In-Season Applications of Dairy Manure Slurry on Reed Canarygrass

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Introduction

Available land for spreading manure is a serious constraint for some livestock producers, especially in summer. Perennial forages in the crop rotation provide land area for manure application. Reed canarygrass (*Phalaris arundinacea* L.) is widely adapted to temperate climates, and is tolerant to both flooding and drought and a wide range of soil pH. Palatable, low alkaloid varieties have been developed. It is among the highest yielding cool season grasses, has high N uptake capacity, and forms a dense sod, making it possible to carry traffic when other fields are too wet. It has been recommended for N removal from land-applied sewage effluents. Thus, reed canarygrass is an ideal candidate for manure applications during the growing season. Our objective was to evaluate reed canarygrass response to manure slurry spreading alternatives and to compare the manure N source with commercial N fertilizer.

Methods

Pure stands of 'Palaton' reed canarygrass were established on Nicollet clay loam soil at Waseca, MN and Webster City, IA, and on a Sparta loamy sand soil at River Falls, WI. After the establishment year, dairy manure slurry and fertilizer N treatments were applied in a randomized complete block design with four replications. Dairy manure slurry treatments were several combinations of rates ranging from 0 to 375 m^3 ha^{-1} (cubic meters/hectare), broadcast or surface-band application, and either split or single annual applications. Application time ranged from early spring to after the 3rd harvest and total N application rates varied with changes in N concentration of the stored slurry at each location. Ammonium nitrate was surface broadcast at 0 to 448 kg N ha^{-1}, with the two highest rates (336 and 448 kg N ha^{-1}) being applied at 224 kg N ha^{-1} in early spring and the remainder after first harvest.

Herbage dry matter (DM) yield and total N concentration (by near infrared reflectance spectroscopy) were determined for each harvest. Apparent manure N use efficiency was estimated as the slope of herbage N yield vs. total N applied. Deep soil cores were collected in some treatments in late autumn and analyzed for exchangeable NH_4-N and NO_3-N using standard methods. Soil solution samples collected in some treatments with ceramic suction cup samplers at the 1.5-m depth were analyzed for NO_3-N.

Results

Highest annual yield with slurry on the clay loam soils was 11.8 Mg ha^{-1}, using a total of 375 m^3 ha^{-1} split either after the 2nd and 3rd harvests (1130 kg N ha^{-1}) or in early spring and after 2nd harvest (1190 kg N ha^{-1}). The early spring/2nd harvest treatment applied 460 kg N ha^{-1} on the loamy sand soil and produced the highest yield observed on this site. Yield response to surface-banded and broadcast slurry was similar, except in one instance at Waseca where yield was reduced by 29% compared to broadcast-applied at the same time when 187 m^3 ha^{-1} slurry was surface-banded after the 2nd harvest. Maximum herbage DM yields were higher on clay loam soils (14.5 Mg ha^{-1}) than on the loamy sand soil (10.2 Mg ha^{-1}), and yields increased by less than 1 Mg ha^{-1} with N rates greater than 224 kg ha^{-1}, whereas yield did not increase above 224 kg N ha^{-1} on the loamy sand soil.

Herbage crude protein (CP) concentrations ranged from 78 to 270 g kg^{-1} and were increased by slurry and fertilizer applications. Topdressed slurry produced herbage CP concentrations higher than 155 g kg^{-1} only at Waseca and River Falls, primarily in the autumn harvest or with the highest manure rate. Highest CP concentration was achieved at high N fertilizer rates and generally was not equaled by slurry. Crude protein concentrations were greater than 155 g kg^{-1} with 224 kg N ha^{-1} in nearly all harvests.

Herbage N removal increased linearly with slurry additions at all locations (Fig. 1). Apparent manure N use efficiencies were 13% to 22% when slurry was

