September–October 2015 issue of *Agronomy Journal*, researchers report the effect of plastic-mulching

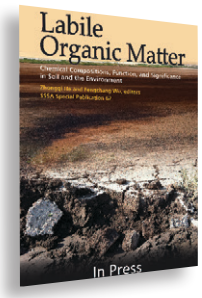
practices on potato and maize yields in semiarid farmland at an altitude of 2400 meters in the Loess Plateau of northwestern China.

The researchers found that the plastic-mulching practice did not increase potato crop yield when compared with no plastic-mulching. It did, however, increase the yield of large tubers and the ratio of large tuber yield to total tuber yield.

Higher soil temperatures under plastic-mulching were only seen during the early growth period, with no significant differences observed between plastic-mulching and no plastic-mulching during late crop growth stages. Higher soil temperatures under plastic mulch during the early growth period in May led to higher maize yields.

The authors conclude that in semiarid farmland at high altitude, farmers can obtain higher economic returns by increasing the ratio of large potato tuber yield to total tuber yield with plastic-mulching technology. Increased soil temperature during the early growth period also improved maize yield.

Adapted from Liu, C., and K.H.M. Siddique. 2015. Does plastic mulch improve crop yield in semiarid farmland at high altitude? Agron. J. 107(5). View the full article online at http://dx.doi.org/10.2134/agronj15.0052s



Effects of Management Practices on Composition of Cattle Manure Organic Matter

Cattle are renowned for their ability to convert marginal feedstuffs into high quality protein (i.e., meat and milk) for human consumption. However, bovine metabolism is a relatively inefficient process and the majority of feed consumed by cattle is excreted in manure. It is estimated that about one billion tons of manure are produced every year by beef and dairy cattle in the United States. Organic matter is a major, and often overlooked, component of manure. It is a heterogeneous and dynamic material that is comprised primarily of partially digested feed, microorganisms and sloughed tissue cells from the animal's digestive tract. Cattle manure may also contain bedding (e.g., straw or shavings), which is supplied to increase animal comfort and productivity. This chapter in the new book *Labile Organic Matter—Chemical Compositions, Function, and Significance in Soil and the Environment* synthesizes and discusses the recent research by the authors and their colleagues on the effects of management and diet on the chemical composition of labile organic matter in cattle manure.

One case study highlighted in this chapter showed that manure organic matter characteristics on a commercial beef feedyard in the Texas Panhandle differed depending on where the material was collected. Open-lot feedyards in Texas typically allow manure to accumulate in animal pens over the course of about 6 months to form a dense "pack" that is overlaid by a layer of more freshly excreted loose surface manure. When it rains, some runoff occurs from cattle pens: manure solids are collected in settling basins and dissolved compounds in the liquid portion are diverted into a retention pond. Using Fourier-transform infrared and Ultraviolet-visible spectroscopies, this work conclusively showed that the size and complexity of manure organic matter increased as it aged during its on-feedyard life cycle. Implications of this would be that fertilization with sediments collected from settling basins or retention ponds may have less carbon available for immediate use by microorganisms than in more recently voided manure.

In another case study, ^{13}C nuclear magnetic resonance (NMR) and pyrolysis gas chromatograph–mass spectroscopy (GC-MS) were used to determine if dairy cattle were managed under "organic/natural" or conventional practices. Analyses with NMR enabled these researchers to distinguish animals on a grass-based diet from those fed primarily grain, while pyrolysis GC-MS could detect the presence of veterinary pharmaceuticals, which use is limited or prohibited in organic/natural dairy products. It was proposed that organic matter features could be used as traceable markers to certify that dairy and beef cattle are managed according to standards for grass-fed or organic products.

Adapted from He, Z., and H.M. Waldrip. 2015. Composition of whole and water-extractable organic matter of cattle manure affected by management practices. In: Labile organic matter—Chemical compositions, function, and significance in soil and the environment. SSSA Special Publication 62. View the full book chapter online at http://dx.doi.org/doi:10.2136/sssaspecpub62.2014.0034. For more chapters from this book, see https://dl.sciencesocieties.org/publications/books/tocs/sssaspecialpubl/sssaspecpub62

Typical open-lot beef cattle feedyard in the Texas Panhandle.

Characterizing the Labile Fraction of Dissolved Organic Matter in Leaf Leachates

As an unmistakable signal of seasonal cycles in temperate climates, unfurling green leaves mark the transition out of winter, and their autumnal efflorescence portends descent back into its depths. Leaves also contribute to the organic matter content of terrestrial and aquatic ecosystems worldwide: in headwaters leaves are a primary source of nutrients and energy, in forest soils leaves are a dominant input of organic matter, and in agricultural systems leaves are an important part of humus that can be used to replenish soils. Greenhouse gases such as CO_2 and CH_4 are released through the microbial decomposition of leaves, while the carbon content of their more recalcitrant constituents can be sequestered for millenia. Thus, the growth and decomposition of leaves are truly integral parts of the global carbon cycle.

Microorganisms find in leaves the necessary nutrients and energy for sustaining their growth, and it is thereby that leaves help to support the base of terrestrial and aquatic ecosystems. But the leachates of leaves are a complex and dynamic mixture of molecules, and only part of this mixture is readily accessible (i.e. labile). While the complex and dynamic nature of dissolved organic matter (DOM) in leaf leachate makes the accurate and absolute assessment of its labile fraction challenging, refined estimation is possible using multiple indicators and advanced analytical methods.

In this chapter of the new book *Labile Organic Matter—Chemical Compositions, Function, and Significance in Soil and the Environment*, the authors discuss the portion of leaf-leachate DOM that is readily degraded by microorganisms: how it is produced for experimentation, its molecular composition and structure, and the cutting-edge analytical techniques that are being brought to bear on characterizing its lability now and in the future.

While the complex and dynamic nature of dissolved organic matter (DOM) in leaf leachate makes the accurate and absolute assessment of its labile fraction challenging, refined estimation is possible using multiple indicators and advanced analytical methods.

Adapted from Cuss, C.W., and C. Guéguen. 2015. Characterizing the labile fraction of dissolved organic matter in leaf leachates: Methods, indicators, structure, and complexity. In: Labile organic matter—Chemical compositions, function, and significance in soil and the environment. SSSA Special Publication 62. View the full book chapter online at https://dl.sciencesocieties.org/publications/books/abstracts/sssaspecialpubl/sssaspecpub62/sssaspecpub62.2014.0043