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ILLINOIS NUTRIENT LOSS REDUCTION STRATEGY
#NLRS2019

RESEARCH SHOWCASE

Illinois Department of Agriculture

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

ILLINOIS Extension
COLLEGE OF AGRICULTURAL, CONSUMER & ENVIRONMENTAL SCIENCES

Manure Legacy Affects Tile P Loads for 70+ Years (and Counting)

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Tile drainage systems convey phosphorus (P) from agricultural fields to surface waters; however, controls on tile P losses at the sub-field scale are poorly understood. We characterized dissolved reactive P (DRP) loads and flow-weighted mean concentrations (FWMC) from 36 monitored tiles across a 145-acre farm under a corn and soybean rotation in east-central Illinois from 2015 through 2017. Soil sampling revealed a hotspot for soil P (135 – 290 lbs/A) in the north section of the field. Tiles underlying this area of high soil P consistently ranked among the highest for annual tile DRP loads. Using a plat map and aerial imagery from 1940, we confirmed this area of the field had been a farmstead with a house and several barns more than 70 years ago. Soil samples with high P levels were located behind the barns likely indicating P accumulation from animal production and manure storage and handling. Across the 36 tiles, plot soil P ranged from 32 to 109 lbs/A and was related to tile P loads ($R^2 = 0.46$). Additionally, we found two plots with large closed depressions had elevated annual tile P loads. Upon further investigations, these two closed depressions had high P accumulation associated with depression depth. Our findings suggest there is need to draw down soil P in areas where soil P is in excess of crop requirements (65 lbs/A). Soil sampling schemes that best characterize soil P variability at sub-field scales should be employed to accurately identify these locations to prevent soil P buildup and diminish the risk of soluble P exports from tile-drained fields.

Removing Dissolved Phosphorus with Edge-of-Field Phosphorus Filters

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Phosphorus (P) loss from intensively managed agricultural landscapes in Illinois is an ongoing concern. The Illinois Nutrient Loss Reduction Strategy (NLRS) proposes management practices to reduce the state's P loss load by a target of 45% of the 1980-1996 annual average, corresponding to a reduction of 8.97 million pounds per year from non-point sources. Edge-of-Field P filters are a novel practice that provides landowners with an engineered option to remove P from runoff or drainage waters. The filters are filled with a media containing aluminum, magnesium, calcium, and/or iron which captures dissolved P from water. This NREC-supported work, showcased using a traditional poster while informing participants of the work, will evaluate potential mitigation strategies for P loss by focusing on a select group of media with high P sorption potential and regionally available as waste materials. The potential media (steel slag and acid mine drainage waste) were evaluated for P sorption capacity as well as factors relevant to field-feasibility such as hydraulic conductivity. These factors influence the potential reuse or lifespan extension of a material. P-sorbing media were assessed using traditional batch isotherm studies to quantify sorption kinetics and potential, and as influenced by media particle size. Media will be assessed using column experiments to mimic realistic contact times and P concentrations anticipated for edge-of-field filters. Finally, the potential of portable X-ray fluorescence spectroscopy as a rapid, low-cost, on-site method to evaluate P saturation and thus life expectancy of the potential filter materials will be investigated. Ultimately, this combination of experiments will be used to identify specific media type and characteristics (e.g., particle size) to optimize field-ready P-sorbing filters for Illinois. These results will lead to the selection of 'best bets' media for field-scale implementation of an edge-of-field P filters in southern Illinois, a priority region for P mitigation from agricultural landscapes.

Modelling and Designing Saturated Buffers for Nitrogen and Phosphorus Mitigation in Illinois

