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EXECUTIVE SUMMARIES

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Organic Pollutants in Compost Reviewed

Composting and application of compost to the soil follow the principle of recycling and sustainability. However, input of heavy metals and organic pollutants to soil by compost can threaten soil quality. Brändli et al. (p. 735–760) compiled and evaluated the available data in the literature on persistent organic pollutants (POPs) in compost and its feedstock. Median concentrations of POPs in compost were up to 10 times higher than in arable soils but were well within the range of urban soils. Urban compost exhibited generally higher POP concentrations than rural compost. This work provides a basis for the further improvement of composting and for future risk assessments of compost application.

Management Decisions and Actual Outcomes Differ

The outcomes of decisions in applying manure are assumed to occur as nutrient management plans intend. Cabot and Nowak (p. 761–773) explore how the viability of this assumption can influence the validity of the management rating for P loss risk assessments. The discrepancy between planned vs. actual outcomes in P management was explored through soil testing of 210 fields on nine animal feeding operations in south-central Wisconsin. Correlation analysis indicated that P loss risk assessments were strongly influenced by ratings assigned to manure application decisions. The statistical distribution of mean soil test P levels across all fields was more homogenous than the distribution of P loss index ratings for these fields. Interviews with producers suggested that reasons for divergence between planned and actual outcomes in managing P arise at the strategic, tactical, and operational levels of decision-making.

Phosphogypsum Reduces Greenhouse Gas Emissions

Phosphogypsum (PG) can be used to amend cattle feedlot manure, thereby increasing N retention by reducing cattle manure pH during composting. Hao et al. (p. 774–781) found that adding PG to cattle feedlot manure had no effect on carbon dioxide and nitrous oxide emission during composting of amended cattle manure, but methane emission was drastically reduced, resulting in an overall greenhouse gas emission reduction of at least 58%.

Mountain Willow Survives Toxic Mine Tailing

Tailing material from historic mining activities has been fluvially deposited in the riparian zone of the upper Arkansas River near Leadville, CO. These tailing deposits are devoid of vegetation and continually erode into the river, reducing water quality. Bourret et al. (p. 782–792) found that growth of mountain willow was superior to Geyer willow when both species were planted in mine tailings amended with lime and biosolids. Potentially phytotoxic levels of Cd, Mn, and Zn in the leaf tissue and phytotoxic levels of Cu and Cd in the tailing had little effect on growth of mountain willow. In addition, mountain willow responded more favorably when grown with the water table maintained at three static depths or fluctuating over time, although both species were negatively influenced to some degree by the fluctuating water table treatment. Results suggest mountain willow should be considered for use in future revegetation projects to stabilize stream banks and reduce surface water contamination, thereby improving critical habitat for wildlife.

Corn Herbicides in Ground Water

In addition to their potential to reach surface water, herbicides used in producing corn can leach into shallow ground water. In parallel with a companion surface water study, de Guzman et al. (p. 793–803) report on a 175-site, 7-yr ground water monitoring program for the same analytes. Parent acetochlor was detected more than 0.1 $\mu g\ L^{-1}$ in three or more samples at seven of the wells. Alachlor and metolachlor were also rarely detected, but atrazine was detected at 101 locations. The geographic distribution of detections did not follow the pattern originally expected when the study began. Rather than being a function primarily of soil texture, detecting these herbicides in shallow ground water was related to site-specific factors associated with local topography, the occurrence of surface water drainage features, irrigation practices, and the vertical positioning of the well screen.

Source Identification of Nitrate Contamination in Ground Water

Agricultural sites usually have several N sources, so it is not easy to identify the major source of ground water contamination using only chemical indicators. Jun et al. (p. 804–815) present a study combining hydrological and isotopic analyses to identify N contamination sources. The results at the study site show that ground water recharge usually occurred in spring and summer through precipitation. In spring, however, irrigation water was the major recharge source near rice fields. Nitrogen inputs were mostly related to ground water recharge from precipitation and irrigation, except in some isolated areas where sewage from a poultry farm entered the ground water system.

