PROTECT WATER QUALITY WITH SLURRY-ENRICHED SEEDING OF CEREAL COVERS ON CORN SILAGE GROUND

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Over the last several years many crop producers have adopted soil conservation practices that protect water quality by preventing runoff, erosion and sedimentation of streams and waterways. There is a need for no-till cropping systems that stabilize soil and prevent overland flow of sediment, nutrients and fecal pathogens yet are compatible with current manure management practices. Such options will retain manure in the root zone for remediation of pathogens and nutrient use in the following crop.

Cover crops have not been used widely in livestock-based cropping systems because establishment costs, competition for labor and added management needs have discouraged their use. Interest in the use of cover crops is increasing because cover crops are effective barriers to overland flow, sedimentation, and manure contamination of waterways. Ongoing work at Michigan State University funded by the *Great Lakes Basin Program for Soil Erosion and Sediment Control* has shown that excellent stands of wheat and cereal rye can be achieved in untilled corn silage ground by a new process that combines seeding, manure application and aeration tillage in one efficient operation (Fig. 1). The *Basin Program* is coordinated by the *Great Lakes Commission* in partnership with the *USDA-NRCS, US-EPA*, and the *Army Corps of Engineers*. A specific objective of the work is to evaluate the new process--slurry-enriched micro-site seeding--which combines low-disturbance aeration tillage, seeding, and slurry application in a sustainable and cost effective manner with little soil disturbance or loss of protective crop residues.

Figure 1. Excellent wheat and cereal rye cover crops were obtained by combining low-disturbance aeration tillage, seeding and slurry application in one efficient operation.

Greater Awareness of Water Quality

The Michigan Department of Environmental Quality (MDEQ) lists pollution from agricultural sources as the third most common cause (1,655 river-miles) of failure to attain water quality standards (MDEQ, 2004). Several federal and state programs such as the *Clean Michigan Initiative, Conservation Reserve Enhancement Program,* and *Section 319* of the *Clean Water Act* (federal funds) have been enacted to increase public awareness of water quality issues and support education and demonstration projects. The MDEQ has trained more than 30 volunteer organizations to assess the quality of waters of the state. An increased interest and awareness of water quality issues has led to an adversarial relationship among some dairy and livestock farmers and their neighbors. The causes of the conflicts are related to sedimentation and manure contamination of surface waters from runoff and tile drains.

Barriers to Runoff and Water Contamination

Farm land is rich in nutrients. Runoff from farm fields can transport sediment, organic solids, nutrients and pathogens to surface waters. Low-disturbance aeration tillage serves as a barrier to runoff and water contamination because it reduces overland flow by increasing surface roughness, improving infiltration and conserving crop residues (Fig. 2).

Figure 2. Soil surface after slurry seeding. Seed-laden slurry filled the cracks and fissures created by the aeration tines. Aeration tillage improved infiltration and reduced overland flow.

Vegetative filters, buffer strips and grass waterways have long been used to separate cropped or manure-applied land from nearby waterways. Cover crops are grown specifically to protect the soil from wind and water erosion, recycle nutrients, and improve soil structure and fertility. When manure is applied to a bare soil surface, near-surface filtration and accumulation increase the chance of nutrient and bacterial transport in runoff water. When manure is applied to a vegetative surface, the near-surface zone of high biomass and organic matter enhance adsorption, straining and filtering of bacteria and nutrients.

Manure Slurry-Enriched Seeding

Replicated plots (12 ft x 100 ft) were established in 2004 in a Capac fine sandy loam at the University Farms at Michigan State University in East Lansing. A commercial variety of winter wheat (Sisson) and a common variety of cereal rye were established in late September in corn silage stubble. The wheat was sown with a Great Plains no-till drill, and both wheat and cereal rye were sown with a new manure slurry-enriched seeding process. The slurry seeding was done with a slurry tanker (3000 gal) equipped with a rear-mounted rolling-tine aerator (12 ft; Aer-Way)[1] and SSD (sub-surface deposition) slurry distribution system. The seed was placed in the spreader tank where bypass flow provided tank agitation and seed mixing. The seed-laden dairy slurry was applied at 5000 gal/ac. Specific comparisons were: 1) surface manure, no tillage, no seed, 2) wheat, 2 bu/ac, no-till drill, 50 lb/ac N as urea in April 2005, 3) wheat, 2 bu/ac, slurry seed, 5° gang angle, 4) wheat, 2 bu/ac, slurry seed, 10° gang angle, 5) wheat, 4 bu/ac, slurry seed, 5° gang angle, 6) wheat, 4 bu/ac, slurry seed, 10° gang angle, 7) cereal rye, 2 bu/ac, 5° gang angle, and 8) cereal rye, 2 bu/ac, 10° gang angle.

