Simulation of Antimicrobial Resistance Gene Fate in Narrow Grass Hedges

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Abstract : Vegetative Filter Strips (VFS) are used for controlling the volume of runoff and decreasing contaminant concentrations in runoff before entering water bodies. Many studies have investigated the role of VFS in sediment and nutrient removal, but little is known about their efficiency for the removal of emerging contaminants such as antimicrobial resistance genes (ARGs). Vegetative Filter Strip Modeling System (VFSMOD) was used to simulate the efficiency of VFS in this regard. Several studies demonstrated the ability of VFSMOD to predict reductions in runoff volume and sediment concentration moving through the filters. The objectives of this study were to calibrate the VFSMOD with experimental data and assess the efficiency of the model in simulating the filter behavior in removing ARGs (ermB) and tylosin. The experimental data were obtained from a prior study conducted at the University of Nebraska (UNL) Rogers Memorial Farm. Three treatment factors were tested in the experiments, including manure amendment, narrow grass hedges and rainfall events. Sediment Delivery Ratio (SDR) was defined as the filter efficiency and the related experimental and model values were compared to each other. The VFS Model generally agreed with the experimental results and as a result, the model was used for predicting filter efficiencies when the runoff data are not available. Narrow Grass Hedges (NGH) were shown to be effective in reducing tylosin and ARGs concentration. The simulation showed that the filter efficiency in removing ARGs is different for different soil types and filter lengths. There is an optimum length for the filter strip that produces minimum runoff volume. Based on the model results increasing the length of the filter by 1-meter leads to higher efficiency but widening beyond that decreases the efficiency. The VFSMOD, which was proved to work well in estimation of VFS trapping efficiency, showed confirming results for ARG removal.

Keywords : antimicrobial resistance genes, emerging contaminants, narrow grass hedges, vegetative filter strips, vegetative filter strip modeling system