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Publication list for Manure Management

Publications and abstracts are listed in reverse chronological order. A limited number of reprints are available, and can be requested by referring to the NAEW number. Use your browser's "find" feature to search for words of interest. For more information, please contact:

Martin J. Shipitalo
Research Soil Scientist
N. Appalachian Experimental Watershed
PO Box 488
Coshocton, Ohio 43812
USA

email: martin.shipitalo@ars.usda.gov
phone: 740-545-6349
fax: 740-545-5125

Owens, L.B., Bonta, J.V., Shipitalo, M.J., Rogers, S. 2011. Effects of Winter Manure Application in Ohio on the Quality of Surface Runoff. Journal of Environmental Quality. 40(1):153-165. **(NAEW #469)**

Abstract:

Winter application of manure poses environmental risks. Six continuous corn, instrumented watersheds (approximately 1 ha each) at the USDA-ARS North Appalachian Experimental Watershed research station near Coshocton, Ohio were used to evaluate environmental impacts of applying manure to frozen soil. For 3 years on frozen, sometimes snow-covered, ground in January or February, two watersheds received turkey litter; two watersheds received liquid swine manure; and two watersheds were controls (received N fertilizer at planting, not manure). Manure was applied at an N rate for corn; the target level was 180 kg N ha-1. There was a 30m setback from the area of application to the bottom of each watershed. In addition, four grassed plots (61 x 12m) were used for beef slurry applications (9.1 Mg ha-1 wet weight); 2 plots had 61 x 12m grassed filter areas below them; 2 plots had 31 x 12m filter areas. There were 2 control plots, one for each of the 2 filter sizes. Ohio NRCS recommends a 61m buffer area for winter manure applications along with slope and vegetative cover recommendations. "Dustpan" runoff samplers were placed at the lower edge of each plot application area and 11m downslope; runoff was collected at the base of each filter area. Nutrient concentrations can be high, especially in runoff soon after application. However, most events with high concentrations occurred with low flow volumes, and therefore transport was minimal. During the first 2 years, runoff was above average and nutrient transport was elevated as a result. Because of manure composition, applying manure at the N rate for crop needs resulted in application of P in excess of crop needs. Elevated P losses contributed to a greater potential of detrimental environmental impacts with P than with N. Filter strips reduced nutrient concentrations and transport, but the data were too limited to compare the effectiveness

of the 30m and 61m filter strips. Winter application of manure is not ideal, but by following prescribed guidelines, detrimental environmental impacts can be reduced.

Ramirez, N., Wang, P., Lejeune, J., Shipitalo, M.J., Ward, L., Sreevatsan, S., Dick, W. 2009. Effect of Tillage and Rainfall on Transport of Manure-Applied Cryptosporidium Parvum Oocysts through Soil. Journal of Environmental Quality. 38(6):2394-2401. **(NAEW #462)**

Abstract:

Most waterborne outbreaks of cryptosporidiosis have been attributed to agricultural sources due to the high prevalence of Cryptosporidium oocysts in animal wastes and the practice of spreading manure on farmlands. No-till is an effective soil conservation practice, but it often results in soil having higher water infiltration and percolation rates than conventional tilled soil that may facilitate the transfer of pathogens to groundwater and subsurface drainage systems. Therefore, we treated six undisturbed no-till and six tilled surface soil blocks (30 by 30 by 30 cm) with liquid dairy manure containing C. parvum oocysts to test the effect of tillage and rainfall on oocyst transport. Two, 4, 24, or 48 hours after manure application the blocks were subjected to simulated rainfall consisting of heavy (30 mm in 30 min) or light rainfall (5 mm in 30 min). Leachate was collected from the base of the blocks in 35 mL increments using a 64-cell grid lysimeter. After percolation ceased the blocks were sectioned into eight, 3.75-cm-thick horizontal slabs. The leachate and soil samples were subjected to oocyst detection and enumeration. Simulated rainfall applied 2 hours after manure addition increased oocyst transport up to 85-fold through no-till compared to tilled soil blocks while oocyst retention in the soil was up to 21-fold higher in tilled blocks. Oocysts transport was greatly reduced when rainfall occurred 48 hours after manure application. This suggests soil tillage, and rainfall timing and intensity, affect transport of C. parvum oocysts through the soil. To minimize transport of Cryptosporidium in manure applied to no-till fields, manure should be applied at least 48 hours before heavy rainfall is anticipated or methods of disrupting the direct linkage of surface soil to the drains via macropores need to be used.