The dairy slurry (9.5% solids, sawdust bedding) provided 125 lb/ac total N (65 lb/ac as NH_4-N; 60 lb/ac as organic N), 43 lb/ac P as P_2O_5, and 140 lb/ac K as K_2O. Drop tubes placed the seed-laden slurry in the fractured and loosened soil behind each set of rolling tines. No additional tillage or soil firming was done.

[1] Mention of trade names, proprietary products, or specific equipment is intended for reader information only and constitutes neither a guarantee nor warranty by Michigan State University, nor does it imply approval of the product named to the exclusion of other products.

Biomass and Grain Yield

Each of the slurry-seeded treatments provided a uniform cover that suppressed weed growth. Although our primary interest was in cover crop establishment, we maintained the plots for grain yield measurements to see how the slurry-seeding method would compare with conventional drilling.

Grain was harvested on July 25, 2005. Wheat yields ranged from 75 to 81 bu/ac and the rye yields ranged from 67 to 71 bu/ac. There were no statistically significant differences between treatments (Fig. 3). Additional work is in progress on farms throughout the Great Lakes region to evaluate the agronomic and environmental benefits of this new cover crop establishment method.

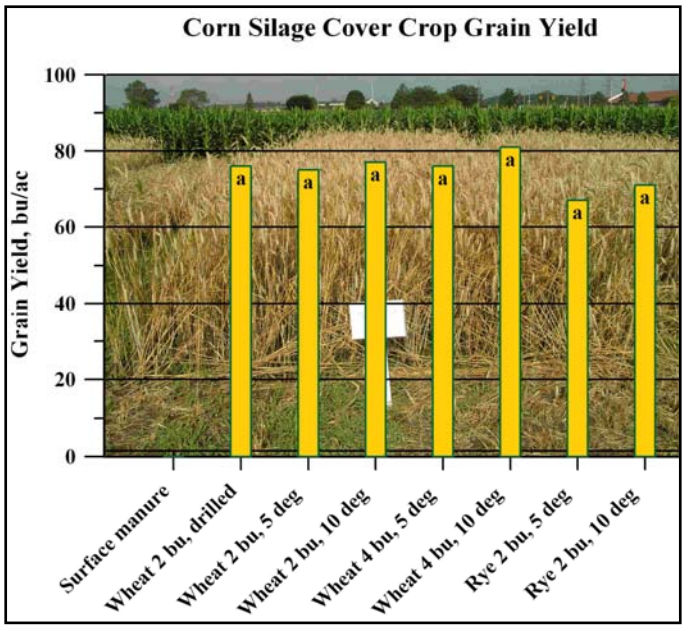

Figure 3. Wheat and rye yields in 2005. Columns with the same a-b letters are not significantly different ($p \leq 0.10$).

Conclusions

The integration of soil conservation and manure land application provided by this new slurry-enriched seeding process provides important operational efficiencies that promote environmentally sensitive manure use. This new method of soil and manure stabilization will expand the land base available for nutrient cycling, reduce cover crop establishment costs and protect water quality. Based on our experience in 2004-2005:

- Manure slurry-enriched seeding of wheat and cereal rye cover crops in untilled corn silage stubble is an efficient and effective establishment method.
- The cereal grain cover crops suppressed weed growth, and manure use did not increase weed competition in the subsequent cover crop.
- Wheat yields with the slurry-enriched process were equal to no-till drilling with spring fertilization (50 lb/ac N).

Additional work is in progress with MSU researchers Dale Mutch and Sieglinde Snapp to evaluate nutrient uptake and release, impacts on soil quality, crop protection benefits, and environmental benefits of slurry seeding in diverse cropping systems.

References

MDEQ. 2004. *Water Quality and Pollution Control in Michigan: 2004 Sections 303(d) and 305(b) Integrated Report.* Michigan Department of Environmental Quality-Water Division. Revised May, 2004. Lansing, MI.