Reducing soil phosphorus buildup from animal manure application

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Keywords: soil phosphorus, animal manure

Introduction Animal manure is an excellent plant nutrient source for pastures but increasing soil P level over time is a major environmental problem (Sims *et al*., 1998). The increase in residual soil P is due to the difference in N-P ratio in the manure and forage crop requirements (Robinson, 1996). All the N in animal manure is normally utilised but only from 20 to 40% of the P is taken up. With moderate rates of manure application, nitrogen becomes the limiting nutrient for grasses. The objective of this study was to see if combining commercial N fertiliser with broiler litter would enhance forage yield and P uptake sufficiently to reduce residual soil P levels.

Materials and methods The study site was a Coastal bermudagrass (*Cynodon dactylon* (L.) Pers.) hay meadow on a Keithville very fine sandy loam (fine silty, siliceous, thermic Glossaquic Paleudalfs) in northeast Texas. Each October from 1998 to 2002 the Coastal bermudagrass was over-seeded with annual ryegrass (*Lolium multiflorum* L.) at 33.6 kg/ha or crimson clover (*Trifolium incarnatum* L.) at 22.4 kg/ha. Broiler litter was applied at 9 t/ha the first two years and 4.5 t/ha the last two years each Oct. to the annual ryegrass-bermudagrass (RB) system and in April to the crimson clover-bermudagrass system (CB). Fifty-six kg N/ha was applied from one to four times/year in Dec., March, May and/or July to the RB system and one to three times/year in April, June, and/or July to the CB system. Yield and P uptake were determined annually and residual soil P was determined at the end of the four-year study. Soil P was determined by the Vanadomolybdic acid color method (Jackson, 1958).

Results Maximum annual dry matter yield of both systems was about 13.5 t/ha. In the RB system, maximum annual yield occurred with 2 to 3 N applications/year. In the CB system, there was no yield response to commercial N fertiliser which implies that between the broiler litter and the clover providing N through symbiotic N_2-fixation, they were meeting the N requirements of the bermudagrass. In the RB system, maximum annual P uptake averaged 46.4 kg/ha that occurred with one to three N applications, depending on the year. The maximum annual P uptake in the CB system averaged 41.3 kg/ha, with no significant difference between treatments in three of the four years. The slightly higher P uptake by the RB system may be due to more efficient nutrient uptake by the fibrous root system of annual ryegrass than the tap root morphology of crimson clover in the CB system. After four years, residual soil P at the 0-15 and 15-30 cm depths were lower in treatments receiving N fertiliser than the broiler litter only treatment in the RB system. In the CB system, there were no differences in residual soil P between the no N treatment and the N fertiliser treatments at the 0-15 depth, which is in agreement with the yield and P uptake data. Several of the N fertiliser treatments did have lower residual P levels than the no N treatment at the 15-30 cm depth. At the 0-15 cm depth, residual soil P in the no N treatment in the CB system (21.7 kg P/ha) was equal to, or less than, the N fertiliser treatments in the RB system (19.0-34.1 kg P/ha).

Conclusions Combining N fertiliser with broiler litter enhanced P uptake and reduced residual soil P. Substituting crimson clover for annual ryegrass was as effective as applying N fertiliser in the RB system for reducing residual soil P.

References

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