United States Department of Agriculture
Research, Education and Economics

Agricultural Research Service
Date: 4/13/2009

Natural Resources Research Update

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Title: Cropping and tillage strategies to minimize off-site impacts of excess nutrients in soil

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Text: If the conditions under which residue materials leach or sorb nutrients can be identified, it may be possible to adopt cropping and management practices that reduce nutrient delivery by overland flow. Conservation practices such as contouring, strip cropping, conservation tillage, terraces, and buffer strips could be utilized to optimize nutrient sorption and storage by crop residues. Nutrients sorbed by residue materials could then be maintained and utilized by subsequent crops rather than transported in runoff causing off-site water quality degradation. When manure is repeatedly applied at rates that exceed crop nutrient requirements, nutrients accumulate near the soil surface. It is possible to redistribute the nutrient enriched surface layer throughout the upper soil profile by plowing. As the nutrient content of surface soil is reduced, the transport of nutrients by overland flow should also decrease. The objectives of this project were to: 1) measure leaching and sorption of P by corn, soybean, and winter wheat residue, and 2) characterize the effects of a single plowing operation on nutrient transport by overland flow from a soil with excessive nutrients. A laboratory study was conducted to simulate the widely varying overland flow – crop residue interactions occurring in the field. Measurements were made of leaching and sorption of nitrogen and phosphorus by corn, soybean, and winter wheat residues placed in solutions containing inorganic nutrients. Variables used were type of residue material, nutrient constituent, solution concentration, and residue / solution contact time. For a given residue material and nutrient constituent, four different solution concentrations were used and changes in solution concentration over five selected residue / solution contact times were measured. In a separate experiment, varying rates of manure were added to a Sharpsburg soil in the Fall of 2002 to provide a range of soil test P values. The following summer, half of the 40 plots were plowed while the others were left undisturbed. Standard procedures were then used to measure P transport by runoff from both the plowed and non-plowed experimental plots. Leaching and sorption of P by crop residue was influenced by type of residue material, nutrient constituent, solution concentration, residue solution contact time, and length of time following harvest. For corn and wheat residue materials, the amount of P leached was greatest immediately after harvest. The quantity of nutrients leached / sorbed by residue materials increased as residue

/ solution contact time became greater. Crop residue materials leached or sorbed nutrients in runoff depending upon existing cropping, management and hydrologic conditions. It may be possible to adopt residue management and conservation practices that minimize off-site impacts of excess nutrients in soil. Before the experimental plots were plowed, Bray soil P values at the 0 – 5 cm depth ranged from 53 to 414 $\mu g\ g^{-1}$. Following the plowing operation, Bray soil P values at the 0 – 5 cm depth varied from 16 to 77 $\mu g\ g^{-1}$. After the plowing operation, DP concentrations of runoff from the plots with former elevated surface soil P levels were similar to the control plots where no manure was applied. Plowing should only be used as a remedial measure to rectify former improper manure management practices, not as a means to allow continued excessive nutrient application.

Cermak, J.D., J.E.Gilley, B. Eghball, and B.J Wienhold. 2004. Leaching and sorption of phosphorus and nitrogen by crop residue. Trans. of the ASAE. 47(1):113-118.

Gilley, J.E. and B. Eghball. 2007. Nitrogen and phosphorus concentrations of runoff as affected by plowing. Trans. of the ASAE. 50(5):1543-1548.