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The potential benefits of saturated buffers have gained interest from many environmental and agricultural groups, and are currently being assessed for inclusion in the Iowa and Illinois Nutrient Loss Reduction Strategy (Illinois NLRS). Saturated buffers are a Best Management Practice (BMP) used in situations where a field is bordered by a vegetated buffer, typically along a waterway, and drained by a tile network. Saturated buffers intercept existing tile lines and disperse some of the water beneath the buffer vegetation. As the water flow is dispersed beneath the buffer vegetation, there is a high potential to reduce nitrate concentrations from direct uptake by the vegetation in the buffer or through the conversion of nitrate into harmless nitrogen gas through denitrification. Drainage outflows and nutrient loads are reduced because a portion of the water dispersed across the buffer is taken up by the vegetation. To date, saturated buffers have had little research focus in tile drained areas of Illinois, with no research that we are aware of that has explored various designs including SIU's pitchfork design. The objectives of this study are to install, and monitor a saturated buffer implementing a new pitchfork design equipped with a backflow check valve to test the impact on water quality (nitrogen and phosphorus) and quantity reaching the tile outlet. These results will be compared to a standard buffer in the same field. Installation was completed March 19th 2019. Discharge and water quality monitoring are in progress through 2023. The study will also assess potential denitrification rates and changes in deep soil carbon and nitrogen pools in the area surrounding the saturated buffers. The first deep soil cores were analyzed on January 25th 2019. In the future cores will be taken each year until 2023. Our data will provide a direct side-by-side comparison of SIU's new design to a standard saturated buffer. These data will provide insight on the effectiveness of saturated buffers in Illinois, and also the potential criteria for new saturated buffer designs.

Key words: Saturated Buffer

Assessing the Phosphorus Loss Reduction Potential of a Slow Release Fertilizer Struvite for the Midwest

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Struvite ($MgNH_4PO_4$; 5-28-0) is recovered from wastewater streams and could be a potential solution to mitigating phosphorus (P) losses from agricultural fields. Struvite has low water solubility (1-5%) but moderate (27%) citrate solubility, presenting a potential trade-off of minimizing runoff P losses and limiting early crop growth. Using blends of a commonly employed soluble P fertilizer, monoammonium phosphate (MAP) and struvite were tested to determine the optimum ratio of struvite to MAP for a wheat-soybean rotation and to evaluate hypothesized crop-specific responses to struvite solubility. A factorial experiment in randomized complete block design at Urbana, Illinois (fine-silty, mixed, superactive, mesic Typic Endoaquolls) evaluated the struvite-MAP ratios (0-100, 25-75, 50-50, 75-25, 100-0) as fall and spring fertilizer broadcast in a wheat-soybean double crop. Above-ground plant biomass and depth-wise (0-3 in and 3-6 in) soil samples at P critical crop phenological stages and grain harvest were used to assess P dynamics from the fertilizer blends in the soil-plant system. Spatially explicit sampling of soil within the crop rows versus furrows were used to assess the hypothesized crop root exudate-mediated P release from struvite as soil available P. Results will be used to optimize a fertilizer ratio of struvite-MAP for key Midwestern grain crops to reduce soluble P losses from agricultural fields while maintaining agricultural production.

Nitrogen Mineralization Following Soybean Production is a Major Source of Tile Nitrate Load

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We believe the unusual weather conditions this past year provided us with a clear view of one of the major sources of tile nitrate, namely soil N mineralization (especially following soybean production). With the early start of tile drainage in late summer of 2018 and the late application of fertilizer N this spring, we saw the influence of soil N mineralization following soybean production without the confounding effects of preplant fertilizer N applications. Using an on-farm replicated tile drainage study in Douglas County, IL, we show that more nitrate loss occurred following soybean production than following corn this past drainage season. We were surprised by the sustained low tile nitrate concentrations throughout the drainage season following corn production at this site last year. Although it is well established that microbial decomposition of corn residue can immobilize soil N, this past year was particularly interesting as the 2018 corn crop was found to be N deficient by the end of the growing season (as indicated by very low stalk nitrate values) and its residue had a very wide C:N ratio (>70:1). We believe that immobilization of soil N during the decomposition of this C-rich (and N-poor) corn residue limited nitrate leaching and decreased tile nitrate loss. On the other hand, we speculate that the soil system is C limited after soybean production and that nitrate liberated from the decomposition of soybean residue can and does substantially add to tile nitrate loads. Over wintering cover crops may be the best strategy for addressing this type of nutrient loss.