Hoorman, J.J. and M.J. Shipitalo. 2006. Subsurface drainage and liquid manure. Journal of Soil and Water Conservation 61(3):94A-97A. (Available in PDF file.) **(NAEW #431)**

Abstract:

Although land application of liquid animal wastes is a widely used BMP, in fields with subsurface drainage it can result in rapid movement to drains and offsite. In the 4 year period, 2000 to 2003, ninety eight incidents where agricultural wastes in drainage waters contaminated streams were recorded by authorities in Ohio. We investigated these reports to determine the factors that contributed to these incidents and to determine possible management options for reducing their occurrence. Violations occurred most frequently with liquid swine or dairy wastes and occurred with all methods of application irrigation, surface spreading, and subsurface injection. In most instances multiple factors contributed to each incident. The factor most commonly cited (41 cases) was application to saturated soils or heavy rainfall after application. Thus, avoiding these conditions should reduce the number and severity of incidents. While

disruption of soil macropores with tillage may reduce movement of wastes to drains, 17% of the incidents occurred on soils that were tilled or wastes were incorporated. Drain line plugs failed 50% of the time they were used.

Shipitalo, M.J. and F. Gibbs. 2005. Preferential flow of liquid manure in macropores and cracks. ASAE Annual International Meeting, July 17-20, 2005, Tampa, FL. Paper No. 052063. Available in PDF file. **(NAEW #424)**

Abstract:

Substitution of conservation tillage for conventional tillage practices can greatly decrease runoff and losses of soil and agrochemicals in overland flow, but enhanced infiltration increases the potential for ground water contamination. Earthworm populations also frequently increase with a reduction in tillage intensity, which suggests that their effects on soil structure and porosity may contribute to the decrease in runoff. In particular, the size and number of Lumbricus terrestris (L.) burrows suggest that they may have a major impact on hydrology. Field research indicates that the amount of rainfall transmitted by L. terrestris burrows increases with storm intensity and is as much as 10% of total rainfall. Laboratory studies indicate that if a heavy, intense storm occurs shortly after surface application of agrochemicals, the water transmitted to the subsoil by earthworm burrows may contain significant amounts of applied chemical, up to a few percent, regardless of the affinity of the chemical for the soil. Transport can be reduced by an order of magnitude or more with the passage of time or if light rainstorms precede the first major leaching event. Because of movement into the soil matrix and sorption, solutes normally strongly adsorbed should only be subject to significant transport in earthworm burrows and other macropores in the first few storms after application. In the case of fields with subsurface drainage, however, close association of earthworm burrows to the drains may substantially increase the risk of surface water contamination by surface-applied agrochemicals and injected animal wastes. Likewise, earthworm burrows may connect to subsoil fractures and contribute to rapid water and chemical movement to drains and ground water.

Hoorman, J.J., J.N. Rausch, T.M. Harrigan, W.G. Bickert, M.J. Shipitalo, M.J. Monnin, S.R. Reamer, F.E. Gibbs, M.I. Gangwar, H. Keener, and L.C. Brown. 2005. Research, educational, and technical assistance priorities for liquid manure application in the Midwest. ASAE Annual International Meeting, July 17-20, 2005, Tampa, FL. Paper No. 052062. Available in PDF file. **(NAEW #423)**

Abstract:

A workshop on Liquid Animal Manure Application on Drained Cropland: Preferential Flow Issues and Concerns (Columbus, Ohio; November, 2004) was conducted to prioritize extension and research activities in the Midwest. Seven extension priorities were identified: 1) Integrate simple manure application rules into the whole farm plan. 2) Required certification and continuing education credits for manure applicators. 3) Develop web-based fact sheets, video clips, and photos and use demonstrations to educate livestock producers on preferential flow issues. 4) Promote partnerships with agencies, industry, producers, and universities. 5) Develop educational programs for agency personnel on preferential flow issues related to manure application. 6) Develop computer programs to apply manure at a safe application rate. 7) Integrate manure

management for liquid manure application into other programs. The top 17 research ideas were identified as well: 1) Pathogen transport and fate rated the highest. 2) Research soil types, water holding capacity, and preferential flow characteristics of soil. 3) Research manure characteristics. 4) Study application methods, application equipment and tillage methods. 5) Develop liquid manure testing methods, sensors, quick tests, and cost effectiveness of testing parameters. 6) Correlate factors from past manure violations cases into a national database. Other research priorities looked at developing alternative technology, adding value to the manure, research on precision application and variable rate technology, researching socio-economic data, water table control structures, water columns studies related to groundwater, storage/handling/application options, fate of liquid manure in agricultural subsurface drains, and developing parameters for manure characteristics.