Indirect Bioleaching of Toxic Metals from Sewage Sludge

Toxic metals can be removed from wastewater sewage sludge through microbial processes involving *Acidithiobacillus ferrooxidans*. Drogui et al. (p. 816–824) report that sewage sludge filtrate can be used as culture medium to biologically produce a concentrated ferric sulfate solution. Subsequently, that ferric sulfate solution can be used as oxidant reagent to solubilize heavy metals from primary and/or secondary sewage sludges. The cost of treating wastewater sewage sludge by bioproducing a ferric ion solution from sewage sludge is much less expensive than the conventional chemical leaching requiring a ferric chloride solution.

CFC Age-Dates Produce a 90-Year Stream Nitrate Record

Few watersheds have a long enough water quality record to explore the lagged relationships between land management practices and water quality trajectories in baseflow-dominated streams. Browne and Guldan (p. 825–835) use a longitudinal synoptic survey of age-dates and water quality in ground water seepage along the meander thalweg of a central Wisconsin stream to (i) accurately reconstruct historical stream nitrate records (1960–2000) and (ii) project future effects of land management decisions on baseflow water quality (2000–2050). The paper provides theoretical and practical approaches for backcasting and forecasting stream water quality from contemporary ground water seepage measurements.

Pyrethroids in Runoff Sediments

Pyrethroid insecticides are strongly adsorbing compounds, and their distribution is mediated by particle transport. Gan et al. (p. 836–841) discovered that along a runoff path, pyrethroids in the sediment phase became increasingly enriched, suggesting that the runoff caused selective transport of chemical-rich fine particles. This study suggests that fine particles are the most important carrier for pyrethroids during runoff. Risk assessment and mitigation should focus on the role of fine particles.

Natural Organic Matter Displays Polymer-Like Behavior

Natural organic matter (NOM) can display polymer-like glass transition behavior. DeLapp et al. (p. 842–853) report glass transition behavior for a series of NOM fractions derived from the same whole aquatic or terrestrial source, including humic acid–, fulvic acid–, and carbohydrate-based NOMs, and a terrestrial humin. Advanced thermal analysis revealed thermal transitions (T_t) ranging from -87°C for a terrestrial carbohydrate fraction to 62°C for the humin fraction. This suggests soil and sediment organic matter may undergo significant physicochemical changes as a function or temperature, subsequently modifying their ability to sorb and desorb organic compounds in the environment.

Testosterone is Very Labile in Agricultural Soil

Testosterone naturally excreted by livestock or poultry can pose an environmental risk through endocrine disruption of wildlife. Lorenzen et al. (p. 854–860) report that testosterone is rapidly biodegraded in agricultural soils. Steroidal transformation products accumulated transiently, but these showed generally lower steroidal activity. Overall, the rapid breakdown of testosterone in soil should attenuate the movement of this hormone to adjacent water.

Hormone Persistence in Organic-Amended Soils

Natural androgenic and estrogenic hormones that reach agricultural land in animal or human wastes can pose a threat to adjacent wildlife through endocrine disruption. Jacobsen et al. (p. 861–871) show that manures and biosolids can influence the kinetics and pathways of hormone dissipation in agricultural soils. Microorganisms carried in these materials hastened the conversion of testosterone and estradiol to less hormonally potent steroidal transformation products, and these were then mineralized by microorganisms in the soil.

Modeling Manure Loss during Rainfall

Modeling the release of total dissolved P from manure is a critical step for nonpoint-source pollution models. Gérard-Marchant et al. (p. 872–876) developed two simple kinetic models of the release of P from manure during a rainfall event. The two models require knowledge of only two readily available parameters: the initial content of water-extractable P in manure and a characteristic time. Each model was compared with previously published experimental data, and both gave excellent agreement with observations. These models deviate from approaches that are currently used in W.G. modeling and constitute a first attempt at a physically realistic description of nutrient leaching from annual fertilizers.

Corn Herbicides in Surface Water

Each spring in the United States more than 50 million kilograms of herbicide are applied to the approximately 30 million hectares where corn is grown. Runoff from these fields can carry a significant fraction of these chemicals directly into streams, lakes, and reservoirs, many of which serve as sources of drinking water. Hackett et al. (p. 877–889) report on a 175-site, 7-yr surface drinking water monitoring program for four of these herbicides and six of their degradates. Drinking water detection frequencies were correlated with product use and environmental fate characteristics, ranging from 7% for alachlor to 87% for atrazine. Reservoirs were particularly vulnerable to atrazine, which exceeded its 3 μg L^{-1} maximum contaminant level at 25 such sites. Acetochlor, the main focus of the study, was detected in 19% of the samples but did not exceed its mitigation trigger (2 μg L^{-1}) at any site.

