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Use of a Metolachlor Metabolite (MESA) to Assess Agricultural Nitrate-N Fate and Transport in Choptank River Watershed, Maryland USA

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A majority of streams in the Chesapeake Bay watershed have been rated as poor or very poor based on biological assessments. The Choptank River estuary, a Bay tributary on the eastern shore, is an example, where crop production in upland areas of the watershed contribute significant loads of nutrients to streams. We used a novel approach based on the relationship between the concentration of nitrate-N and the stable, water-soluble herbicide degradation product MESA {2-[2-ethyl-N-(1-methoxypropan-2-yl) -6-methylanilino]-2-oxoethanesulfonic acid} to distinguish between dilution and denitrification effects on the stream concentration of nitrate-N in agricultural subwatersheds. The ratio of mean nitrate-N concentration/(mean MESA concentration * 1000) for 15 subwatersheds was examined as a function of percent cropland on hydric soil. The observed inverse relationship ($R2 = 0.65$, $p < 0.001$) accounts for not only dilution and denitrification of nitrate-N, but also the stream sampling bias of the croplands caused by extensive drainage ditch networks. MESA was also used to track nitrate-N fate within the estuary of the Choptank River. The relationship between nitrate-N and MESA concentrations in samples collected over three years was linear ($0.95 \leq R2 \leq 0.99$) for all eight sampling dates except one where $R2 = 0.90$. This very strong correlation indicates that nitrate-N was conserved in much of the Choptank River estuary, that dilution alone is responsible for the changes in nitrate-N and MESA concentrations, and more importantly nitrate-N loads are not reduced in the estuary prior to entering the Chesapeake Bay.