Subsurface Poultry Litter Application: Experiences and Advances in Maryland and Pennsylvania

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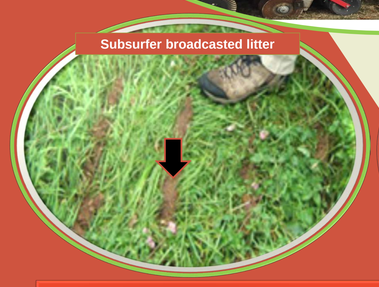
PROJECT OVERVIEW

Numerous forays into subsurface banding application of dry poultry litter have evolved over the past 15 years beginning with inventions at USDA-ARS units in Alabama and Arkansas (Pote et al. 2011). Numerous field experiments and testing have generally resulted in positive environmental and agronomic effects, but also highlight the limits of these benefits, particularly in production systems with a surfeit of nutrients and long histories of soil nutrient accumulations. This exhibition reflects results of a combination of short and long-term agronomic and environmental studies conducted in Maryland and Pennsylvania.

SUBSURFER TECHNOLOGY UPDATE

The Subsurfer recently underwent some much needed engineering modifications to improve the speed, litter delivery system, and other flaws as shown below. Revised Subsurfer prototypes are presently being tested across many states. Additional improvements are expected to move this promising technology to a more advanced stage towards adoption by producers.



MATERIALS AND METHODS

Long - term runoff, leaching and corn yield studies were conducted at the UMES Research and Teaching Farm, Princess Anne, MD. Runoff and lysimeter leachate water samples were collected from plots under four manure treatments (Fig-3), and analyzed for phosphorus (P) and nitrogen (N). Short-term corn yield studies were conducted on a private farm in MD and on five farms in PA (map above). Corn yield was compared between plots with turkey litter applied broadcast and below the surface using the Subsurfer.

PHOSPHORUS & NITROGEN RUNOFF AND LEACHATE LOSSES

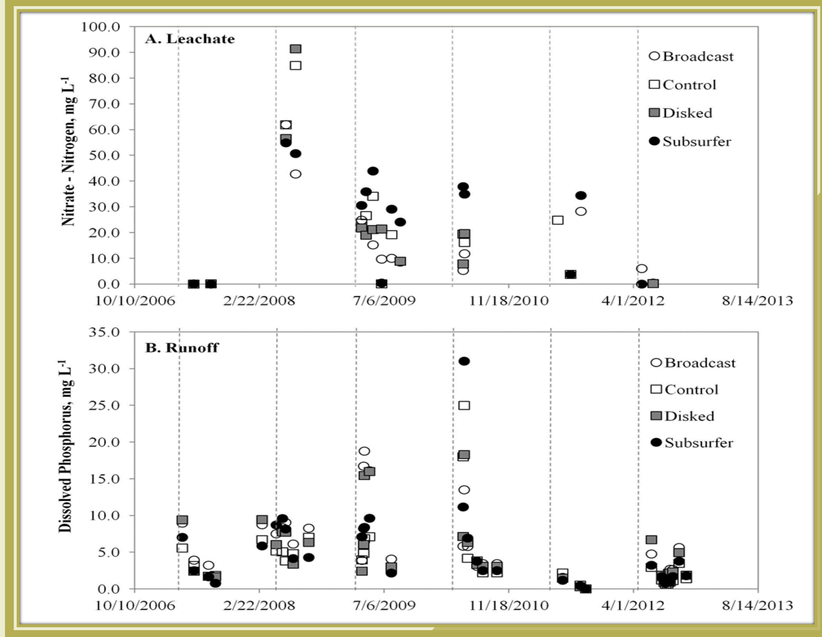


Figure-1. Concentrations (UMES Farm-mg L^{-1}) of nitrate-N in leachate (A) and dissolved P in runoff (B). Dates of manure applications are indicated by dashed lines.

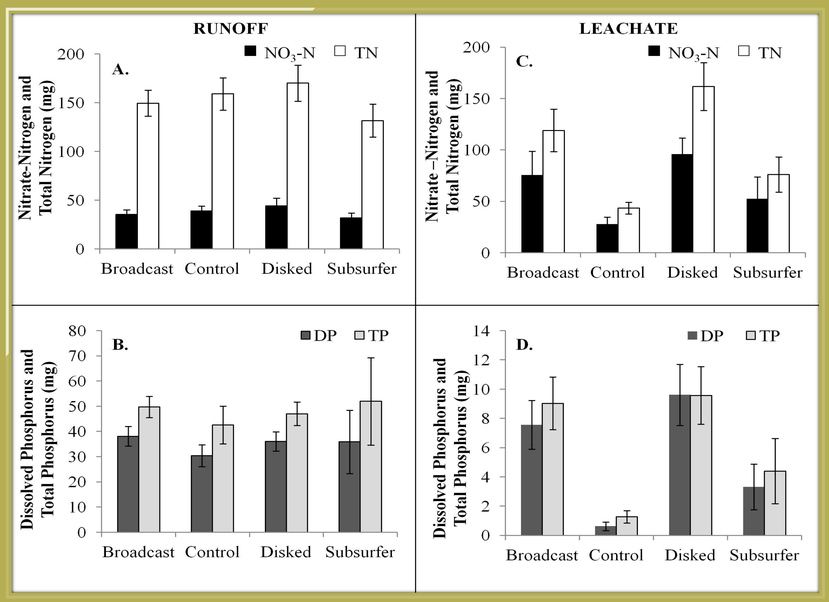


Figure-2. Comparison of N and P mean loads in surface runoff (A and B), left and leachate (C and D), right. Error bars are standard errors of nitrate, total N, dissolved P, and total P (sample numbers (n) ranged between 47 and 77 for each nutrient and form.

