TILLAGE AND FERTILIZER SOURCE EFFECTS ON NITRATE LEACHING IN COTTON PRODUCTION IN SOUTHERN PIEDMONT

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INTERPRETIVE SUMMARY

Problem

The contamination of water resources by nitrate from agricultural sources is a major health and environmental quality issue confronting the US today. The type of tillage, as well as fertilizer N source, rate, and usage may influence the movement of nitrate through the soil profile. Recent rapid growth in cotton acreage, continuing expansion of use of poultry litter as alternative fertilizer source, and increasing adoption of alternative tillage methods have the potential for water quality degradation in the Southeast. The objective of this study was to quantify and compare potential nitrate losses from cotton production managed under no-tillage and conventional-tillage systems and fertilized with poultry litter and ammonium nitrate.

Literature summary

There is a prevalence of elevated nitrate concentrations in surface water and groundwater in watersheds of intensive agricultural use. Water infiltration and preferential flow typically increase when tillage is reduced or eliminated increasing the risk of potential contamination for ground water level by soluble nutrients. Field studies, however, often provide wide-ranging estimates of the relative effect of contrasting tillage practices on nutrient leaching losses. Only limited data are currently available for the Southeast concerning the fate of nutrients under contrasting tillage treatments. Little is known about the possible interactions of tillage and poultry litter use in determining nutrient movement to ground and surface water.

Study Description

The experiment was conducted in 1997 and 1998 at the USDA-ARS J. Phil Campbell, Senior, Natural Resource Conservation Center, Watkinsville GA. The site consisted of 12 instrumented, tile-drained plots each 30 ft by 100 ft, located on nearly level (0-2%) slope Cecil sandy loam. Factorial combinations of two tillage and two fertilizer treatments each replicated three times was imposed. The conventional-tillage consisted of chisel plowing and disking while no-tillage consisted of coulter planter use only. Fertilizers were poultry litter applied at a rate of 2 tons/acre (30% moisture basis; equivalent to about 54 lb/acre available N), and ammonium nitrate applied as conventional fertilizer at a rate of 54 lb/acre available N. Rye was used as cover crop on all plots each winter and received 50 lb/acre available N as ammonium nitrate before planting. Tillage treatments started on the 12 plots in April 1992 in connection with another study. Stoneville 474 variety cotton was planted on May 14, 1997 and May 14, 1998. Harvest dates were November 4, 1997 and November 12, 1998. Pesticides and fertilizers were applied before planting and, in conventional-tillage plots, incorporated into soil by light disking immediately afterwards. There was no soil incorporation of pesticides and fertilizer in no-tillage plots. Drainage was measured by tipping buckets, and recorded digitally by data loggers. About 10 oz of the drainage flow was automatically collected after every 160 gallon flow and stored in the field in refrigerated samplers until taken to the laboratory for nitrate analysis.

Applied Question

Is there more nitrate loss in subsurface drains from cotton managed under no-tillage and fertilized with poultry litter compared to conventionally-tilled cotton fertilized with ammonium nitrate?

There was no difference in nitrate leaching between no-tillage and conventional-tillage treatments in 1997. Poultry-litter-treated plots had a total nitrate loss of 9.4 lb/acre N/A compared to 5.9 lb/acre N/A for ammonium-nitrate-treated plots. This difference between fertilizer sources is for all practical purposes non-significant and may have been due, at least in part, to a larger than expected N mineralization from poultry litter. In our calculation we had estimated that 50% of the organic N in poultry litter would be come available to the crop.

Before the application of N, nitrate concentrations in draining water were below 3 ppm in all treatments. During the first two months after N application concentrations increased to 20 or 30 ppm in the conventional-tillage plots and to 10 or 15 ppm in the no-tillage plots. Concentration in poultry litter treatments were up to 5 ppm larger

compared to ammonium nitrate treatments. By late September, concentrations had decreased to about 5 ppm in the conventional-tillage and poultry litter treatments, and to about 1 to 3 ppm in the remaining treatments.

There was no significant drainage in 1998 and thus we collected little effluent. Rainfall was 7 inches below normal for May through November, with deficit in each month. Most events were well below 1 inch, the approximate threshold above which drainage was observed in 1997. From our observations so far, no-tillage did not increase nitrate leaching when compared to conventional-tillage. Although poultry litter led to a larger

Nitrate loss than conventional fertilizer, the difference between fertilizer sources was relatively small and for practical purposes non-significant. We report in another paper in these proceedings, that no-till produced 30% more lint compared to conventional till over three years. Also, yield from no-tillage-poultry-litter plots was almost 50 percent larger than that from conventional-tillage-conventional-fertilizer plots. These are encouraging results for those engaged in promoting no-tillage and poultry litter use in cotton production in the Southeast.