Ferrihydrite Adsorbs Soil Phosphorus

Many soil resources in the United States are subject to excessive runoff and erosion losses. The transport of P by runoff from such upland areas in either sorbed or dissolved forms creates eutrophication-related problems in offsite aquatic environments. Ferrihydrite is a highly reactive iron oxide mineral that can be prepared synthetically for purposes of adsorbing P; however, the cost of such material is prohibitive on a large scale basis. Instead, Rhoton et al. (p. 890–896) identified a natural source of ferrihydrite as a by-product of a water treatment process, which was applied to agricultural soils to assess its ability to sorb P in soil solutions. Data indicated that this naturally occurring ferrihydrite sorbed substantial quantities of P from soil solutions, and that it was most effective under acid soil conditions (below pH 7.0). These results suggest that ferrihydrite added to soils at rates exceeding 1.35 Mg/ha (1.5 tons/acre) will effectively reduce P losses in runoff.

Ground Water Inputs along the Lower Jordan River

The chemical composition of the Lower Jordan River shows sharp changes along its flow path. The hypothesis was that ground water fluxes control the river chemistry mainly because of the expected increase in their relative contribution following the dramatic reduction of the river discharge (current river discharge is about 40 times lower than the flow rates a few decades ago). Using an acoustic Doppler velocimeter, Holtzman et al. (p. 897–906) obtained discharge measurements in the river and its tributaries. Coupled with detailed water sampling and chemical analysis, they were able to quantify the water and solutes flows that enter the river through ground water fluxes. These measurements and mass balance calculations indicated ground water input was 20 to 80% of the river water flow, and 20 to 50% of its solute mass flow. The study shows the ground water sources contain high sulfate concentration and have similar chemical characteristics as found in agricultural drains and in the 'saline' Yarmouk River.

Degraded Agricultural Streams have Telltale Fauna

Relationships between water quality, in-stream and riparian habitat quality, and biotic integrity in agricultural Midwestern streams are poorly understood. Stone et al. (p. 907–917) found that invertebrate communities in these systems were typical of highly degraded aquatic habitats, but that they reflected gradients of conditions. Orthophosphate concentrations, in-stream habitat quality, and riparian forest cover were all related to biological integrity, but relationships with physical habitat quality were strongest. Results demonstrate that biological assessment of these degraded aquatic habitats is feasible and that efforts to restore or improve them should focus on physical habitat quality and riparian vegetation.

E. coli Transfer to Drainage Water after Grazing

Understanding factors responsible for the transfer of fecally derived bacteria from agricultural land to surface waters is important to safeguard both water quality and public health. Oliver et al. (p. 918–925) investigated the effects of artificial drainage on *E. coli* transfer from large-scale grassland hillslope lysimeters that had been grazed by cattle for 6 mo. The *E. coli* derived from cattle excreta was lost in comparable amounts in both drained and undrained pastures. Results show artificial drainage can facilitate *E. coli* transfer via subsurface routes. Consequently, the installation of drains, primarily to reduce overland flow, does not necessarily reduce the potential for fecal bacteria transfer from land to water.

Colloidal Phosphorus in Sandy Soils

Fertilization exceeding crop requirement causes an accumulation of P in soils, which might increase concentrations of colloidal and dissolved P in drainage and enhance eutrophication of water bodies. Ilg et al. (p. 926–935) tested if and how increasing P saturation increases concentrations of colloidal and dissolved P in soil. Dissolved P was the major fraction of water-soluble P in topsoils, whereas colloidal P comprised 94 $\pm$ 4% of water-extractable P in subsoils. Accumulation of P in soils increased concentrations of dissolved P and mobilized colloidal P. The experiments highlight the importance of colloidal P as a potentially mobile, water-soluble fraction of soil P and underlined the increasing effect of P accumulation in soils on concentrations of dissolved P.

