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PoultryPractices

Oklahoma Cooperative Extension Service

A newsletter for poultry producers and poultry litter applicators...

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Editor's Column

In this issue, we discuss innovative technology for filtering phosphorus in stormwater runoff. We also summarize new research examining sediment and phosphorus contributions from streambank erosion and the impact of riparian areas. The benefits of using GPS guidance for pasture management are explored. Finally, we update an ongoing nutrient application strategy field study that compares poultry litter to commercial fertilizer.

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Josh Payne

Improving Water Quality with Phosphorus Drainage Filters

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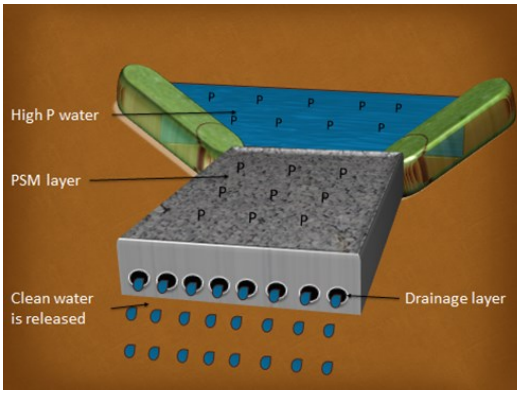
The transport of phosphorus from soils to surface waters can cause nutrient enrichment resulting in algal blooms and excessive aquatic plant growth. Algae can impact recreational use and cause taste and odor problems in drinking water. Once the algae and other aquatic plants die, a decomposition process begins to take place by oxygen consuming bacteria. This process can lower dissolved oxygen levels within the water potentially impacting aquatic life including fish populations. Phosphorus is considered the limiting nutrient because its absence limits the growth of algae and aquatic plants.

Some urban and agricultural soils are saturated with P as a result of historic nutrient imbalances from excessive urban fertilization or intensive animal production. There are two main forms of P, particulate P and dissolved P, which are transported to surface waters. Particulate P is that which is bound to soil particles. Controlling erosion through cover crops, vegetative buffers and riparian areas reduces particulate P transport. Dissolved P is 100% bio-available to aquatic plants upon reaching a water body and erosion control does little for reducing its movement. Controlling dissolved P losses from urban and agricultural landscapes is especially challenging once soil P accumulates to high levels. Even after cessation of P fertilization and implementation of traditional best management practices, dissolved P will continue to "leak" out of high P soils for many years. It would require many decades to draw down soil P saturation below commonly accepted environmental thresholds by harvesting agricultural crops or urban yard waste.



Since few, if any, best management practices (BMPs) can address the dissolved P loads leaving high P soils, researchers at OSU have developed a system to aid in designing P drainage filters that utilize industrial materials to bind dissolved P from runoff.

Illustration of how a phosphorus drainage filter improves water quality.

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GPS Guidance Systems for Pasture Applications

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The use of global positioning system (GPS) based guidance systems is a fast growing and changing market. Most people are exposed to some sort of GPS in their daily lives, whether it is in a cell phone, a navigation system in a vehicle, or simply a hand held GPS. Likewise, GPS systems are becoming more prevalent in production agriculture. These systems are primarily used in crop production; however, there are many potential benefits in pasture systems. With so many different devices to choose from how does one decide which is best for specific farming applications and budgets?

It is challenging to maintain consistent swath width during pasture applications with spinner fertilizer spreaders or boom-less sprayers. Estimating the distance to the previous pass from tire tracks has an obvious disadvantage and so does attempting to drive toward an object at the opposite end of the field. However, a GPS guidance system can provide some assistance for driving parallel passes with the correct application width. In fact, GPS guidance systems are intended to increase productivity by minimizing overlap and skips. Improving steering accuracy could potentially reduce crop inputs such as chemicals, fertilizers and seed, as well as other inputs such as fuel and time.

Accuracy should be understood when discussing GPS based guidance systems. Performance of a GPS receiver can be considered in two ways, accuracy and precision. Accuracy is defined by how well the receiver can locate itself on the face of the earth. This is more important when you want the capability to return to an exact location at some time in the future. Precision is determined by the consistency or repeatability of the receiver. Precision for GPS guidance systems is typically reported in terms of pass-to-pass error. A more precise system will have a lower pass-to-pass error.

