

ABSTRACT

Ahiablame, Laurent Mensah. M.S.A.B.E., Purdue University, May 2009. Nutrient Attenuation under Natural Conditions in Agricultural Drainage Ditches. Major Professor: Indrajeet Chaubey, Douglas R. Smith, and Bernie Engel.

Even though multiple studies have quantified various processes controlling nutrient transport in natural streams, little consideration has been given to nutrient transport processes in agricultural drainage ditches. The objectives of this study were to: (1) examine patterns in ambient nutrient concentrations and nutrient spiraling in drained water during flow events, (2) evaluate spatial and seasonal variations in sediment-nutrient interactions in drainage ditches, and (3) characterize the magnitude and transport of tile added-nutrients and their retention in the drainage ditches. In this study water and sediment samples were collected in J.B. Foltz ditch (Reynolds, Indiana), Box ditch and Marshall ditch (West Lafayette, Indiana). Ditch water was collected and analyzed for soluble phosphorus (SP), total phosphorus (TP), ammonia ($\text{NH}_3\text{-N}$), nitrate ($\text{NO}_3\text{-N}$), and total nitrogen (TN). Sediments were collected and extracted to determine equilibrium phosphorus concentration (EPC_0), exchangeable phosphorus (Ex-P), phosphorus sorption index (PSI), and exchangeable nitrogen (Ex-N). Effects of tile effluent on nutrient concentrations and transport in these ecosystems were also evaluated using both datasets.

The water quality constituent concentrations during various flow regimes did not indicate any longitudinal pattern in nutrient concentrations. $\text{NO}_3\text{-N}$ and SP concentrations in the ditches were high and comparable to $\text{NO}_3\text{-N}$ and SP concentrations in previous studies in the Midwest. Comparisons between measured nutrient concentrations in tile effluent and ditch water resulted in high SP, TP and $\text{NH}_3\text{-N}$ concentrations in the ditch water, whereas $\text{NO}_3\text{-N}$ concentrations were higher in tile effluent. Uptake lengths were long indicating that nutrients were generally not assimilated as efficiently as by natural streams. Even though little uptake of nutrients was evident in these ditches, relatively greater amounts of $\text{NH}_3\text{-N}$ were retained followed by SP and $\text{NO}_3\text{-N}$, respectively. EPC_0 measurements indicated that sediments acted as temporary sinks or sources for P. Mean Ex-P was generally high during Oct-Dec at all three sites but higher in Box ditch than in the other two ditches. PSI and Ex-N were higher in J.B. Foltz ditch than in the other two ditches. Sediments in tile-fed drainage ditches did not appear to be sensitive to inputs from tile drains. Results indicated that the study reaches were very dynamic showing periodical increases or decreases in nutrient concentrations. The drainage ditches were nutrient-rich streams that may influence the quality of downstream waters.