Modified Leachfields Reduce Total Nitrogen

Septic system leachfields can contribute to ground water pollution by releasing dissolved N in the form of nitrate. Low cost, passive modifications that increase N removal could substantially reduce the overall impact on ground water resources. Bedessem et al. (p. 936–942) report that bench-scale laboratory models constructed with an organic layer below the leachfield increased the average total N removal, from 31% without the organic layer to 67% with the organic layer. This increase in denitrification in the modified leachfield model reduced effluent nitrate-N concentrations to limits required in drinking water.

Composting Reduces Hormones into Environment

Animals naturally produce and excrete the steroid hormones 17β-estradiol and testosterone in feces and urine. These hormones are more potent than most man-made environmental contaminants of concern that also interact with the estrogen or androgen receptors. Hakk et al. (p. 943–950) report that 139 d of poultry manure composting reduced the water-soluble levels of these hormones by more than 84%. Commercial kits were used to measure concentrations of both hormones in aqueous extracts over time. The decrease in both hormones followed first-order kinetics, and the rate constant was the same for both 17β-estradiol and testosterone. The results of the study demonstrated that aerobic composting of poultry manure was an effective means of reducing the amount of steroid hormones released into the environment from animal wastes.

Lagoon–Soil Liner Evaluation

The soils used for constructing the liners of animal-waste lagoons are a key component in reducing the downward movement of NH_4^+ from the lagoon liquor. DeSutter and Pierzynski (p. 951–962) used cation selectivity experiments and theory to evaluate soils and soils with bentonite or zeolite added to them to determine how well they can potentially reduce the downward movement of NH_4^+ from the liquors of swine and cattle lagoons. Their research concluded that two native, Great Plains soils are predicted to retain up to 53% of downward-moving NH_4^+ on their exchange sites when exposed to liquors from swine and cattle lagoons. Addition of bentonite or zeolite to these native soils may not increase the selectivity of the soil mixtures for NH_4^+ but will increase the overall cation exchange capacity and ultimately decrease the amount of soil needed to adsorb downward-moving NH_4^+. Assessing and using soils for liner materials that can help reduce the downward movement of NH_4^+ will decrease the risk of ground water pollution and potential site remediation costs.

Field Scale Application of Oily Food Waste to Corn

Oily food waste is produced by food service and food processing industries and contains high concentrations of fat, oil, and grease derived from animal and vegetable sources. Municipalities across Canada strictly regulate the discharge of oil, fat, and grease to main sewerage system. Oily food waste has a high C/N ratio (90:1) and can recycle soil available N through immobilization and re-mineralization during its decomposition. Experiments were conducted by Rashid and Voroney (p. 963–969) during 1995 and 1996 at a farm having rolling topography to examine available N and corn yield at different landscape positions of FOG-amended fields and to determine whether N fertilizer management could be improved by considering the spatial variability of soil NO_3–N at different landscape positions in FOG-amended fields. Spatial and temporal variability in soil NO_3–N was observed during both years. Corn grain yields at all N fertilizer rates were affected by slope position and followed the pattern: lower $>$ upper $\geq$ mid. Nitrogen fertilizer requirements for corn production in conjunction with FOG management were also affected by slope position. Essentially no additional fertilizer N was required for corn production at lower landscape position. It was estimated that site-specific fertilizer N management on FOG-amended fields could result in an average saving of 51 and 63 kg N ha^{-1} during 1995 and 1996, respectively.

Source-Dependent Phosphorus Extractabilities in Amended Soils

Managing fertilizer applications to maintain soil P at environmentally acceptable levels should consider how manure and synthetic fertilizer sources contribute to soluble and extractable forms of P. In soils recently amended with beef cattle manures, Schwartz and Dao (p. 970–978) demonstrated that although water-extractable P was strongly related to agronomic soil tests, these relationships differed for inorganic P and manure P sources. Consequently, using agronomic soil tests to assess vulnerability to P loss may exaggerate the risks of manure-amended soils over risks associated with soils amended with inorganic P. These source-dependent relationships limit the use of agronomic soil extractants to correctly infer water-extractable P and dissolved P in runoff.