Benchmark Sediment Monitoring Network for Illinois Streams: Analysis of Long-term Sediment Data

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Excessive sedimentation in Illinois streams continues to be a critical water quality issue that has both environmental and economic consequences. Studies show that sedimentation can directly or indirectly degrade the biological health of streams. Water supply reservoirs and shipping lanes require dredging from time to time to maintain their functions. The Illinois State Water Survey (ISWS) established the Benchmark Sediment Monitoring Program (BSMP) in 1980 to monitor in-stream suspended sediment concentrations and determine sediment loads at 50 locations throughout Illinois. Currently, only 15 of these stations are active. Long-term suspended sediment data collected at these sites represent a unique dataset that is essential for evaluating long-term sediment transport rates in Illinois streams. Annual and composite suspended sediment-discharge relationships were developed and then used to estimate annual mean sediment concentrations and annual loads at each monitoring station with complete USGS discharge records for water years 1981-2016. In this period, the La Moine River at Colmar and Spoon River at London Mills exhibited the largest and second largest average annual sediment yields, which were estimated to be 479 and 472 tons per year per square mile (tons/yr/mi2), respectively. The highest and second highest mean annual sediment concentrations (i.e., 595 and 583 milligrams per liter (mg/L), respectively) were obtained for the two La Moine River stations at Ripley and at Colmar. In contrast, the Rock River at Rockton and the Kankakee River at Momence generated average annual sediment yields of 66 and 85 tons/yr/mi2 and sediment concentrations of 80 and 78 mg/L, respectively, which are among the smallest. To determine the presence or absence of long-term trends in annual mean discharge, annual load, and annual mean concentration at each of the monitoring stations, a 36-year trend analysis was conducted. Annual mean discharges showed no trends in any of the stations during this period, but annual mean load and annual mean suspended

sediment concentration were found to show statistically significant decreasing trends in four and six of the stations, respectively. Three of these stations exhibited decreasing trends in both sediment load and concentration. This unique set of sediment data collected in the BSMP provide valuable baseline rates of sediment transport throughout Illinois and thus, is extremely useful in evaluating, monitoring, and documenting the success of conservation efforts such as the Illinois Conservation Reserve Enhancement Program (CREP). Furthermore, it can help identify watershed areas that benefit the most from implementation of conservation practices designed to reduce sediment loads.

University of Illinois Extension Watershed Outreach Associates Update

Haley Haverback-Gruber and Jennifer Woodyard

University of Illinois Extension

Haley Haverback-Gruber and Jennifer Woodyard are the University of Illinois Extension Watershed Outreach Associates. Haley is located in two nitrogen priority watersheds in northwest Illinois, and Jennifer is located in two phosphorus priority watersheds in southeastern Illinois. These individuals were tasked with serving as educators and technical advisors on the Illinois Nutrient Loss Reduction Strategy (NLRS) and the best management practices (BMPs) within it to reduce agricultural nutrient loss.

Haley and Jennifer have been developing new collaborations and relationships with stakeholders and farmers in their watersheds to update and create watershed management plans. They have also focused on offering a diverse array of interactive educational opportunities to increase farmers' ownership and buy-in of the nutrient loss issue and to increase the adoption of BMPs that are suitable for their region. The coordinators have developed statewide networks with organizations that share similar goals. Haley and Jennifer's poster will include an overview of these activities and their thoughts on future efforts.

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Struvite: a Slow Release Phosphorus Source for Illinois Corn and Soybean

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Struvite (NH_4MgPO_4-$6H_2O$) recovered from point source wastewater streams is a candidate renewable P fertilizer in non-point sources. This recovered P has the potential to reduce dependence on highly water soluble non-renewable P resources and P losses from agricultural systems. A greenhouse experiment evaluated the effects of struvite-monoammonium phosphate (MAP) blends (100-0, 75-25, 50-50, 25-50, 0-100) on V12 corn (*Zea mays* L.) and R1 soybean (*Glycine max* L.) in a fine, smectitic, mesic Aquic Argiudoll (0-30 cm of A horizon, silt loam texture, pH 5.6). A corresponding field trial on the same soil type was conducted in 2019 for corn using the same blends sans the 100% struvite treatment, removed because of the poor crop responses observed in the greenhouse experiment. At the field scale, tillage (conventional and no-till), placement (broadcast and banding), and timing (fall and spring) were tested. Struvite-MAP blends were evaluated at the greenhouse scale for dry biomass, plant P and N concentration, total uptake, and changes in soil P and N concentrations for struvite granule size (1.5 vs. 3mm) and placement (incorporation vs. banding) in a replicated factorial design. Corn biomass, P and N concentration, and uptake were similar up to 50% substitution of MAP with struvite and similar up to 25% substitution in soybean at the greenhouse scale. Field scale corn yield will be presented here as well. Results indicate there is promise for struvite to replace a portion of MAP application rates potentially increasing P use efficiency while lowering loss risk benefitting farmers and the environment.

