WATER QUALITY IN RUNOFF FROM NATURAL RAINFALL FROM DIFFERENT SURFACE MANAGEMENT TREATMENTS ON A MIAMIAN SOIL IN CENTRAL OHIO, USA

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Soil erosion from farmland is a global concern. Excess erosion can have two major effects: decreased crop yield and deteriorated water quality. Environmental pollution from chemical fertilisers and pesticides is a sensitive issue. Conventional agricultural practices are portrayed as a threat to human health inciting public outcry. Field experiments that are designed to explain the effects of erosion on water quality are needed. The objectives of this study are to evaluate the effects of soil management on (1) soil and nutrient loss; (2) changes in chemical and physical properties of soil; (3) levels of NO_3-N, NH_4-N and PO_4-P in runoff water after fertiliser application to maize (*Zea mays* L.).

MATERIALS AND METHODS

Soil erosion from natural rainfall and runoff were monitored using field runoff plots over three years from 1988 to 1990 on a Miamian (fine mixed mesic Typic Hapludalf) soil of 5-6% slope. The Miamian soil surface layer is brown, friable, silty clay loam about 23 cm thick. The subsoil, which extends to a depth of about 91cm, is yellowish brown and dark yellowish brown, very firm clay loam. The experiment was conducted at the Agronomy farm of the Ohio State University, Columbus. There were four treatments: (1) ploughtill where the plots were ploughed up and down the slope (PT); (2) ploughtill with a fine mesh suspended 15-cm above the soil surface to minimise kinetic energy of the rain (PN); (3) bare soil followed by surface soil removal. The plot was kept bare by regularly spraying with herbicides from 1988 to 1989. On 15 May 1990, 20 cm (2920 Mg/ha) topsoil was removed (S); and (4) uncultivated fallow followed by ploughing (F). All treatments were replicated three times. Plots were separated from each other by fiberglass sheets leading runoff to the collection device. The collection system was designed to retain 1/5 of the runoff in a 200-litre barrel. Runoff volume was determined after each storm and a sub-sample was analysed for K, Ca, Mg and P loss determination. Soil samples were collected prior to experimental setup in 1988 and after maize harvest in 1990. Aggregate stability was determined by the wet sieving method. Organic carbon content of the soil was determined by dry combustion method. Soil loss was calculated based on sediment concentration in runoff and total volume of runoff collected; and from the eroded sediment deposited in and around the collection device. On May 24, 1990 all plots were ploughed, fertilised and maize was planted.

RESULTS

Cumulative soil loss for the study period (1988-1990) was 0.4 Mg for F, 23.2 Mg for PN, 58.6 Mg for PT, and 118 Mg/ha for S treatment). Mean annual runoff losses were 26, 69, 116 and 118 mm/year for the F, PN, PT, and S treatments, respectively. Organic carbon content was reduced by 57% due to scalping. Mean loss of K, Ca, Mg, and P was in the order S > PT > PN > F treatments.

CONCLUSIONS

In terms of acceptable level of water quality, 19% of the samples had NO_3-N concentrations exceeding 10 mg/L, well above the standard safety level for drinking water in Ohio. No-till treatment is a practical option for a Miamian soil to minimise water quality deterioration.