Effluent Effects on Urine Patch Gas Emissions

Adding dairy farm effluent that contains water soluble C to pastures may influence the amount of N_2O released from urine patches. Further, this boost of C could enhance the reduction of N_2O to N_2. Clough and Kelliher (p. 979–986), however, concluded that dairy farm effluent did not mitigate N_2O production from urine patches. In fact, increases in the N_2O and N_2 flux occurred from the urine patches when DFE was applied 1 wk after urine deposition. The amount of water-soluble C applied in the effluent proved to be insignificant compared with the amount of soil C released as CO_2 after urine application.

Rapid Manganese Removal from Water

Manganese is notoriously difficult to remove from contaminated waters because of its high solubility over a wide range of pHs. Johnson and Younger (p. 987–993) have designed a new treatment system consisting of a passively aerated subsurface gravel bed. Providing air at depth and using catalytic substrates help overcome the slow kinetics usually associated with Mn oxidation. The treatment system results in rapid manganese removal (8 h hydraulic residence time) and can be used in colder climates and/or where large areas of land are unavailable. Furthermore, as Mn oxyhydroxides precipitates are continually generated, the system successfully removes other ecotoxic elements such as Zn.

Trees Need Filler on Waste

Trees establishing on blocky quarry waste are subject to rapid desiccation. Rowe et al. (p. 994–1003) discovered that slate processing fines help with initial tree establishment on blocky slate waste by filling large pores in the waste. Superabsorbent hydrogel was less effective, perhaps because excessive shrinkage and movement cause discontinuities in this medium. Hydrogel sorbed plant nutrients and thus may reduce leaching, but also may reduce their availability. Rapid root growth was observed within both of the pore-filling media, and hydrogel may be useful as a lightweight admixture to imported soil or processing fines on sites where access is difficult.

Acetochlor Leaching Not Observed

The Acetochlor Registration Partnership conducted a prospective ground water monitoring program to investigate acetochlor transport to ground water at eight sites. Newcombe et al. (p. 1004–1015) found that these sites show a distribution of soil textures weighted toward coarser soil types, although they also include finer-textured soils that dominate most corn growing areas of the United States. The acetochlor PGW program demonstrated that acetochlor does not leach to ground water at detectable concentrations, and when applied in accordance with label restrictions, is unlikely to move to ground water at concentrations hazardous to human health.

Sediments Take Up Remote Pb Pollutants

Over the past 150 yr in North America, human activities have greatly increased the fluxes of trace metals to the aquatic environment. Ndzangou et al. (p. 1016–1025) report that Pb is an effective tracer of metal input in lake sediments. In Lake Clair (southern Québec) sediments deposited before 1872, Pb concentrations and isotopic ratios were relatively stable, reflecting the natural Pb background. The maximum Pb enrichment factor of 35 times was found in sediments deposited in 1975. At this time, Pb isotopic signatures mainly reflect the use of alkyl-lead in gasoline. From 1967 to 1996, 30 to 60% of the accumulated anthropogenic Pb came from the United States.

Crop Uptake of Cadmium

Plant uptake is one of the major pathways by which soil cadmium (Cd) enters the human food chain. Ingwersen and Streck (p. 1026–1035) present a simple process-oriented model suited to predicting the Cd uptake of crops at the regional scale. In 1998 and 1999, soil and plant material was sampled at 40 potato, 40 sugarbeet, and 32 winter wheat fields, all of which had received considerable loads of heavy metals from irrigation using municipal waste water for up to 40 yr. In both years, the authors found a close linear relationship between Cd content of plant material and the Cd concentration in soil solution. Moreover, they observed a trend of a relatively increased Cd uptake in the year with the higher saturation deficit of the air. The proposed model assumes that the crop uptake of Cd is proportional to mass flow (i.e., the product of water transpired, Cd concentration in soil solution, and a plant-specific empirical parameter).

Green Roofs Retain Stormwater

As our forests and agricultural lands are replaced with impervious surfaces due to urban development, recovering green space is becoming increasingly critical for the health of our environment. Because of lost green space, stormwater management has become a major concern. VanWoert et al. (p. 1036–1044) report that establishing vegetation on rooftops, known as green roofs, is one method of mitigating stormwater runoff. Roof surface (conventional roof, media only, and vegetated), media depth, and roof slope all influenced stormwater retention. Vegetated green roofs not only reduced the amount of stormwater runoff, they also extended runoff duration beyond the actual rain event. Green roofs show promise as a technology that can help provide a sustainable built environment.

