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Engineering Success

A newsletter from Biosystems and Ag Engineering Extension

Keeping grain in good condition

By: Carol Jones, Assistant Professor, Stored Products Engineering

Keeping stored grain in the best possible condition requires four steps: proper sanitation of storage facilities, correct loading of the grain into the bins, temperature and moisture management sometimes requiring aeration control, and monitoring the grain in storage.

The object of storing grain is to maintain the grain in the best condition possible until the time is right to move it into a market position. Producers should consider these general tips to improve management of stored grain and oilseeds.

1. Proper sanitation of storage facilities:

• Clean bins and all handling equipment prior to receiving the grain or oilseeds

• Remove all trash, tall grass and weeds, and any leftover grain from both inside and outside the bins

• Seal any cracks, missing bolts, gaps, and other openings not necessary for handling the grain

• Spray with empty bin pesticides

2. Correct loading of the grain into bins:

• Load grain only to the top of the sidewalls, not to the roof of the bin. Headspace is required for proper ventilation and condensation prevention.

• Eliminate peaks in the grain by "coring" the grain. Coring is accomplished by removing grain through the bottom auger to bring the peak of the grain down to the level of the shortest point of the top grain surface. Coring the grain improves the effectiveness of aeration by distributing the air throughout the grain evenly, and it removes the fines that have collected in the middle of the grain bulk. Since insects tend to congregate in the fines, this helps to reduce insect populations and damage.

3. Temperature and moisture management:

• Run aeration fans until the entire grain bulk reaches the outside average daily temperature. In other words, operate fans until the grain can be cooled as much as possible due to the current outside air temperatures. When the temperatures drop in the fall, run the fans again to reduce the grain temperature to below 60 degrees and close to 40 degrees if at all possible. This reduces insect activity and keeps oilseeds from becoming rancid. Never delay the movement of the temperature front through the grain for long periods of time because condensation will form where the front has stalled out in the grain. This causes mold and insect damage buried in the grain that is hard to detect and remediate. It takes approximately 150 hours to move a temperature front through a grain bin if the aeration system is sized for 1/10th of a cfm per bushel (cubic feet per minute). If the aeration system has twice that capacity to move air or 1/5th of a cfm per bushel, it will take half the time or approximately 75 hours.

• Place grain in the bins at recommended moisture contents.

4. Monitor the grain in storage:

• Conditions that you cannot or do not monitor cannot be managed! Remediation of problems is much easier when the problem first begins to form. Therefore, monitoring the following conditions is important to reduce risking the crop.

• Monitor temperature by observing temperature cable readings if available, by probing grain as close to the middle as possible, or by measuring the temperature of the air at the exhaust side of aeration fans. An increase in temperature when the outside air temperature is decreasing is a certain sign of microbial activity, insect activity and spoilage within the bin. The cause of this increase must be found and remedied immediately to prevent further damage to the stored grain or seeds.

• Check for condensation under the roof or down the sidewalls of the bin,

• Check for crusting of the top surface of the grain

• Check for off odors

• Monitor insect traps to identify both populations and types of insects present in the bin

With bin sizes and fluctuations of grain prices ever increasing, proper management of the product in storage is both an economic and a safety requirement. Out of condition grain may cause hazardous working conditions for employees or producers by bridging or by sticking to walls. When workers enter the bin to encourage the product to flow during unloading, entrapment and engulfment can result. Both situations are extremely hazardous.

If producers consider these general tips to improve management of stored grain and oilseeds it will be easier to keep grain in good condition so that entry into the bin is not required.

With proper management, the crop can be maintained close to the condition in which it was placed in the bin, thus providing maximum profit and safe handling conditions. It's certainly worth the effort and investment to save both lives and dollars.

Low impact development for stormwater management and control in Oklahoma

By: Jason Vogel, Extension Stormwater Specialist

Control and management of stormwater volume and water quality is an important concern for the people of Oklahoma.

