

Nutrient Concentrations of Runoff as Affected by Moldboard Plowing

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Introduction

The excessive application of manure can lead to an accumulation of nutrients near the soil surface. As nutrient content in surface soils increases, nutrient concentrations in runoff may also become greater. Moldboard plowing has been shown to redistribute nutrients within the soil profile and reduce soil nutrient values near the surface. Therefore, it is possible that moldboard plowing of soils with excessive nutrients could also reduce N and P transport by overland flow.

Objective:

Measure the effects of moldboard plowing on the redistribution of nutrients within the soil profile and nutrient transport by overland flow

Methods

Study Site Characteristics

- Research was conducted at the University of Nebraska Rogers Memorial Farm located 18 km east of Lincoln, NE
- A Sharpsburg silty clay loam soil containing 11 percent sand, 54 percent silt, and 35 percent clay was located at the study site



Experimental Design

- Forty 0.75-m wide by 2-m long plots were established using a randomized block design
- Composted beef manure was applied at dry weights of 0, 68, 105, 142, and 178 Mg/ha
- Twenty plots were moldboard plowed to a depth of approximately 23 cm
- Soil cores were obtained before and after tillage at 0-5, 5-15, and 15-30 cm depth increments
- Soil samples were analyzed for water-soluble P (WSP), Bray-1 P, NO₃-N, and NH₄-N

Rainfall Simulation Procedures

- Rainfall simulation procedures established by the National Phosphorus Research Project were employed in this study
- A portable rainfall simulator was used to apply rainfall for 30 minutes at an approximate rate of 70 mm/hr
- Two additional rainfall events of the same intensity and duration were simulated at approximately 24 hour intervals
- Runoff was collected and analyzed for DP, NO₃-N, NH₄-N, and TN



Data Analysis

- ANOVA and LSD tests were performed to determine the effects of tillage, compost application rate, and soil depth on soil characteristics
- The effects of tillage and compost application rate on water quality parameters were also identified using ANOVA and LSD tests

Results and Discussion

Soil Characteristics as Affected by Plowing

- Plowing significantly reduced Bray-1 P content at the 0-5 cm soil depth from 200 to 48 mg/kg
- Bray-1 P at the 5-15 cm soil depth increased significantly after plowing from 17.5 to 70.6 mg/kg
- NO₃-N content was reduced significantly following plowing at all three soil depth increments
- NH₄-N decreased significantly with soil depth, but was not significantly affected by tillage or compost application rate



Nutrient Concentrations of Runoff as Affected by Plowing

- Tillage significantly reduced runoff concentrations of DP (Fig. 1), NO₃-N (Fig. 2) and TN
- Neither tillage nor the application of varying amounts of compost significantly affected NH₄-N content of runoff

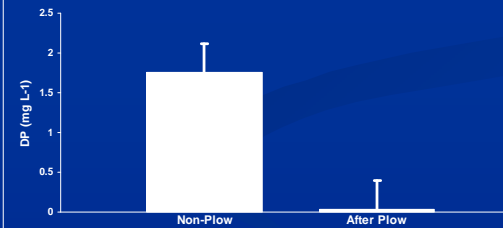


Fig. 1. Mean concentration of dissolved phosphorus (DP) in runoff for the non-plow and plow treatments. Vertical bars are standard errors.

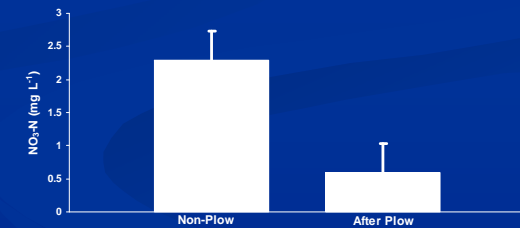


Fig. 2. Mean concentration of NO₃-N in runoff for the non-plow and plow treatments. Vertical bars are standard errors.

Conclusions

- Moldboard plowing significantly reduced the content of WSP and Bray-1 P at the 0-5 cm soil depth
- Soil NO₃-N values decreased significantly at each depth increment after tillage
- Concentrations of DP, NO₃-N, and TN in runoff were reduced significantly on the moldboard plow treatments
- Plowing should only be used as a remedial measure to rectify former improper application practices, not a means to provide continued excessive manure application