ABSTRACT

Zuercher, Benjamin W. M.S., Purdue University, December, 2007. Application and Evaluation of the AnnAGNPS Model for Atrazine Prediction in the Cedar Creek Watershed. Major Professors: Dennis C. Flanagan and Jane R. Frankenberger.

The transportation of non-point source pollutants such as pesticides to public drinking water sources involves complex hydrologic processes that take place in the contributing watersheds. Mathematical models combined with Geographic Information Systems provide a means of simulating the complex processes that affect hydrology and pesticide loss. This study was designed to test the Annualized Agricultural Non-point Source Pollution (AnnAGNPS) model's applicability and effectiveness in predicting stream discharge and atrazine loss, simulating the effects of no-till and conventional tillage, scaling to larger and smaller areas in the Cedar Creek Watershed and its Matson Ditch Subcatchment (MDS).

AnnAGNPS was calibrated to predict the monthly average stream discharge in the 707 km² Cedar Creek subwatershed of the St. Joseph River watershed and the 45 km² Matson Ditch sub-catchment (MDS) of the Cedar Creek Watershed (CCW) in northeast Indiana. Validation of AnnAGNPS for stream discharge prediction was conducted in the CCW but not in the MDS. The results showed that AnnAGNPS calibrated to the CCW and MDS produced satisfactory predictions of stream discharge.

The AnnAGNPS model calibrated to stream discharge in the MDS was also calibrated and validated to the monthly mean atrazine concentration. Calibration of AnnAGNPS for atrazine prediction was only possible after correcting the model's source code. Calibration and validation results were good for the prediction of pesticide concentration.

Prediction simulations were performed with AnnAGNPS to assess the hydrologic and pesticide loss effects of the current tillage rotation, no-till, and conventional tillage in both the CCW and MDS. Simulations in the CCW showed only slight differences between the tillage managements. In the MDS there was a subtle reduction in stream discharge from no-till management in post harvest and pre-plant conditions. A noticeable reduction in atrazine concentrations was shown for the current practice. However, due to AnnAGNPS limitations it was likely the result of an increased amount of runoff from the current practice carrying a mass of atrazine similar to the conventional and no-tillage managements.

This study also assessed the scalability of AnnAGNPS by applying the model calibrated to the CCW to the MDS and the model calibrated to the MDS to the CCW. The model calibrated to the CCW and applied to the MDS indicated that the CCW calibrated model had the potential to predict the observed MDS stream discharge if a larger amount of observed stream discharge data were available. AnnAGNPS calibrated to MDS and applied to the CCW overpredicted

stream discharge to the point that it showed little upward scaling potential. Atrazine prediction results from the model calibrated to the MDS and scaled to the CCW appeared to have potential. However, it is unlikely that the model can adequately predict atrazine concentrations since the stream discharge was poorly predicted at the larger scale.