GPS guidance systems can improve driving accuracy in pasture operations where it is difficult to see the previous pass and swath width is important for accurate application.

In general, guidance systems can be broken into three categories based on GPS accuracy. A real time kinematic (RTK) GPS system is the most precise and accurate. RTK systems offer sub-inch pass-to-pass precision and very repeatable accuracy. These systems are the most expensive and are really more than is required for pasture operations. The second category contains receivers capable of providing pass-to-pass accuracy less than 4 inches. These are dual frequency GPS receivers that require a subscription signal for differential correction. The cost of the signal varies with provider. Though the pass-to-pass precision with dual frequency receivers is good, they are not as accurate or repeatable as RTK systems. However, both systems are still more than would be required for pasture use.

The third category offers pass-to-pass precision of about 8-10 inches. These are typically powered by GPS receivers that are using a single frequency differential correction from a subscription provider or the FAA's Wide Area Augmentation System (WAAS). The WAAS signal is free and these are the least expensive GPS receivers. An operator cannot consistently make steering corrections that result in pass-to-pass accuracy less than 6-8 inches over an extended time period. So unless you are considering an autosteer system, purchasing a GPS receiver that is more accurate than a single frequency receiver is probably 'overkill.' While a dual frequency receiver may be alright on an operator steered system, RTK should be reserved for auto steering systems.

In addition to the accuracy of the GPS receiver, some consideration should be given to the display used for operator steered systems. The most common system is a lightbar that aids drivers in steering along an intended path across a field. The simplest lightbar displays are made of a single horizontal row of lights. The center light, which is sometimes a different color or shape, indicates the "guidance path". As the vehicle deviates left or right of the path the lights are turned on to represent the path location with the goal being to keep the vehicle on the center path. There are many variations in lightbar displays. Some have a single row of lights, while others may have two rows of lights. Other systems incorporate the row of lights with LCD display screens that show the field and guidance paths. The display will usually indicate the error in an offline distance so the operator knows how far off the intended path they are.

To operate the system, the operator must input basic machine/implement parameters such as implement width and agricultural operation being performed. Then the driver begins by steering the first pass through the field and selecting an A-B line by pressing a button at the beginning (A) and end (B) of the pass. The computer records the location of each of the points and uses the implement width to determine the location of each subsequent parallel pass across the field. The operator must perform the head land turns and position the vehicle close to the next swath. The actual vehicle location is compared to the calculated paths by the computer based on GPS location. The error and direction to the nearest line is displayed on the display unit so the operator knows which way to steer the vehicle to remain on the desired path.

The guidance paths are independent of any obstacles in the field, thus the operator must be alert because the system will not warn you of any obstacles. This means if you have a tree, terrace, hole, or any other obstacle you can drive around it and still line back up on your path. In some of the newer units, especially the ones with LCD displays, you can mark these obstacles so they will be displayed on your unit in the field, and possibly warn of your approach to them.

In conclusion, there are many GPS guidance systems available on the market with prices starting around $900. Understanding the potential use and accuracy of GPS guidance systems can make selection easier. For pasture guidance operations, WAAS based GPS guidance systems are an excellent choice because they offer low cost technology that can greatly assist driving accuracy in pastures.

Phosphorus Application Strategy Research Update:

Poultry Litter Nutrient Availability & Carryover

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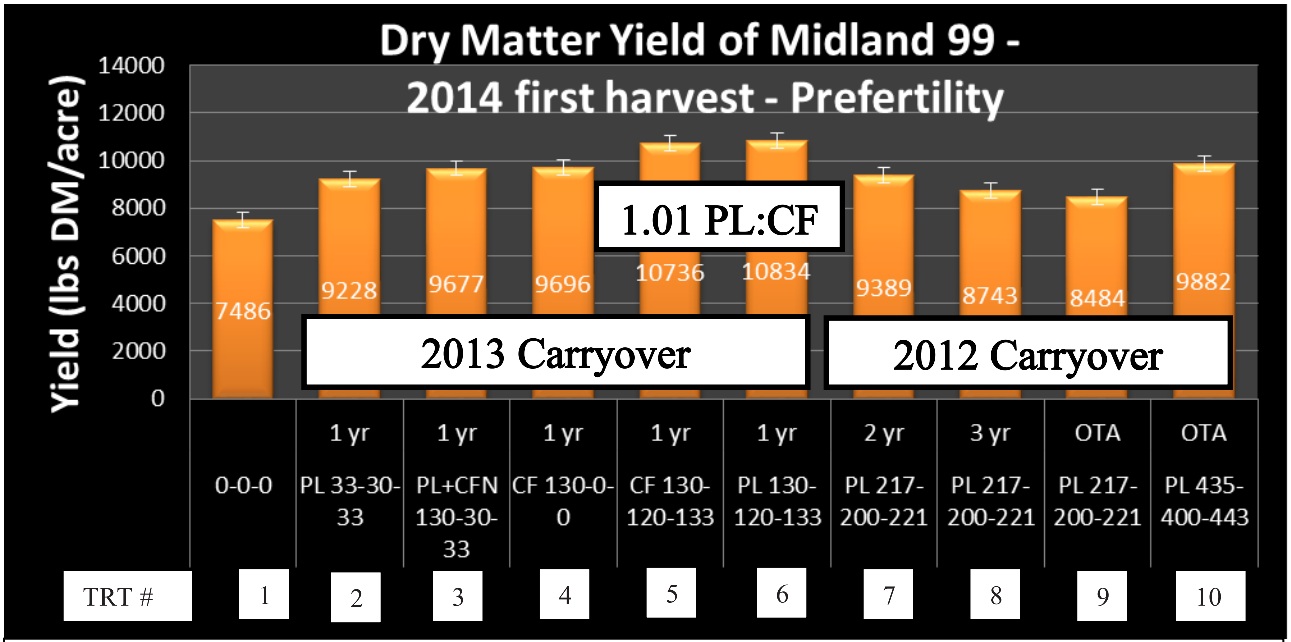
Since 2014 has drawn to a close, let's take a moment to reflect on the third year of data from a long term study at the Eastern Research Station to assess nutrient carryover in forages and directly compare poultry litter to commercial fertilizer applications. Growing conditions in 2014 were as close to ideal as possible throughout the summer. Treatments in this study consist of common agronomic rates of poultry litter (PL) and "nutrient equivalent" treatments of commercial fertilizer (CF) on an annual, two, or three year basis and were first applied in May 2012. Annual treatments were re-applied in June 2013 and July 2014. Fertility applications are staged after the first harvest of the growing season. Therefore, first harvest yields are an indicator of possible nutrient carryover from the previous years' application. Data reported here is an average of replications, but has not yet been subjected to statistical analysis. Additionally, actual soil nutrient carryover will be analyzed at a later date.

Figure 1. Dry matter yield of Midland 99 Bermudagrass before fertility treatments at 2014 first harvest.



†Application timing; 1 yr = annual, 2 yr = every two years, 3 yr = every third year, OTA = One time application.
‡Nutrient rates are indicated as lbs nutrient applied/Acre in terms of N-P-K, with PL = poultry litter and CF = commercial fertilizer.