Rausch, J.N., J.J. Hoorman, T.M. Harrigan, W.G. Bickert, M.J. Shipitalo, M.J. Monnin, S.R. Reamer, F.E. Gibbs, M.I. Gangwar, H. Keener, and L.C. Brown. 2005. Overview of guidelines for liquid manure application on drained cropland in the Midwest. ASAE Annual International Meeting, July 17-20, 2005, Tampa, FL. Paper No. 052061. Available in PDF file. **(NAEW #422)**

Abstract:

The movement of manure to surface water from artificially drained cropland is a concern. A Liquid Animal Manure Application on Drained Cropland: Preferential Flow Issues and Concerns Workshop was held in Columbus, Ohio (November, 2004). The objectives of this workshop were: (1) integrate state guidelines and recommendations for mitigating liquid manure discharges from artificially drained cropland; (2) identify and prioritize extension and outreach needs related to manure application and pollution of water resources; (3) identify and prioritize research needs related to the downward movement of animal manure on artificially drained cropland. Regional guidelines for drained fields include monitoring outlets/inlets; matching manure application rates with soil infiltration rates, water-holding capacity of the soil, and crop/soil nutrient needs; and not applying manure when subsurface drains are flowing. Avoid applying manure to flood prone fields, adjust application rates to environmental conditions and ability of the soil to store and utilize manure nutrients (based on nitrogen and phosphorous), and apply manure at a uniform rate and volume to avoid ponding and manure runoff. Extension activities include developing simple rules for manure application and management; requiring producer certification/education for manure application; developing web based fact sheets, video clips, photographs and demonstrations for preventing manure runoff; promoting partnerships with agencies and animal industry; and educating agency personnel on manure runoff issues. Research needs are summarized in a companion paper in this session. Research is needed on pathogen transport and fate; soil preferential flow characteristics; evaluating manure management and equipment application; total manure characteristics (solids content, viscosity, nutrients, pathogens, color); and developing liquid manure testing methods, quick tests, and sensors.

Hoorman, James J., Jonathan N. Rausch, and Martin J. Shipitalo. 2005. Ohio livestock manure violations. ASAE Annual International Meeting, July 17-20, 2005, Tampa, FL. Paper No. 052060. Available in PDF file. **(NAEW #418)**

Abstract:

Land application of liquid manure and agricultural wastes to agricultural land is a widely used BMP, however application to crop fields with subsurface drainage may result in rapid movement to the drains and surface water. In the 4-year period, 2000 to 2003, ninety-eight Ohio incidents were recorded where manure wastes flowed through agricultural subsurface drains (tile drains) to contaminate streams. We investigated these reports to determine the factors that contributed to these violations. Violations occurred most frequently with land application of liquid swine or dairy manure wastes. Deep cracks in the soil, old root channels, earthworm burrows, and loamy soils promoted preferential flow of manure to drain lines and to surface waters. Violations occurred with all methods of application – irrigation, surface spreading, and subsurface injection. Multiple factors contributed to most incidents. Farm operators accounted for 63 manure violations and custom applicators one-fourth (26). Most operators did not have approved manure management plans (58 operations). Twenty-eight (72%) of the 39 operations that had a manure management plan did not follow their plans. Saturated soils or heavy rainfall (41 cases) was the most common factor cited. Lack of manure storage management, over application, equipment failures, and broken/shallow tile were other major factors identified. Avoiding these conditions should reduce the number and severity of incidents. Tillage may reduce movement of liquid manure contamination to subsurface drains by disrupting soil macropores, but 17% of the incidents occurred on soils that were tilled. The lack of proper manure application was a key factor in most manure violations.