Measuring Nutrient Loads from Illinois Rivers: Comparison of Nutrient Loads and Uncertainties Determined from Continuous and Discrete Monitoring

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U.S. Geological Survey

Since 2015, the U.S. Geological Survey has operated a continuous water-quality monitoring network in Illinois for the purpose of estimating nutrient loads from Illinois rivers to the Mississippi River. While this network and similar continuous monitoring networks are generally considered to provide more accurate estimates than discrete sample-collection counterparts, rarely are such claims accompanied by appropriate uncertainty analyses. Data from the Illinois network is used to make a side-by-side comparison of the nutrient loads and associated uncertainties from both monitoring approaches. This information is essential for assessing when and where the cost of continuous monitoring is justifiable and provides a preliminary indication of the precision to which Illinois' continuous water-quality monitoring network can detect changes in nutrient loads.

Impacts of Flue Gas Desulfurization Gypsum Application on Water Quality and Crop Production in Southern Illinois

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Loss of nutrients from agricultural land to water bodies is an agronomic, environmental, and health concern. The eutrophication of aquatic systems due to diffuse pollution of agricultural phosphorus (P) is a world-wide water quality problem. It is critical to develop effective practices to keep nutrients in the soil and prevent their loss in runoff to maintain and improve water quality. Flue Gas Desulfurization (FGD) gypsum has been found to reduce phosphate leaching in other Midwestern states, but has not been researched in Illinois. The objective of this project is to assess FGD gypsum's impact on water quality, soil physical properties and on grain yields. Surface runoff flumes were installed in an area with high soil P levels on the SIU University Farms to assess the effects of gypsum application rate (@ 1 ton/ac, @ 2 tons/ac, @ 6 tons/ac) on surface runoff water quality. After each significant rain event (≥ 0.5 inch), surface runoff samples are collected and analyzed in the lab for dissolved reactive phosphate (DRP), total phosphorus (TP), sulfate, and total suspended solids. To assess gypsum's impact on yield and soil physical properties, a replicated large-scale field study was established on three producers' farms in areas of southern Illinois, including four treatments: gypsum (1 ton/acre), calcium (lime), sulfur (elemental sulfur), and a control to determine how each element in gypsum may impact yield. Analysis of the water samples after treatment application January to May 2019, have shown a decrease in DRP and TP load by 13.2%, 31.5%, 36.4% and 12.5%, 27.9%, 35.4 % in treatments 1 ton/ac, 2 tons/ac and 6 tons/ac, respectively, compared to control. The economic cost of gypsum addition and the practicality of farmer adoption will be evaluated through a partial budget analysis. This research is planned for four years and is supported by Illinois Nutrient Research and Education Council.

Corn-Soy-Wheat Rotation Meets Proposed Numeric Nitrate Standard

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To protect IL water quality and reduce nutrient loads exiting the state of Illinois by 45%, the IL Nutrient Science Advisory Committee has proposed a numeric nutrient criteria and eutrophication standard (based on the annual flow weighted mean) of 4 ppm nitrate-N for wadeable streams and rivers. To put this in perspective, during the past 26 years of monitoring the Upper Embarras River at Camargo, IL (a wadeable river draining 119,000 acres), we have found the average annual N load to be 27 lbs/A and the annual flow weighted mean nitrate concentration to be 9 ppm. The lowest flow weighted mean nitrate concentration was 5.7 ppm in 2010, which followed a year with little fall N application due to weather constraints. The predominant cropping system during this 26 year period of record was a corn/soybean rotation; however, we have found that tile nitrate can be dramatically reduced when employing a longer rotation (Corn-Soy-Wheat/Double-Crop Soy) and planting cereal rye after corn. By changing the system (longer rotation, reduced tillage, and cover crop), we have been able to decrease the flow weighted mean nitrate concentration of a tile from 7.7 ppm in the first year to a 4-year average of 3.7 ppm, demonstrating tile nitrate reductions of more than 50%, while maintaining or improving yield and profitability. The longer rotation shows that wheat is an effective scavenger of N that naturally forms in the soil (from the microbial breakdown of N-rich soybean residue) following soybean harvest and into the spring. Cereal rye has also shown effectiveness at decreasing tile nitrate concentrations after corn. We have produced an excellent double crop of soybean following wheat in the past 3 years (when double crop soy is planted before July 1), which has made this phase of the rotation the most financially beneficial (compared to corn or soybean alone). Our results show a quick response time of tile nitrate to management and suggests long lag times are not an issue to improving tile water quality and therefore river water quality in the tile drained regions of IL. This research is demonstrating proof of concept that we can greatly reduce tile nitrate loads by coupling the carbon and N cycles through a more diverse rotation and the use of cover crops.

