Low-Disturbance Manure Incorporation Benefits

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These days there is not much room for inefficiencies on the farm. Since weather and milk prices will remain variable and be out of reach, focusing on what is manageable is important. For many farms, the nutrient management arena is a place where inefficiencies commonly lurk.

Manure is an excellent source of nitrogen (N), phosphorus (P), and other nutrients in addition to organic carbon compounds contributing to overall soil quality, which is particularly important for corn silage systems. To get the most out of manure, careful management is necessary, maximizing potential nutrient recovery and other soil and environmental benefits.

Band aerator *(Photo: Bill Jokela)*.

Shallow disk injector *(Photo: Bill Jokela)*.

Managing N is notoriously difficult due to active biological cycling and its propensity for loss via surface runoff, leaching, and denitrification. Practices that can reliably conserve N are economically and environmentally beneficial. Nearly 80% of the ammonia-N fraction is lost in a week's time if manure is not incorporated. The most effective way to capture more N from manure is incorporating via a tillage operation or injecting it.

While liquid dairy manure can be incorporated with various tillage implements, tillage intensity and soil disturbance levels can affect erosion potential, soil structure, and runoff water quality. In hay crop or cover crop situations, minimal disturbance during application is important to reduce crop damage and no-till farming seeks to minimize any disturbance.

Alfalfa, grass, and combinations thereof are a staple in the dairy industry, and applying liquid manure after hay harvests is commonly done. Recently published research in the *Journal of Environmental Quality,* conducted at the ARS Dairy Forage Research Center, evaluated low disturbance manure application in an alfalfa-grass system compared to broadcast application. In addition to stand integrity estimated by percent plant species composition, rainfall simulation generated artificial surface runoff and provided estimates of sediment and nutrient loss.

Manure treatments were included (four replications each): surface banding, banding with aeration (see photo), shallow disk injection (see photo), surface broadcast, and a no-manure control. Surface application of manure (broadcast and banding without aeration) had significantly greater concentrations and loads of total N, total P, sediment, and dissolved P compared to shallow disk injection and banding with aeration.

Overall, shallow disk injection was associated with improved runoff water quality and significantly lower runoff dissolved reactive P concentrations, the bioavailable form of P. Neither shallow disk injection nor banding with aeration appeared to damage stand integrity compared to broadcast or no manure application.

Fall manure application after corn silage harvest is a routine practice on many dairy farms. A second recently published study evaluated low disturbance liquid dairy manure application in a corn silage-winter rye cover crop system. The low disturbance methods were: sweep-injection, strip till-injection, shallow disk injection, banding with aeration, and broadcast. These were compared to broadcast-disk incorporation, three fertilizer N treatments applied in the spring (67, 134, and 202 kg N ha^{-1}), and a no-manure control.

Average corn yield was greater for sweep injection and did not differ significantly from the high N fertilizer rate. In addition, yield averaged across low disturbance treatments did not differ from the two higher fertilizer N rates.

Compared to disking, low disturbance methods maintained greater crop residue with levels comparable to the control. Finally, results also showed that shallow disk injection had greater soil aggregate stability and total carbon content, suggesting that other soil health benefits may be associated with this practice.

While the nutrient conservation and runoff risk mitigation potential of low disturbance manure application are attractive, there are likely additional soil quality benefits possible as suggested by our research. Organic matter can be thought of as the backbone of soil health. Much of what we are trying to achieve through soil health practices is to enhance active and more stable forms of organic carbon because it supports so many other vital soil processes and plant vigor.

Maintaining soil structure and aggregate stability is one of the most important biophysical functions of organic carbon, since loss of soil structure has cascading negative effects on other vital processes including air/water flow, water infiltration, surface runoff, compaction potential, and nutrient availability.

Soil health and environmental quality are a complex interplay among a region's climate, soils, and long-term management. Consistently applying nutrient management best practices and tailoring them to site-specific field conditions is an important component to optimize overall farm efficiency. Low disturbance manure application/ injection is an important manure management practice and research clearly shows it is a good option for enhancing nutrient retention/reducing losses in both corn and hay forage crops.

Journal article citations:

Sherman, J.F., Young, E.O., Coblentz, W.C., and J. Cavadini. 2020. Runoff water quality following low-disturbance manure application in an alfalfa-grass hay crop forage system. J. Environ. Qual. https://doi.org/10.1002/jeq2.20058.

Sherman, J.F., E.O. Young, W.E. Jokela, and J. Cavadini. 2020. Influence of low disturbance fall liquid dairy manure application on corn silage yield, soil nitrate and rye cover crop growth. J. Environ. Qual. https://doi.org/10.1002/jeq2.20085.