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Comparison of Water Quantity and Quality Between Subsurface Tile and Edge-of-Field Runoff From a Wisconsin Agricultural Landscape

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Abstract Text:

Three years (Nov. 04 – Oct. 07) of discharge and water-quality data were collected from two subsurface tile and surface-water sites within two small (13.2 and 20.5 acres) basins on a private Wisconsin dairy. Discharge was monitored continuously and composite water samples for rainfall and snowmelt-induced runoff events were collected and analyzed for nutrients (nitrogen and phosphorus) and sediment.

Results from this study indicate that tile lines flowed for most of the study period including the time of year when the ground was frozen (~50%). Tile runoff ranged from 5 – 40% of the annual precipitation and was equal to 2 – 10 inches of the annual precipitation. Over the three year study, tiles flowed for 138 to 337 days depending on precipitation.

Tile flow amounting to 85% of annual runoff from each basin included 14-32% of sediment losses and 45% of total phosphorus losses which ranged from 0.3 – 1.3 pounds per acre with dissolved phosphorus comprising 45-67% of the total. Tile flow included up to 90% of the annual total nitrogen loss, with individual field losses of nitrogen through the tiles ranging from 3 – 98 pounds per acre. In year one, nitrate made up 20-58% of the total nitrogen losses, while in year two, nitrate contributions increased to over 95%.

High nitrogen losses were on first year corn following alfalfa which was either sprayed in the fall or winter killed. A dry growing season which included liquid manure applications in spring and fall followed by a wet late fall period are believed to be the reason for the high nutrient loads. Nutrients were retained in the medium to fine textured subsoils until sufficient soil water was available to move them through to the tile lines.

Impact Statement:

Before this work was conducted, tile flow was thought to have little impact on water quality in Wisconsin. Through these studies we have identified that water quality in the eastern third of this state can be significantly impacted by tile drainage. This work is currently being used to better understand the relationship between nutrient and sediment losses from surface drainage systems compared to tile drainage systems. This data has been used to develop education and training programs for producers, consultants and agency personnel throughout the state.