Alfalfa Yield Impacts of Low-Disturbance Manure Application

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Manure management is a key aspect of modern dairy production, influencing agronomic, economic, and environmental facets of the business.

Modern dairy production relies on capturing nutrient and production efficiencies to optimize profitability. Manure provides crops with needed nutrients and also helps maintain soil quality with inputs of soil organic carbon (SOC), underpinning long-term soil quality/health.

Several considerations should be evaluated to optimize manure application benefits on forage crops (i.e., species, development stage, manure nutrient content/forms, application rates, soil tests, environmental risks, soil moisture, weather conditions, application method/timing).

Manure handling, transport, and application equipment have evolved fast with many possibilities for applying liquid manure to hay forage crops. While broadcast/surface application is common, particularly after cuttings, incorporating or injecting with low-disturbance manure incorporation (LDMI) tools is possible. LDMI tools (i.e., banding, aeration-banding, shallow disk injection) can conserve more nitrogen (N) than broadcast alone in perennial hay and corn systems.

It is fairly well established that excessive tillage on certain soils increases erosion potential compared to undisturbed perennial or long-term no-till systems. However, LDMI tools used under improper conditions (i.e., wet soil, manure applied too late on regrowth) or improperly used can cause crop and soil structural damage.

LDMI attempts to strike a balance between tillage disturbance and decreasing nutrient losses by increasing manure-soil interaction. Research conducted at other ARS laboratories and multiple university trials indicate greater overall soil N and phosphorus (P) retention when manure is incorporated into hay forage crops with LDMI equipment compared to broadcast.

LDMI trial results in alfalfa-grass stands at the Marshfield Agricultural Research Station in Stratford, WI, indicted shallow disk injection significantly reduced dissolved P losses in simulated rainfall-runoff events (Sherman et al., 2020). Aeration-banding also reduced N and P losses but not to the same extent. Shallow disk injection and aeration-banding maintained similar residue coverage and percent alfalfa compared to broadcast, suggesting yields may not differ substantially between LDMI and broadcast.

In another Marshfield trial, alfalfa-grass dry matter (DM) yields were measured for three seasons along with ammonia and greenhouse gas fluxes for LDMI, broadcast, and a no-manure control. While manure application (regardless of method) increased DM yield, impacts of individual LDMI treatments on alfalfa DM yield were inconsistent, suggesting similar yield potential among application methods (Sherman et al., 2021).

Research from other groups evaluating LDMI yield impacts have indicated some level of yield depression is possible, particularly if low disturbance tillage is done too aggressively or under suboptimal field conditions. A farm systems model developed at the USDA-ARS Pasture and Watershed System Laboratory, calibrated with long-term field and farm economic data suggests fairly similar yield potential and associated rates of return for LDMI (shallow disk injection and aeration-banding).

In summary, LDMI methods show promise for conserving nutrients in dairy systems, but more research is needed to better assess effects on long-term forage yield and quality compared to broadcast, drag hose, and other viable application techniques.

References

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