Novel Method for Measuring Pesticide Sorption in Soil

Organic chemicals showing a low affinity to soil are susceptible to leaching and pose more risk of ground water contamination. Ahmad et al. (p. 1045–1054) developed a novel technique for accurately measuring sorption of hydrophilic, weakly sorbing organic chemicals in soils, for which determination by conventional methods is often prone to errors. The technique makes use of accumulation of the solution that has been equilibrated with the sorbed pesticide. Water is introduced into soil spiked with a pesticide of interest. Pesticide sorption is then determined from the pesticide contents in soil, which increases linearly with the accumulation of the equilibrated solution. The method was tested for two hydrophilic pesticides (monocrotophos and dichlorvos) and produced sorption coefficients that successfully predicted the retardation of pesticide transport in soil. The method is particularly suitable for weakly sorbing organic compounds and provides a useful tool for accurately assessing leaching potential of these chemicals to ground water.

Lipids Compete with PAHs

Removing lipids frees high-energy sites for incoming contaminants. Chilom et al. (p. 1055–1062) report that removing lipids increases not only the sorption capacity of the samples but also the exothermicity of the process. The entropy changes were small and positive for all geosorbent samples, but changes were smaller and more negative when the lipids were removed. This indicates that the interaction of PAHs with soils and sediments in the absence of extractable lipids is stronger and the mechanisms involved may be different, changing from a partitioning-like mechanism to specific adsorption.

A Thermodynamically Based Index to Quantify Sorption Hysteresis

Sorption of organic chemicals to soils and sediments often exhibits true hysteresis (i.e., nonsingularity of the sorption–desorption isotherm not attributable to known experimental artifacts). Since true sorption hysteresis is fundamentally important to contaminant fate, a way to quantify it is necessary. Sander et al. (p. 1063–1072) derive a thermodynamically based index to quantify true sorption hysteresis that does not require any assumptions about the physical or molecular properties of the solid, and that does not depend on a specific equilibrium model. The index is based on the difference in Gibbs free energy between the real desorption state and the hypothetical fully reversible state. The index can be incorporated into existing sorption models.

Petroleum–Wastewater Irrigation Affected Soil Functions

Soil functions in paddy fields irrigated for more than 50 yr by petroleum wastewater have been seriously affected. Li et al. (p. 1073–1080) reported that microbial diversity and enzymatic activities could be used to assess soil function. The petroleum pollution in the irrigation area resulted in an increase of the number of aerobic heterotrophic bacteria and an increase in the diversity of eubacteria at the current pollution level. Petroleum hydrocarbons induced an increase in the activities of oxidoreductases and soil substrate–induced respiration. The decrease in urease activity can be used as a sensitive indicator of degradation of soil function.

Snap Bean as Ozone Bio-Indicators

Ozone is an air pollutant that is toxic to plants, causing visible injury to foliage and a reduction in the growth and yield of many agronomic, horticultural, and forest species. One approach to assessing and comparing the effects of ozone on vegetation is to identify ozone-sensitive plants that can be used as bio-indicators. Burkey et al. (p. 1081–1086) compared ozone-sensitive and ozone-tolerant snap bean grown under ambient and low ozone conditions. Ambient ozone levels in Raleigh, NC, suppressed the yield of an ozone-sensitive snap bean by as much as 60% over controls with low sensitivity to ozone, but the effect was 10% or less in tolerant lines. Visible leaf injury was also greater for sensitive genotypes. The results suggest that a snap bean bio-indicator system can detect ambient ozone effects at present-day ozone concentrations.

BMPs Significantly Reduce Phosphorus Losses in Farm Runoff

Quantifying the effects of management programs on water quality is critical to agencies responsible for protecting water resources. In the Catskills region of New York State, a comprehensive management program was instituted in the early 1990s to protect and improve the water quality of reservoirs supplying drinking water to New York City. Dairy farms in the watershed received agricultural best management practices (BMPs) designed to reduce excess P losses and control eutrophication of the reservoirs. Bishop et al. (p. 1087–1101) report the results of a paired watershed study conducted to quantify the effects of BMPs on runoff from one of the farms participating in the program. Pre- and post-treatment farm P losses were compared using a sophisticated multivariate analysis of covariance applied to 6 yr of event-based monitoring data. After treatment, the results showed a reduction of 43% for total dissolved P and of 29% for particulate P in overall event loads. The study clearly demonstrated that the changes in both farm management and physical infrastructure produced statistically significant decreases in event P losses that were measurable at the small watershed scale.