In 2003, the Oklahoma Department of Environmental Quality adopted "Phase II" stormwater regulations that required smaller cities with "urbanized area" to comply with Phase II stormwater permits.

In Okla., the two Phase I cities (Tulsa and Oklahoma City) each have individual permits, while approximately 45 Phase II areas come under the General Permit (OKR04) Phase II Small Municipal Separate Storm Sewer System.

To meet the Environmental Protection Agency (EPA) requirements these communities, along with the Phase I communities of Oklahoma City and Tulsa, will need to implement stormwater control structures and practices that are practical and sustainable.

A popular and effective approach for stormwater management and control uses the principals of low impact development (LID). LID is the practice of minimizing changes to the hydrologic cycle (runoff and infiltration after a storm) across the landscape during and after development.

LID strategies integrate green space, native landscaping, natural hydrologic functions, and various other techniques to generate less runoff from developed land. However, the implementation of LID into stormwater systems requires institutional knowledge of how to construct and maintain the practices once they are implemented. Additionally, the soils of Okla. introduce unique situations and challenges for the proper selection and implementation of appropriate LID practices for stormwater treatment and control within the landscape.

The low impact development extension and research program at OSU provides information and design aids related to low impact development that will make an impact on stormwater management in Okla.

LID stormwater practices include rainfall harvesting, bioretention cells and rain gardens, stormwater wetlands, pervious pavement, and green roofs. These practices are flexible and can be designed to manage and control stormwater at different scales and for different land uses, including residential, commercial, and industrial.

The Department of Biosystems and Agricultural Engineering (BAE) at Oklahoma State University, in cooperation with the departments of Horticulture and Landscape Architecture, Plant and Soil Sciences, and others, are working to develop research and extension projects that will benefit Oklahomans in each of these LID areas. These practices are flexible and can be designed to manage and control stormwater at different scales and for different land uses, including residential, commercial, and industrial. Further information about each of these LID practices can be found on our website at **lid.okstate.edu**.

Rainwater harvesting

Rainwater harvesting is the practice of capturing stormwater runoff, often from rooftops, and storing the water for later use for such activities as irrigation, livestock watering, flushing toilets, or washing clothes.

Glenn Brown, BAE professor, has helped design a 'sand cistern' for storing and filtering harvested rainfall at two locations in Stillwater, Okla., other rainwater harvesting research projects are being conducted.

We also offered a rainfall harvesting workshop in Oklahoma City in February, and a rainbarrel workshop at the Stillwater Garden Festival in June. Registration is available to attend a rainwater harvesting workshop that will be held at Northwestern Oklahoma State University in Woodward, Okla. on Saturday, Nov. 13.

Bioretention cells and rain gardens

Bioretention cells, sometimes called rain gardens, are essentially excavated areas in the landscape that are filled with compost–amended sorted sand and planted with water– and drought–tolerant plants. These are used to infiltrate, store, and filter stormwater runoff near the location of the rainfall. Bioretention uses the chemical, biological and physical properties of plants, microbes and soils for removal of pollutants from storm water runoff.

Some of the processes that may take place in a bioretention facility include: sedimentation, adsorption, filtration, volatilization, ion exchange, decomposition, phytoremediation, bioremediation, and storage capacity. Bioretention cells can be designed to mimic the pre–existing hydrologic conditions by treating the associated volumes of runoff.

The use of bioretention cells rain gardens in Okla. is slowly increasing, thanks in part to the work of BAE adjunct faculty member Kevin Gustavson, who works from Tulsa, Okla. Brown also has continuous research using fly ash in bioretention cells to remove phosphorus from stormwater runoff. Extension research on design of rain gardens is also in the works, and will probably be offered in 2012.

Stormwater wetlands

Stormwater wetlands are similar to bioretention cells, but with poorer draining sub–soils which causes more ponding and growth of plants capable of flourishing in wet conditions.