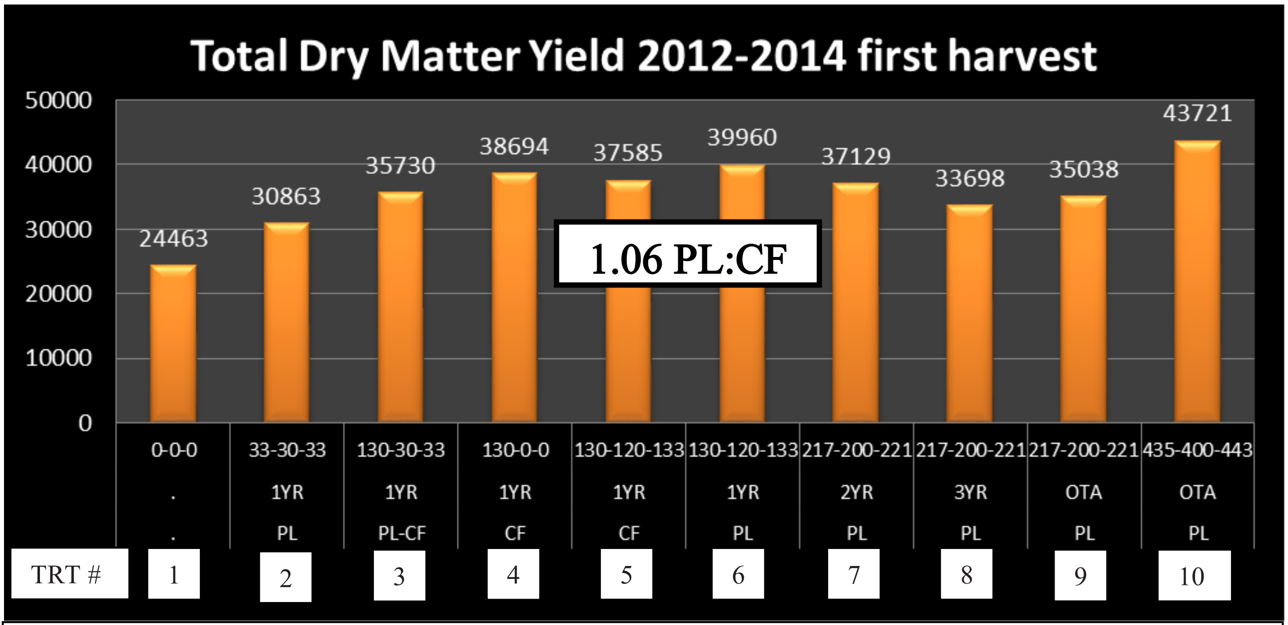
It is widely accepted that since much of the Nitrogen in PL is in an organic form, release of this N occurs over a period of 2-3 years. Our current OSU rule-of-thumb is that 50% of N is available in year 1, 15% is released in year 2, and 5% in year 3. Therefore, repeated annual applications of PL can increase (build up) the amount of N available to plants in one growing season. Referring to Figure 1, it is likely we are beginning to see this N release from previous year applications when comparing treatments 5 and 6. These treatments are true "nutrient equivalent" rates of CF sources and PL in regards to N,P and K. Recall that year 1 data from 2012 (a very dry year) illustrated that PL-treatment 6 produced 93% of the forage yield observed with CF – treatment 5.

For the first harvest in 2014, representing two consecutive years of PL application, forage yield is now favoring PL when compared to CF sources by 1%. This data may further indicate that more immediate N credit is received from PL than previously thought in typical Eastern OK soils.

In 2014, CF and PL applications elicited a yield increase one or two years after application when compared back to the control. Last year's data illustrated the highest application rate from 2012 was still the highest yielding in early 2013, indicating significant N contribution was still occurring within one year of application. However data from this year indicates a trend that 2014 yield was greater from 2013 applications than from applications in 2012, regardless of rate. This substantiates previous data that N contribution from even very high rates of PL is greatly diminished by the third growing season. This is evident when comparing treatments 10 and 6 or treatments 7 and 2, where even drastic differences in total applied N rates (435 vs 260 or 217 vs 66 respectively) result in little yield difference. Much of the N in these higher application rates is either lost to the environment over time or taken up rapidly by more actively growing plant populations and subsequently removed through harvest. A solid case could be made that the "long-term" contribution of PL nutrients to forage yield is relatively short-lived and dictated by available N rather than P or K contributions. Granted, the unused P and K would be available for future use once N is reapplied to the forage stand.

Figure 2 represents forage production over 2.5 growing seasons, encompassing a severe drought and 1.5 "good growing" summers. Interestingly, the one-time application (OTA) of PL at 435-400-443 remains the highest producing treatment in the study. Although its lead was rapidly decreasing by mid-season of 2014 this continues to illustrate the effect of large applications of PL nutrients, while saving 2/3 of the application costs over a 3-year period. We expect this treatment to fall behind significantly in 2015 when compared to the other "normal rate" annual applications. When comparing the nutrient equivalent treatments 5 and 6, it again becomes obvious that PL is a solid competitor with CF in regards to N availability and subsequent yield. This data is backed by an increased level of confidence, since it was collected from both an extremely dry growing season and two ideal moisture growing seasons. At this point in the study, PL has yielded 6% more forage than the same nutrient rate applied as CF.