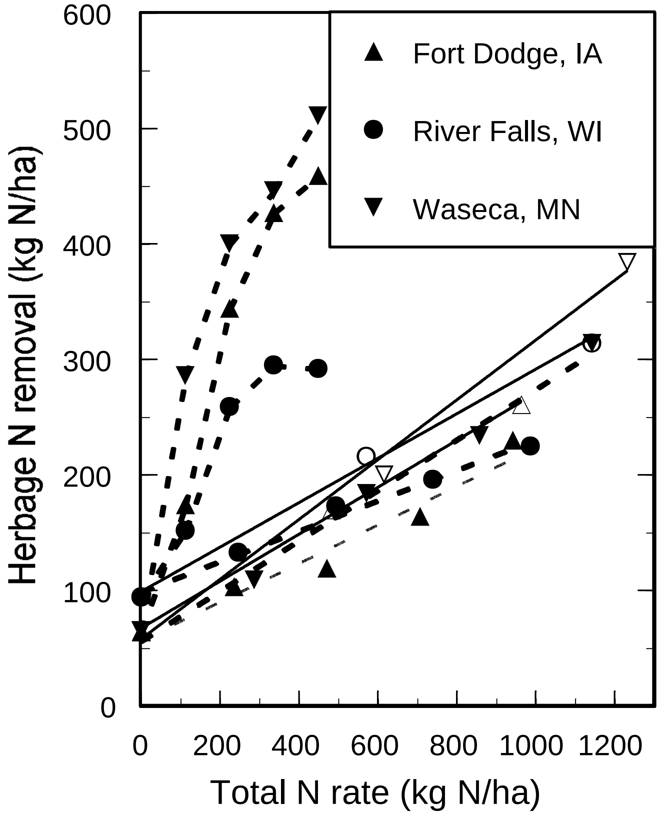

Figure 1. Herbage N removal by reed canarygrass with dairy manure slurry or fertilizer N at three sites in the Upper Midwest, USA. Slurry treatments were split-applied either in early spring and after the 2nd harvest (open symbols) or after 2nd and 3rd harvest (closed symbols); fertilizer N was applied up to 224 kg N ha^{-1} in early spring, with the remainder after the 1st harvest.

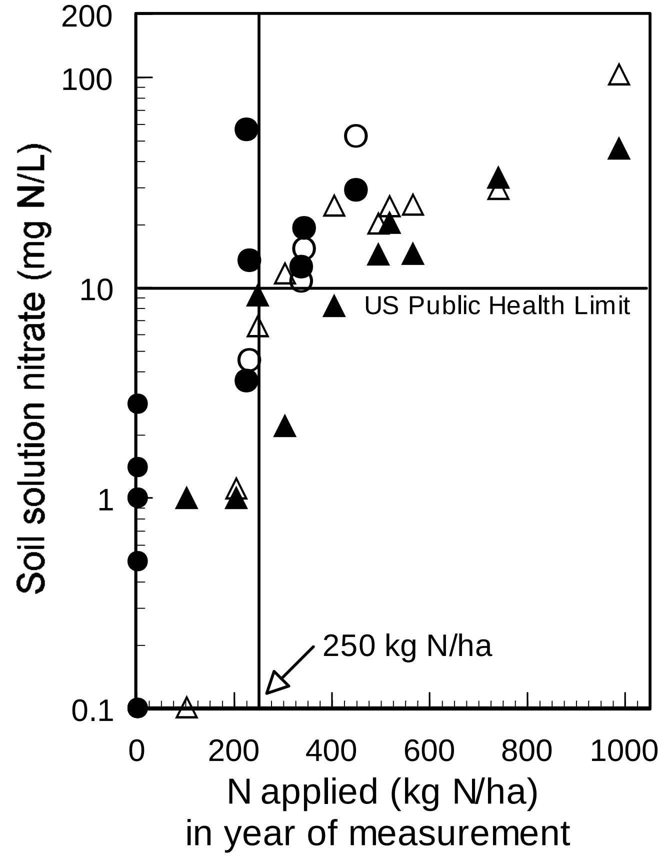

Figure 2. Dairy manure slurry (triangles) or fertilizer (circles) effect on soil solution nitrate concentration in ceramic cup samplers placed 1.5m deep in a sandy loam soil at River Falls, WI. Samples were collected in spring (open symbols) and autumn (closed symbols). Risk of ground water contamination increased at N rates exceeding 250 kg N ha^{-1}.

applied after the 2nd and 3rd harvests; efficiencies of 19% to 26% were achieved when slurry was applied in early spring and after the 2nd harvest. Herbage NO_3 concentrations generally were small (< 0.2 g NO_3-N kg^{-1} dry matter with slurry, < 2.8 g kg^{-1} with fertilizer), even with high rates of slurry addition. Surface banding after harvest did not improve N use efficiency compared to broadcast applications.

There was no evidence of excessive soil solution NO_3-N concentrations for any treatment on the clay loam soils. On the sandy loam, however, soil solution NO_3-N concentrations at 1.5 m in autumn and spring often exceeded the USA Public Health limit of 10 mg NO_3-N L^{-1} with application of more than 250 kg N ha^{-1} (Fig. 2), indicating a higher risk of significant NO_3-N leaching loss. Inorganic N did not accumulate in the soil profile at any site.

Conclusions

Low alkaloid reed canarygrass cultivars are a high yielding, palatable forage resource. Palaton reed canarygrass was responsive to application of high rates of dairy manure slurry during the growing season. Apparent N removal efficiency was good on all soils, but nitrate leaching losses may be significant when high rates of slurry (or fertilizer) are applied to sandy soils. We conclude that reed canarygrass can provide a window of opportunity for summer manure slurry applications, especially on fine-textured soils, without posing a hazard to ground water supplies.

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