Cover Crops: Solution to Sediment and Nutrient Loss?

A Paired Watershed Study

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Use of cover crops, to manage the loss of sediments and nutrients caused by surface and sub-surface flow is a commonly used best management practice in the midwestern United States. Until recently, plot level studies were the primary method for evaluating the impact of cover crops on water quality. Singh. et. al. (2018) established one of the few watershed scale studies that focused on analyzing stream water quality and discharge in a stream that drained fields in cover crops. The objective of the study is to quantify the potential of cover crops in improving water quality at watershed scale. The project will undergo continuous monitoring of two watersheds to analyze changes in the water quality and stream discharge from a no-till corn/soybean rotation with cereal rye (*Secale cereal*) and hairy vetch (*Vicia villosa*) as the winter cover crops in the treatment watershed. The study site located at Southern Illinois University, Carbondale, IL, will evaluate the sediment, phosphate, nitrate, ammonia, total N, and dissolved organic carbon exports from the paired watershed using ISCO automated water samplers. The study design is a paired watershed design where watershed #1 (42ha) will be the treatment watershed and is under mixed land use of 66.4% cropland, 30.3% forested cover and 3.3% impervious surface. Watershed #2, the control watershed, has a total area of 27 ha with its area comprising 91% cropland, 6.6% forested cover, and 2.4% impervious surface. Calibration data of 3 years and treatment period of 2 years will be used as reference to perform the study to determine if the water quality results are similar between the two watersheds, or if new patterns emerge. Data for water quality (major anions including nitrate and phosphate) will be determined from field sample collection and laboratory analysis while the regression equation from the calibration period will be in used to predict the data if a treatment did not occur and compare it to observed data in the treatment watershed. The overall difference in actual and predicted results will serve as base for realizing the impacts of the cover crop treatment on water quality and stream discharge.

Key words: Paired Watershed, Cover Crops, Nutrients

Impact of Cover Crops on Nutrient Leaching in Vadose Zone

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Winter fallow season is a critical time for nutrient management as precipitation has great potential to flush nutrients from the soil profile. Cover Crops (CC) during this time period are considered a promising strategy to reduce nutrient leaching. A replicated plot study was established in 2014 at the Southern Illinois University Carbondale Research Farm. Pan lysimeters were installed in different CCs and tillage rotations to monitor nutrient leaching. The research layout includes a complete randomized design with two tillage practices [conventional tillage (CT) and no tillage (NT)] and three different crop rotation treatments [corn-noCC-soybean-noCC (CncSnc), corn-cereal rye-soybean-hairy vetch (CcrShv), and corn-cereal rye-soybean-oats+radish (CcrSor)]. Pan lysimeters were installed below the A horizon (~22-30 cm in depth) in each plot. Soil solution was sampled weekly or biweekly depending on precipitation and analyzed for nitrate-N and dissolved reactive phosphate (DRP). During the CC season in spring 2018, cereal rye in CcrShv and CcrSor significantly reduced nitrate-N leaching by 82% and 68% compared to the CncSnc. Yet, in the CC season in spring 2019, hairy vetch and oats and radish cover crop rotations had 75% and 68% higher nitrate-N leaching respectively compared to noCC treatment. In fall 2018 nitrate leaching was highest in CcrSor rotation under CT. DRP leaching was reduced 66% in CncSnc under NT when compared to CncSnc under CT after cash crop harvesting. This study highlights the role of different cover crop species in limiting nutrient loss as well as the importance of timing the release of nitrogen from cover crop biomass to meet the N demands of subsequent cash crops.