Figure 2. Total Dry Matter Yield of Midland 99 Bermudagrass 2012-2014 (first harvest).



†Application timing; 1 yr = annual, 2 yr = every two years, 3 yr = every third year, OTA = One time application.
‡Nutrient rates are indicated as lbs nutrient applied/Acre in terms of N-P-K, with PL = poultry litter and CF = commercial fertilizer.

The next two years will provide much usable data from PL treatments 7 and 8 that are interval applied strategies. Ongoing results from this study will be released as field reports when collected in the future.

This study is being conducted in conjunction with Dr. Josh Payne.

Estimating Sediment and P Loads from Streambanks

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Nutrients and sediment are two primary pollutants of waterways. Phosphorus (P) is considered the limiting nutrient because its absence limits the growth of algae and aquatic plants. Common sources of P include fertilizer application to agricultural and urban landscapes, legacy P (accumulated P that can serve as a long-term source of P to surface waters), and wastewater treatment plant discharge. Another potential contributor of P to streams is streambank erosion. Bank erosion is known to contribute sediment to surface waters; however, few studies have examined both sediment and P loading from streambanks.

Within the Illinois River Watershed many streambanks are composed of layers including a coarse gravel subsoil underneath a sandy or silt loam topsoil. Bank erosion usually occurs when the gravel subsoil portion is undercut by streamflow causing the unsupported topsoil layer to collapse (Figure 1).

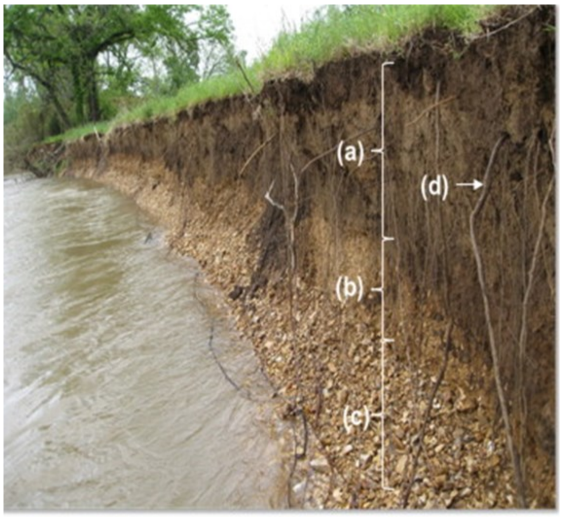


***Figure 1**. Layered streambank with a) silt-loam topsoil, b) packed gravel, c) loose gravel toe and d) exposed tree roots from bank retreat. Source: Miller et al. (2014).*

Conservation practices such as the installation of riparian tree coverage areas are often recommended to trap sediment and nutrients and reduce streambank erosion. Rainfall events within the watershed have caused a considerable loss of acreage due to streambank erosion. A recent study by OSU examined streambank erosion in the Barren Fork Creek Watershed and the impact of riparian areas on bank sediment and P loading to streams.

What was done?

Ten streambank sites on the Barren Fork Creek were selected for the study. Seven sites had a protected riparian zone and three were unprotected with no riparian tree coverage. Aerial imagery from 2003, 2008 and 2010 was used to illustrate streambank erosion. Estimated loads of total sediment, total P and water soluble P were then calculated using aerial imagery and vertical and horizontal streambank soil samples.

Results:

Streambank erosion occurred at nearly every site; however erosion was most prevalent at the unprotected sites (Figure 2). Streambank retreat was 3 times lower in riparian protected areas compared to unprotected areas over a 7 year period (2003-2010). Unprotected sites showed significantly higher sediment and total P loading compared to protected sites (Table 1). Since total P is largely sediment bound, it can be subject to streamflow transport and streambank deposition before reaching downstream reservoirs.