Stormwater wetlands are designed for several reasons: improving water quality, improving flood control, enhancing wildlife habitat, and providing education and recreation. The types of pollutants targeted to be removed can influence the design. Stormwater wetlands use several mechanisms to remove pollutants including sedimentation, filtration, adsorption, microbial activity (nitrification and denitrification), and plant uptake.

OSU is designing a research and demonstration wetland that will receive stormwater from one of our research stations as part of the Stream Restoration project on Cow Creek near the Botanical Gardens in Stillwater. Construction on the stream and wetland is expected to begin in November or December. In conjunction with that project, we are planning to offer an extension workshop on 'Techniques for Riparian Wetland Construction'. We will also collaborate with Dan Storm, BAE professor, on an experimental process for adding alum to riparian wetlands for phosphorus removal in streams and rivers.

Pervious pavement

Pervious pavement utilizes pavers, pervious concrete, or pervious asphalt to allow water to infiltrate into the ground rather than running off and washing off pollutants into surface waters. By capturing stormwater and allowing it to seep into the ground, pervious pavement can recharge groundwater, reduce stormwater runoff, and reduce pollutant loading to surface waters.

This pavement technology creates more efficient land use by eliminating the need for retention ponds, swales, and other stormwater management devices. In doing so, pervious pavement has the ability to lower overall project costs on a first–cost basis. During the spring we held a successful workshop reviewing designing pervious concrete. Also, we are working with pervious concrete in a current class project. Look for more pervious pavement training opportunities in the coming months.

Green roofs

Green roofs are vegetated layers that sit on top of the conventional waterproofed roof surfaces of a building. Because of their very wide range of environmental and economic benefits (in particular their insulation and cooling properties, ability to significantly reduce rainwater runoff from roofs, and their value in promoting biodiversity and habitat in built–up areas), green roofs have become important elements of sustainable and green construction in many countries.

Due to high visibility, green roofs clearly signal the intent for sustainable building and can provide a positive and distinctive image to a building or development. Obstacles towards widespread implementation of green roofs in Okla. include plant selection and the structural capacity of current buildings to hold the extra weight associated with a green roof installation.

OSU is currently collaborating with OU to investigate the water budget, energy budget, and plant survival on a green roof project located on the roof of the National Weather Center in Norman, Okla. We are also completing a student project to design a lighter green roof media. Additional research is proposed in cooperation with the OSU horticulture department to investigate sustainable plant types for Oklahoma Green Roofs.

On a personal note, my family and I are enjoying our move to Oklahoma very much and wish to thank everyone for their friendliness and hospitality. If you have questions regarding stormwater issues, please e-mail me at jason.vogel@okstate.edu. For more information regarding low impact development, please visit our website at **lid.okstate.edu**.

Jason Vogel joined the faculty of Biosystems and Agricultural Engineering in December 2009 and is serving as the Extension Stormwater Specialist.

lid.okstate.edu

A study of poultry litter runoff after rainfall and *E. coli* considerations

By: Josh Payne, Area Animal Waste Management Specialist

Poultry litter is recognized as an excellent source of the plant nutrients nitrogen, phosphorus and potassium. In addition, litter returns organic matter and other nutrients such as calcium, magnesium and sulphur to the soil, building soil fertility and quality.

Questions exist concerning *E. coli* contamination of waterways following manure land application events. To address these questions, Josh Payne, area animal waste management specialist; Garey Fox, associate professor; and Jorge Guzman, graduate student, all with the Department of Biosystems and Agricultural Engineering; conducted a field study evaluating surface runoff transport of *E. coli* following poultry litter application to pastureland.

The experimental design of this study included pasture plots established at the Eastern Oklahoma Research Station in Haskell, Okla. These plots consisted of ryegrass, fescue grass, bermudagrass and some johnsongrass.

Variables for this study were that cattle had not been allowed access to the pasture for more than one year and poultry litter had previously been applied one year prior to the study.

Broiler litter was applied to 14 plots at a rate of 2.2 tons per acre. Two control plots received no litter application.