Field-Based Watershed Verification and Demonstrations of Best Management Practices at the MWRD's Fulton County Site

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Although several best management practices (BMPs) can potentially reduce nutrient loss from agricultural fields, many of them are not extensively tested in a large (watershed) scale. For generating data for a potential nutrient trading market in Illinois and increasing the rate of adoption of BMPs, the Metropolitan Water Reclamation District of Greater Chicago has established six fields in three pairs for use in watershed verification of BMPs' effectiveness. We used the United States Environmental Protection Agency's paired watershed research approach, in which one field in a pair serves as reference (control) and the other receives the BMP treatment. The nutrient loss values do not need to be equal between the two fields, over time before application of the BMP treatment (calibration period), but rather the relationship must be consistent. Since the reference field serves statistically as a control with respect to climatic and hydrological differences, any differences in nutrient loss following installation of BMPs could be precisely attributed to the BMPs. During the three-year calibration period (2017-2019), each pair of the fields have been managed identically, and the data collected will be used to develop a regression equation between the paired field for nutrient loads to surface water. Best Management Practices are planned to be installed in one field of each pair in 2020, and the monitoring will continue for another three - five years. Another regression equation between two fields of each pair will be developed for nutrient loads to surface water. The change in the regression slope in the response period relative to the calibration period can be used to calculate the change of nutrient loads to surface water from agricultural fields after the implementation of the BMPs. The poster will show the progress in the calibration of paired fields and the plan for future BMP installations and monitoring.

The Influence of Water and Sediment Control Basins (WASCoBs) on Crop Yields and Water Quality near Atterberry, Illinois

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The Illinois Nutrient Loss Reduction Strategy (NLRS) has set goals for a 15% reduction in nitrogen and 25% reduction in phosphorus by 2025. To achieve these goals a multitude of in-field and edge-of-field Best Management Practices (BMPs) have been developed and implemented. Water and Sediment Control Basins (WASCoBs) are a BMP used in areas with rolling topography to mitigate erosion. Little is known about impacts of WASCoBs on soil quality, nutrient runoff, or crop yields. With WASCoBs being so prevalent on the landscape it is necessary to know how they function independently, as well as in conjunction with other BMPs such as cover crops. The objective of this research is to evaluate the influence of cereal rye cover crop in a corn-soybean rotation on nutrient losses, water quality, soil health, and crop yields in fields with and without WASCoBs. The treatments in this project are watersheds in a corn/soybean rotation field utilizing different BMP's. The treatments are: 1) 3.77 acre watershed with a WASCoB and no Cover Crop. 2) 3.35 acre watershed with WASCoB, planted in cover crops. 3) 0.60 acre watershed with an ephemeral gully, no WASCoB, planted in cover crops. 4) 9.51 acre watershed with an ephemeral gully, no WASCoB and no cover crops. Storm event water samples are collected using automated ISCO water samplers fitted with level loggers. The water samples are analyzed for nitrate, ammonium, dissolved reactive phosphorus, total phosphorus, sediment, and dissolved organic carbon. Annual fall soil samples will be collected and analyzed for soil fertility. This project is in progress on a farm owned by Brian Satorius near Atterbury, IL in Menard County. WASCoBs were completed in June 2019. Data from this research will impact the agriculture community, researchers, and policy makers, as it will provide supporting evidence on the effectiveness of individual BMPs and Integrated Best Management Systems (IBMS) for improved nutrient management.

Key Words: WASCoB, cover crops, nitrate, phosphate

Linking Energy and Ecosystem Services: Willow Buffers in an Agricultural Landscape

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With the projected declines in fossil fuel availability, the focus on alternative sources of energy will be important as the global population continues to grow along with the demand for energy. Renewable energy is one solution to this problem, and agricultural landscapes are projected to produce the largest portion of biomass for the renewable energy. The production of biomass on marginally productive agricultural landscapes will have a low impact on food supply and land use change while improving ecosystem service provision. However, these potential benefits may vary widely across location and crop type, and therefore research is needed to quantify the environmental impacts of perennial bioenergy crops integrated into agricultural landscapes. This 9-year study (2011-present) evaluated the impacts of strategically placed short-rotation shrub willow (*Salix miyabeana 'SX61'*) buffers in a corn-soybean field in central Illinois on nutrient loss reduction and recovery, soil health, and invertebrate biodiversity. Results of the study show that willows can significantly reduce leached nitrate-nitrogen from neighboring grain crop, as well as reduce nitrous oxide emissions, increase subsurface organic matter, and provide habitat for important invertebrate functional groups such as pollinators and predators. The position of the buffers within the agricultural field was important for the provision of some of these services and for enhanced biomass production. However, placement did not appear to influence invertebrate diversity, which was more correlated to sampling date. The presence of different landcovers (willow, grain, and riparian edge) are all important to support these species throughout the year.