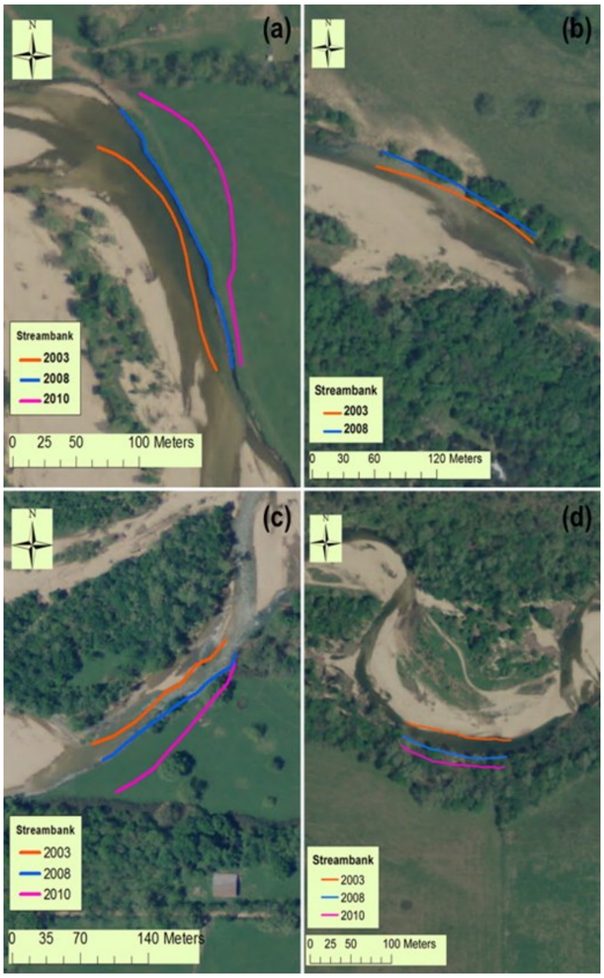


***Figure 2**. Aerial imagery of bank retreat due to streambank erosion in 2003, 2008 and 2010. Images a and c are unprotected sites while images b and d are protected sites. Source: Miller et al. (2014).*

***Table 1**. Average loading of unprotected and protected sites over 7 year period.*

Pollutant	Unprotected site	Protected site	P-value
Sediment loading	15,322 tons	2,535 tons	<0.001
Water soluble P loading	110 lbs	21 lbs	0.117
Total P loading	9,239 lbs	1,499 lbs	0.017

The research team also video surveyed the banks of the Barren Fork Creek throughout the Oklahoma portion of the watershed in a helicopter. The survey estimated the percentage of streambanks that were eroding and failing (Figure 3). On average, 36% of Barren Fork Creek illustrated unstable, failing streambanks. The percentage of streambank failure decreased when going upstream in the watershed from the confluence with the Illinois River towards the Oklahoma/Arkansas state line.

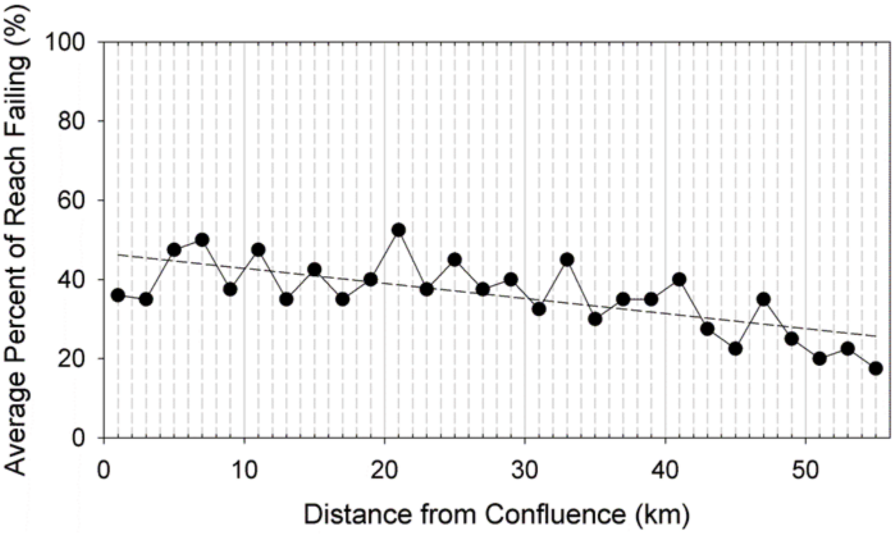
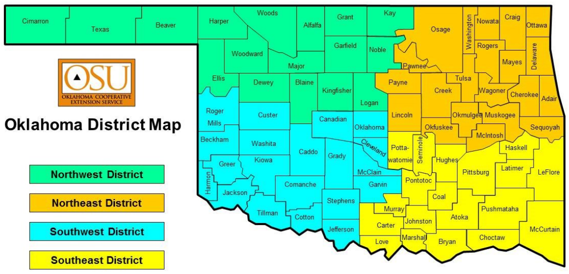