An artificial rainfall simulator was used to produce 2–year and 5–year storm events. Rainfall was applied at 0 hours, 24 hours and 120 hours after litter application. Surface runoff was collected using a flume installed in a trench (Figure 1). Water samples were tested for *E. coli* populations.

Results of this study showed that *E. coli* event mean concentrations (EMC) in sampled runoff decreased at 24 hours and 120 hours when compared to 0 hours after litter application (Table 1). However, a slight increase in populations was observed at 120 hours as compared to 24 hours. This slight growth may have been due to litter in contact with the soil surface and protected from ultraviolet light and moisture loss by vegetative cover.

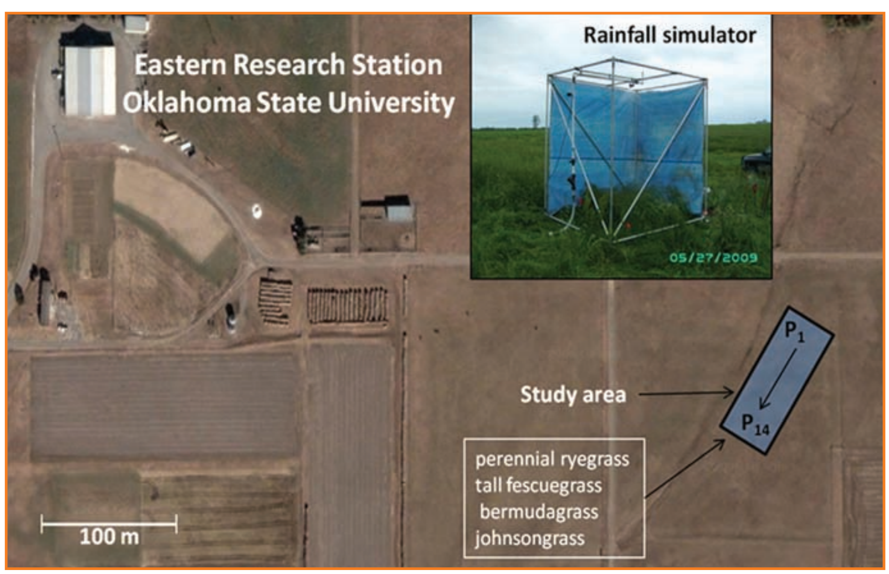
In control plots, *E. coli* was always detected, indicating other sources of *E. coli* aside from poultry litter. In fact, average EMCs from the control and treated plots were not significantly different. This was perhaps the result of the limited number of control experiments. Other sources may include rodents, birds, and other small mammals.

In conclusion poultry litter applications may contribute to runoff of *E. coli* when rainfall events occur shortly after litter application. However, other sources of fecal contamination may serve as a significant component of the total *E. coli* EMC, especially as the time lag between litter application and rainfall event increases. The implications of this study may affect poultry litter application timing decisions based on predicted rainfall events.

continued on page 3

Pictures at left: Illustration of vegetation, rain gauge, and borders of one of the plots and the outflow flume and flow collection device at the downslope end of the plot.

Picture below: Aerial image of the Oklahoma State University Eastern Research Station in Haskell, Oklahoma, including the study area location of the plots and the rainfall simulator used for the 2-year and 5-year rainfall intensities.



A study of poultry litter runoff after rainfall and *E. coli* considerations, *continued*

Table 1. *E. coli* event mean concentration (EMC, MPN/100 mL)

	Control	0 hours	24 hours	120 hours
Average EMC	6.8×10^{3}	1.6×10^{5}	1.3×10^{4}	4.3×10^{4}
Maximum EMC	7.7×10^{3}	2.2×10^{5}	2.6×10^{4}	6.2×10^{4}
Minimum EMC	5.5×10^{3}	5.0×10^{4}	7.1×10^{3}	1.9×10^{4}
	P-Values from ANOVA Test on Average EMCs (95% CL)			
0 hours	0.053		0.008	0.024
24 hours	0.412	0.008		0.026
120 hours	0.058	0.024	0.026	

References:
Guzman, J. A., G. A. Fox and J. B. Payne, 2010. Surface runoff transport of *Escherichia coli* after poultry litter application on pastureland. Trans. ASABE. 53(3):779-886.

