Public Abstract
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Title:DELINEATION OF CRITICAL MANAGEMENT AREAS AT PLOT, FIELD, AND WATERSHED SCALES FOR CLAYPAN SOILS

The claypan soil region of Missouri has a high runoff potential that increases the possibility of transport of non-point source pollutants (NPS) to downstream sites. The present study was undertaken to better understand the impact of land use management on soil hydraulic properties and their impact on hydrology, and generation and transport of non-point source pollutants from claypan soils. A simple strategy was developed to identify critical management areas (CMAs) and target them for placement of best management practices (BMPs) for maximum reduction of runoff and NPS.
Soil hydraulic properties were measured in claypan soils with the hypothesis that hydraulic properties for claypan soils can be significantly affected by long-term soil and crop management. Sampling was conducted from two fields of Mexico silt loam. One field has been under continuous row crop cultivation for over 100 years, while the other field was a native prairie that has never been tilled, Tucker Prairie. Significant differences in soil hydraulic properties were found, the mean value of soil permeability was 57 times higher in the native prairie site than in the cropped field in the upper soil horizon. The bulk density of the surface layer at the prairie site was two-thirds of the value at the cultivated site and was significantly different throughout the soil profile. Subsequently, a model simulation study was conducted to estimate the impact of long-term agriculture on surface runoff, sediment transport and atrazine herbicide transport as well as corn and soybean yields. A calibrated and validated APEX (Agricultural Policy Environmental eXtender) model for the 80 acre field was utilized to simulate the impact of long-term agriculture on selected model outputs. The APEX model was run for thirty years (1978 to 2007) for pre- and post-cultivation scenarios with a corn-soybean crop rotation and mulch tillage management. There was a significant increase in annual atrazine herbicide transport (82%), and significant reductions in corn (39%) and soybean (75%) yields for the post-cultivation scenario. These results show that improvement of soil properties from permanent vegetation on agricultural lands would be beneficial not only enhancing crop yields but also reducing non-point source pollutants.
The second portion of the study was conducted on a plot scale to identify CMAs and inherent soil and topographic parameters responsible for NPS generation and transport using the APEX simulation model. Claypan surface saturated hydraulic conductivity (Ksat), depth to claypan (CD), and average surface slope (SL) were major parameters impacting runoff and NPS generation and transport. Two indices using these soil and topographic parameters were developed, the Conductivity Claypan Index (CCI; CD*Ksat /SL), and the Claypan Index (CPI; CD/SL). These indices were used for CMA delineation in an 80 acre field under row crop cultivation. These indices captured 100% of CMAs based on runoff and sediment transport and 75% of CMAs based on atrazine herbicide transport, as predicted by APEX. These critical areas were also areas with lower grain crop productivity. When these CMAs were simulated under permanent vegetative grasses instead of grain crops, there was a reduction of 25, 32, and 55% in runoff, sediment transport, and atrazine transport, respectively. These indices developed at the field level were also used at a watershed scale. The CMAs in the 18,000 acre Goodwater Creek Experimental Watershed (GCEW) were delineated using the two indices CCI and CPI. Twenty-five % of the total watershed area under agricultural land use had the lowest values of CCI and CPI indices; these areas were treated as CMAs. The Soil and Water Assessment Tool (SWAT) model was satisfactorily calibrated and validated for streamflow, sediment transport, phosphorus transport, and atrazine transport for the GCEW; these simulation data were used to confirm the CMAs delineated by the indices. The CPI and CCI indices in conjunction with knowledge of

current management practices were found to be an easy and less costly and time consuming method to delineate CMAs in watersheds with claypan soils. To reduce runoff and non-point source pollutants, these delineated CMAs were targeted with BMPs which included filter strips, grassed waterways, and terraces. Thirty year simulations using these BMPs showed significant reductions in simulated sediment transport (51 to 54%) and phosphorus transport (19 to 23%) in the watershed. Targeting CMAs with BMPs delineated using the CCI and CPI indices can be an effective tool to reduce sediment and phosphorus transport from claypan watersheds.