***Figure 3**. Percentage of streambanks eroding and failing in the Barren Fork Creek watershed in Oklahoma from a helicopter video survey. The x-axis is the distance from the confluence with the Illinois River in Oklahoma. Source: Miller et al. (2014).*

Stream banks represented a significant source of sediment and P (10% of the USGS estimated dissolved P load and exceeded the USGS estimated total P load) loading to Barren Fork Creek within the Illinois River Watershed. Sites with an established riparian forest illustrated significantly lower rates of streambank retreat which further justifies the use and management of riparian buffers.

Reference:

Miller, R.B., G.A. Fox, C.J. Penn, S. Wilson, A. Parnell, R.A. Purvis and K. Criswell, 2014.
Estimating sediment and phosphorus loads from streambanks with and without riparian protection. Agriculture, Ecosystems and Environment. 189:70-81.



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Improving Water Quality with Phosphorus Drainage Filters—continued from page 1

Some examples of phosphorus-sorbing materials (PSMs) include acid mine drainage residuals from the coal mining industry, drinking water residuals from municipalities, flu gas de-sulfurization gypsum from the power production industry, and steel slag from steel production. Structures, designed to contain PSMs, can be strategically placed in "hot spots" or drainage ditches where runoff with elevated concentrations of dissolved P is likely. After the PSMs become saturated with P, they can be replaced with new PSMs thereby effectively removing P from the watershed.

To date, P drainage filters have been installed in Oklahoma at a golf course and a poultry farm. The most recently installed filter has a targeted 50% capture rate of the total dissolved P entering the structure per year. Researchers have also developed a user-friendly model to aid in designing filters based on inflow P concentrations, flow volumes, retention time and PSM characteristics.

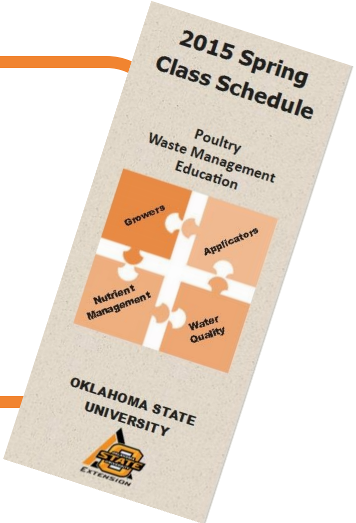
Phosphorus drainage filter installed at a golf course.

Phosphorus drainage filter installed at a poultry farm.

Potential uses include improving stormwater quality for urban development, golf courses, and agriculture. The Natural Resources Conservation Service is currently developing a national standard for this new BMP so that construction of P drainage filters may be cost-shared. For more information, refer to OSU brochure [L-447: Phosphorus Removal Structures](#).

The Oklahoma Cooperative Extension Service proudly continues to provide the state-mandated Poultry Waste Management Education for Oklahoma registered poultry operators and certified poultry waste applicators.

The 2015 Spring Class Schedule is now available on-line at [poultrywaste.okstate.edu](#) or from your local county Extension office.



2015 Spring Class Schedule

Poultry Waste Management Education

Growers

Applicators

Nutrient Management

Water Quality

OKLAHOMA STATE UNIVERSITY

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