Mitigation of Nutrient and Pesticide Loss with Runoff from Fairway Turf

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Water quality surveys have detected excess nutrients and numerous pesticides in surface waters of rural and urban areas. The off-site transport of these chemicals are both an agronomic and environmental concern resulting in reduced efficacy in the area of application and contamination of non-target surrounding ecosystems. The use of fertilizers and pesticides in highly managed turf systems has raised questions concerning their impact on the quality of water resources and the contribution of managed turf systems to surface water contamination. To address these questions we designed and implemented experiments that would measure the quantity of fertilizers and pesticides transported with runoff from fairway turf, and evaluate the ability of turf management practices to reduce the transport of applied chemicals with runoff.

Both chemical application strategies and cultural practices were evaluated. Our overall goal is to identify management practices that maximize fertilizer and pesticide retention at the site of application, thereby improving desired results of turf maintenance and pest control while minimizing environmental impacts.

Chemical application strategies: Potassium bromide (KBr) and fluorobenzoic acids (FBAs), traditional and alternative conservative-tracers, have been utilized as valuable hydrologic tools for characterizing water movement through soil. We applied three FBAs and KBr to selected areas of turf plots, representing a bentgrass fairway, to evaluate water movement and the influence of location of chemical application to their transport with surface runoff. Within 24 hours of the tracer application, precipitation was generated with a rainfall simulator and runoff samples were collected. A portion of each runoff sample was analyzed for bromide ion using an ion-selective electrode and double-junction reference electrode. The remaining sample was filtered, acidified and analyzed via liquid chromatography-mass spectrometry for the three FBAs. Co-application of FBAs and KBr demonstrated these alternative and traditional hydrologic tracers have similar transport patterns and they can be utilized in differential application studies to characterize chemical transport with water movement. Use of conservative water-soluble tracers represents a worst-case scenario for off-site movement of fertilizer and pesticides. Selective application of multiple FBAs enable identification of areas of high impact that contribute the most to chemical transport with runoff. This data can be utilized in model simulations to assess potential environmental impacts as well as provide information to determine chemical application strategies to reduce off-site transport of applied compounds.

Rainfall simulation and runoff collection

Aeration of the turf plots

Cultural practices: Turf plots were managed as a golf course fairway (1.25 cm height of cut) following a standardized protocol for fertilizer and pesticide application, simulated precipitation and collection of runoff and turf/soil samples. Half of the plots received solid-tine aeration while the remaining plots were managed with hollow-tine aeration. Fertilizer (18-3-18 [N, P2O5, K2O]) and a commonly utilized herbicide (2,4-D), insecticide (chlorpyrifos), and fungicide (flutolanil) were applied to each plot to evaluate their tranport with runoff. Forty-eight hours prior to pesticide application each plot was pre-wet to saturation to ensure uniform water distribution. Pesticides, fertilizer and a conservative tracer (KBr) were each applied to the turf 24 hours prior to the intiation of the simulated precipitation. Replicate samples of surface runoff water and turf/soil cores were collected for analysis to determine levels of fertilizer and pesticides removed from the site of application with runoff water or leaching to the underlying soil. Rainfall simulations and collection of resulting runoff were completed two days and 63 days following aeration (2d, 63d). Preliminary results for fertilizer transport show reduced runoff volume (2d, 63d), nitrogen loss (2d) and phosphorus loss (2d, 63d) with hollow-tine aeration relative to solid-tine aeration. Completion of pesticide analysis and statistical analysis of fertilizer and pesticide data will determine the statistical relevance of the initial observed trends.

Identifying practices that reduce off-site transport of applied chemicals will increase fertilizer and pesticide efficacy at the intended sites of application and will also minimize their potential adverse impacts to the surrounding surface water resources. Results of this research will provide information that will allow for informed decisions on best management practices that are both environmentally responsible and provide quality turf.