Effects of Cattle Manure Application on Bahiagrass Yield and Phosphorus Leaching on a Florida Spodosol

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Introduction

Increased number of confined animal feeding operations (CAFOS) in the U.S. has raised concerns over the excessive amount of manure generated each year.
Manure from CAFOS can be recycled and used as a fertilizer in forage production systems.
However, applying manure to meet forage N requirements generally increases soil P concentration. Conversely, application rates based on forage P requirements is not practical and may limit land application of animal manure.
There is therefore an urgent need to develop efficient N based manure application strategies that will increase crop yield but also reduce environmental impacts associated with excessive soil P accumulation.

Objectives

To evaluate the effects of different manure application strategies on bahiagrass (*Paspalum notatum* Flugge) yield and P leaching on a Florida spodosol.

Materials and Methods

Study was conducted at the University of Florida Range Cattle Research Center at Ona from 2005 to 2006.
Treatments were 200 and 400 kg N ha^{-1} from Cattle manure (CM) or 50/50 CM and ammonium nitrate (AN) combination.
These were applied either in split or single.
Plots of size 6.1 m X 6.1 m with 6.1m alley were bermed into isolated hydrogical units for effective monitoring of groundwater P contamination.
A ditch witch was used to burry 5 mil thick plastic sheet around each plot (Fig. 1 and 2).
Two monitoring wells were installed in each plot at 60- and 120-cm for groundwater monitoring.
Water samples were collected at each rainfall event >25 mm.
Total dissolve P (TDP) concentration was determined using ICP-OES.
Soil samples were taken from the Ap (0-15 cm), E (16-60 cm) and Bh (61-120 cm) horizons after each growing season to determine Mehlich-1 extractable P.
Bahiagrass was harvested at 28-d intervals for dry matter determination.

Fig. 1. Berming of plots.

Fig.2. Plots bermed into isolated hydrogical units.

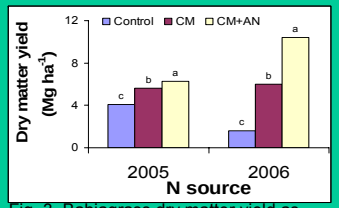

Fig. 3. Bahiagrass dry matter yield as affected by N source.

Table 2.Total dissolved P concentration in the wells as affected by N source.

N source	P concentration	
	2005	2006
	mg L^{-1}	
Shallow well (60 cm)		
Control	0.1 b†	0.03 c
CM‡	2.3 a	11.3 a
CM+AN§	1.3 b	1.7 b
Deep well (120 cm)		
Control	0.01 a	0.3 a
CM	0.33 a	1.0 a
CM+AN	0.23 a	1.5 a

† means followed by the same letter are not different at $P \leq 0.05$
‡ CM = Cattle manure
§ CM+AN = Cattle manure + ammonium nitrate

Table 1. Effect of N source on soil P concentration.

N source	P concentration	
	2005	2006
	mg kg^{-1}	
Ap horizon		
Control	2.4 c†	2.0 c
CM‡	31.3 a	40.0 a
CM+AN §	11.5 b	18.4 b
E horizon		
Control	0.03 a	1.26 c
CM	1.29 a	6.89 a
CM+AN	0.49 a	2.45 b
Bh horizon		
Control	33 a	18 a
CM	37 a	26 a
CM+AN	36 a	23 a

† means followed by the same letter are not different at $P \leq 0.05$
‡ CM = Cattle manure
§ CM+AN = Cattle manure + ammonium nitrate

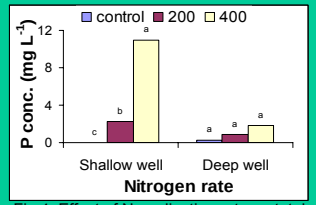

Fig.4. Effect of N application rate on total dissolved P concentration in the wells.

Results

Applying N as CM or CM+AN increased bahiagrass DMY compared to the control (no N applied).
In both years, DMY was greater for the CM+AN treatments compared to the CM (Fig. 3).
Extractable soil P concentration in the Ap horizon was greater for the CM treatments than the treatments that received CM+AN (Table 1).
No significant differences among N sources were observed on soil P in the E horizon in 2005. However, soil P concentration in the E horizon was greater for the CM treatments in 2006 (Table 1).
No treatment effect was observed on P concentration in the Bh horizon over the 2-yr period (Table 1), suggesting that no P leached beyond the E horizon Table 1)
TDP concentration in the 60-cm well were 0.1 and 0.03 mg L^{-1} for the control, 2.4 and 11.3 mg L^{-1} for the CM and 1.2 and 1.7 mg L^{-1} for the CM+AN treatments in 2005 and 2006, respectively (Table 2).
Increased N rates increased TDP concentration in 60-cm well (Fig. 4).
No significant differences among treatments in TDP in the 120-cm well (Fig.4), suggesting that minimal P leaching occurred below the 60-cm depth.

Conclusions

The study showed that combining cattle manure and ammonium nitrate increases forage yield and reduce P risk to the environment.

References

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Acknowledgement

This research was funded by TSTAR.