Water Quality from a Flat Landscape

Considerable effort has gone into implementing conservation tillage and nutrient management practices to reduce pollution delivered to surface waters. While conservation tillage is effective on steep landscapes, Thoma et al. (p. 1102–1111) report that on flat landscapes with high clay content, conservation tillage that leaves about 30% surface residue cover provides little benefit to water quality, suggesting that conservation tillage with 30% residue cover alone will not be sufficient to reduce sediment pollution in the Minnesota River by 40%. This is largely because overland flow from flat landscapes is slow, minimizing management practice influence on pollution delivery. Fall-injected liquid hog manure had minimal impact on runoff or tile line water quality compared with spring-applied urea, mainly because the organic source of nutrients, as well as below surface injection of manure, slowed nutrient availability. This indicates that liquid hog manure, if properly managed, would have minimal impact on the Minnesota River water quality.

Determining Phosphorus Sorption Capacity of Residuals

The high amorphous Al oxide content, in Al-based drinking water treatment residuals (WTR), results in a high P sorption capacity (P_{max}). Therefore, WTR may be used beneficially to sorb excess agricultural P to protect surface or ground water quality. Dayton and Basta (p. 1112–1118) evaluated experimental conditions and methods used to accurately determine the WTR P_{max}, which can be predicted indirectly using the relationship between P_{max} and amorphous Al-oxide. Using WTR to protect water quality may provide environmental and economic benefits to communities and utilities.

Management Strategy Impacts on Ammonia Volatilization from Swine Manure

Ammonia emitted from manure can have detrimental effects on health, environmental quality, and fertilizer value. The objective of the study by Panetta et al. (p. 1119–1130) was to measure the potential for reducing ammonia volatilization from swine (*Sus scrofa domestica*) manure by temperature control, stirring, addition of N binder (Yucca) or urease inhibitor (NBPT), segregation of urine from feces, and pH modification. Swine manure [total solids (TS) 7.6–11.2%, total Kjeldahl nitrogen (TKN) 3.3–6.2 g/L, ammonium nitrogen (NH_4^+–N) 1.0–3.3 g/L] was stored for 24, 48, 72, or 96 h in 2-L polyvinyl chloride vessels. The manure was analyzed to determine pre- and post-storage concentrations of TS and volatile solids (VS), TKN, and

NH_4^+–N. The concentration of accumulated ammonia-N in the vessel headspace (HSAN), post-storage, was measured using Dräger grab sample tubes (Dräger Safety, Pittsburgh, PA). Headspace NH_3 concentrations were reduced 99.3% by segregation of urine from feces ($P <$ 0.0001). Stirring and NBPT (152 μL/L) increased (HSAN) concentration (119 and 140%, respectively). Headspace NH_3 concentration increased by 2.7 mg/m^3 for every 1°C increase in temperature over 35°C. Slurry NH_4^+–N concentrations were reduced by segregation (78.3%) and acidification to pH 5.3 (9.4%), and increased with stirring (4.8%) and increasing temperature (0.06 g/L per 1°C increase in temperature over 35°C). Temperature control, urine–feces segregation, and acidification of swine manure are strategies with the potential to reduce or slow NH_4^+–N formation and NH_3 volatilization.

Humic Substances in Pig Slurry–Amended Soils

An in-depth acid–base characterization of humic acid and fulvic acid fractions of pig slurry and pig-slurry–amended soils using acidic functional group contents and proton-binding affinities is important for achieving a better understanding of the agronomic efficacy and environmental impact of pig slurry amendment. By using a current potentiometric titration method and the NICA model, Plaza et al. (p. 1131–1137) found that amendment with pig slurry causes a decrease of acidic functional group contents and a slight increase of the proton affinity of the carboxylic-type groups in soil humic and fulvic acids. Further, the affinities for proton binding by the phenolic-type groups of soil humic acids decrease slightly. These effects can have a large impact on the biological availability, mobilization, and transport of macro- and micronutrients, toxic metal ions, and xenobiotic organic cations in pig slurry–amended soils.