OK-FIRE training sessions

By: J.D. Carlson, Associate Researcher

A number of OK-FIRE training opportunities will take place this fall. Developed by Carlson and others at OSU in conjunction with the Oklahoma Mesonet, OK-FIRE is a weather-based decision-support system for wildland fire managers in Oklahoma. OK-FIRE is useful for both wildfires and prescribed fire.

The benefits of using OK-FIRE include better anticipation of wildfire conditions, guidance for optimal staff levels, and tracking existing and forecast weather and fire danger conditions during the wildfire itself, leading to better suppression strategies. In addition, OK-FIRE can provide guidance to counties in their burn ban decisions. OK-FIRE also is important for those who do prescribed burning as it can help in the planning and monitoring of conditions during the burn.

All sessions this fall will be half-day workshops in a computer lab setting in which participants will have hands-on computer experience with the OK-FIRE website. The beginning class is geared toward those who are new to OK-FIRE and will provide a general overview, including weather, fire, and smoke sections of the website and the fire prescription planner. For the first time, an advanced class is available for those who have already attended an OK-FIRE workshop. This class will concentrate on topics related to the fire danger model, including details of its operation, the importance of satellite-measured vegetation greenness, fuel moisture, and the role of fuel models.

To register for a workshop, please contact Melissa Moore at 405-744-5431, or by e-mail at melissa.s.moore@okstate.edu. There is no fee to attend; however, workshops will be filled on a first registered, first served basis.

Additional information can be found at **http://okfire.mesonet.org** or by contacting J.D. Carlson, OK-FIRE Coordinator at 405-744-6353, or e-mail at jdc@okstate.edu.

Sessions this fall will take place:

Oct. 27, **ALTUS**, beginning class, morning; advanced class, afternoon
Oct. 29, **SAYRE**, beginning class, morning; advanced class, afternoon
Nov. 3, **DUNCAN**, beginning class, morning; advanced class, afternoon
Nov. 4, **SULPHUR**, beginning class, afternoon
Nov. 5, **SULPHUR**, advanced class, morning
Nov. 10, **WOODWARD**, beginning class, morning; advanced class, afternoon
Nov. 11, **ALVA**, beginning class, afternoon
Nov. 23, **EL RENO**, beginning class, morning; advanced class, afternoon
Dec. 1, **McALESTER**, beginning class, morning; advanced class, afternoon
Dec. 2, **ANTLERS**, beginning class, afternoon
Dec. 3, **ANTLERS**, advanced class, morning
Dec. 8, **JENKS**, beginning class, morning; advanced class, afternoon
Dec. 9, **SALLISAW**, beginning class, afternoon
Dec. 14, **ENID**, beginning class, morning; advanced class, afternoon
Dec. 16, **STILLWATER**, beginning class, morning; advanced class, afternoon

http://okfire.mesonet.org

Extension Water Programming

The retirements of Mike Kizer and Mike Smolen has left a gap in the extension water programming efforts in the Department of Biosystems and Agricultural Engineering. For the time being, we do not have anyone working in the water quality and drinking water areas.

We currently have one extension faculty member, Jason Vogel, working in a water related field. His area of expertise is low impact development and storm water management. Though Vogel can provide some assistance or can direct you to a specialist in another state, he cannot cover the areas vacated by Kizer and Smolen. Please be patient as we move forward. We believe these are important areas and will hopefully have someone to cover this material in the future.

Subscription request

To receive a copy of the Engineering Success: A newsletter from OSU Biosystems and Ag Engineering Extension, e-mail Randy Taylor at randy.taylor@okstate.edu with **BAE Newsletter** in the subject line.

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