CONCENTRATIONS: No significant differences ($p \leq 0.05$) in runoff and leachate (Fig. 1), were observed, but runoff N and P concentrations from control treatments were higher than other treatments during heavy storm events (Fig. 1).

LOADS: Surface runoff loads for both N (Fig. 2A) and P (Fig. 2B) showed no significant differences ($p \leq 0.05$) between treatments. Loads from the controls at the level of other treatments reflect the impact of legacy and seasonal carry-over nutrients. Lower nutrient loads were observed in leachate from the control and subsurface treatments (Fig. 2C, 2D).

YIELDS: Subsurface banding at UMES increased corn yields significantly ($p \leq 0.05$) in all growing seasons except in 2010 (lowest seasonal rainfall - Fig. 3). No differences ($p \leq 0.05$) in yield were observed between treatments on PA private farms (Fig. 4).

CORN YIELDS MARYLAND AND PENNSYLVANIA SITES

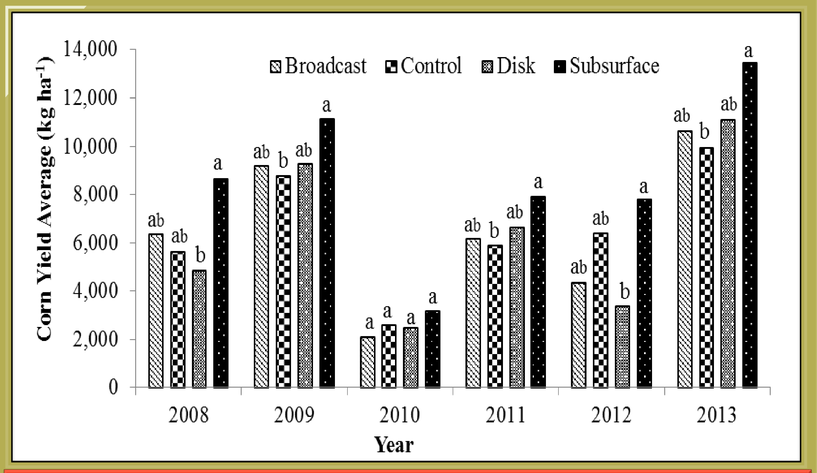


Figure-3. Seasonal effects of poultry litter application methods on no-till corn yield, UMES Farm. Bars with the same letter indicate corn yields were not significantly different at $p \leq 0.05$.

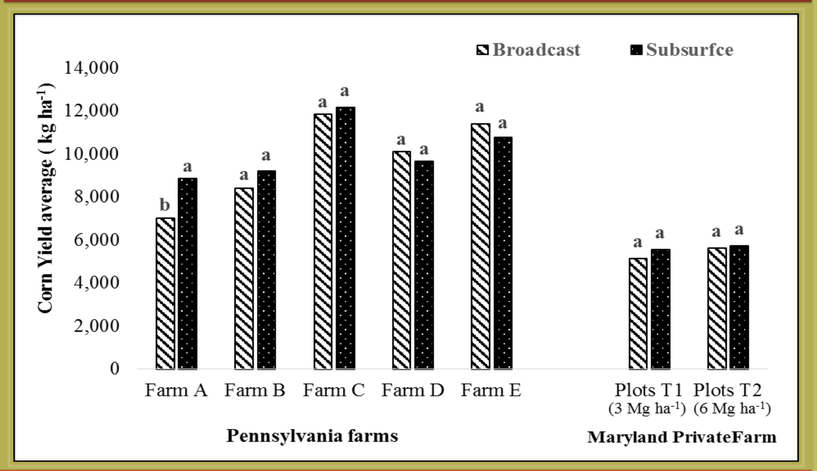


Figure-4. Corn yield from plots treated with surface broadcast and subsurface poultry litter applications at five Pennsylvania farms (A–E), and at a private farm in MD. Litter application rates (T1 = 3 Mg ha^{-1} and T2 = 6 Mg ha^{-1}) were compared at the MD farm. Bars with the same letter indicate yields were not significantly different at $p \leq 0.05$.

AGRONOMIC & ENVIRONMENTAL IMPLICATIONS

Subsurface poultry litter application produced positive benefits to water quality, but mixed results relative to crop yields. When subsurface banding produced higher yields, it was likely due to more available water residing within the applied litter band zones which were closer to plant roots. This was indicated by lower surface runoff and leachate water volumes generated from these plots compared to other treatments. Lower N losses in both surface runoff and leachate, and lower P losses in leachate in subsurface banded plots point to higher soil nutrient retention. Ultimately, higher water and nutrient retention in subsurface treated plots resulted in higher yields than other treatments, and less negative impacts on water quality.

LITERATURE CITED

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ACKNOWLEDGEMENTS

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