REGIONALIZED LEVELS OF SOIL PHOSPHORUS AND PHOSPHORUS SATURATION IN BEEF CATTLE PASTURES WITH AND WITHOUT GRAZING

G.C. SIGUA*[1], R.O. MYER[2], C.L. MACKOWIAK[2], S.W. COLEMAN[1], and C.C. CHASE Jr.[1]

[1]USDA-ARS, Subtropical Agricultural Research Station, Brooksville, FL 34601; [2]North Florida Research and Education Center, University of Florida, Marianna, FL 32446

*gilbert.sigua@ars.usda.gov

ABSTRACT

Available soil phosphorus (P) in various agro-ecosystems is regulated by climate, soil type, vegetation, and management practices. Available soil P in bahiagrass beef cattle pastures were compared with rhizoma peanut pastures and bermudagrass pastures. For each location, the main plot was represented by grazing management (grazing vs. no grazing) while forage type (bahiagrass vs. perennial peanut-bahiagrass mix at Brooksville, FL and bahiagrass vs. bermudagrass at Marianna, FL) represented sub-plot treatments. Soils were sampled concurrently from these locations (2004 to 2007) with or without grazing. Soil available P concentration and the degree of soil P saturation varied with pasture location ($P<0.0001$), grazing management ($P<0.01$), and forage type ($P<0.0001$). There were interactions between pasture location and grazing management as well as between grazing management and forage type. Soil P concentration at Brooksville did not vary between grazed and non-grazed pastures but soil P concentration varied with forage type (peanuts, 25.1 mg kg^{-1}; bahiagrass, 19.3 mg kg^{-1}) with an interaction between grazing management and forage type. At Marianna, soil P concentrations were greater in the non-grazed (11.3 mg kg^{-1}) than in the grazed (8.9 mg kg^{-1}) pastures. Based upon results from this study, pasture grazing by beef cattle appeared to have minimal (if any) effect on soil available P status.

MATERIALS AND METHODS

Exclosure at Marianna, FL (Bahiagrass)

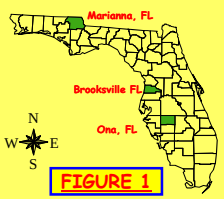
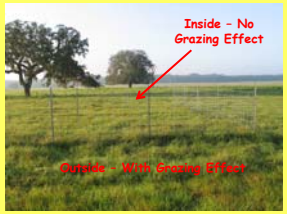


FIGURE 1



Exclosure at Brooksville, FL (Bahiagrass)

Forage Yield (Fresh) Measurement using Drop Height Technique

Exclosure at Marianna, FL (Bermudagrass)

Exclosure at Brooksville, FL (Rhizoma Peanut)

Cattle production at these pasture locations is forage-based with perennial tropical grass, bahiagrass (*Paspalum notatum*, Flugge), the predominant species. The other major forage species in Brooksville and Marianna are rhizoma peanuts (*Arachis glabrata*, Benth) and bermudagrass (*Cynodon dactylon*, L.), respectively. All the pasture fields that were included in this study received annual nitrogen fertilization of 90 kg N ha^{-1}.

Site Description

The study sites were located in two (Brooksville and Marianna) Florida pastures with cow-calf operations. The site in Brooksville, FL was at Turnley Unit (82.29° W; 28.62° N) of the USDA-ARS, Subtropical Agricultural Research Station. Soil (Candler fine sand) at this location can be described as well-drained hyperthermic uncoated typic quartzipsamments. The study site in Marianna, FL was located at the University of Florida North Florida Research and Education Center (85.18° W; 30.87° N) on a well drained acidic, sandy soil (fine loamy, kaolinitic, thermic kandiudults). Figure 1 shows the locations of the two study sites.

Soil Sampling

Soil samples were collected in the spring and fall of 2004, 2005, 2006, and 2007. Composite soil samples (nine sub-samples) were collected using a steel bucket type auger (6.6-cm diameter) to a depth of 25 cm. Soil core samples were collected from the 0- to 25-, 25- to 50-, and 50- to 100-cm depths from each pasture using a hydraulic sinker drill (Concord Environmental Equipment, Hawley, MN) to assess and quantify vertical distribution of soil P and other crop nutrients.

Analyses of P and P Saturation

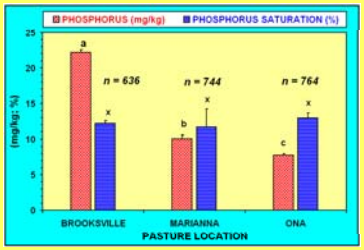
Soil samples were air-dried and passed through a 2-mm mesh sieve prior to chemical extraction of soil phosphorus. Sample extractions were conducted at USDA-ARS Laboratory located in Brooksville, FL. Soil available phosphorus was extracted with double acid (0.025 N H_2SO_4 + 0.05 N HCl) as described by Mehlich (1953) and analyzed using an inductively coupled spectrophotometer.

The degree of soil saturation with phosphorus (DPS) as described below was computed using the phosphorus, iron, and aluminum contents (mg kg^{-1}) of the soils.

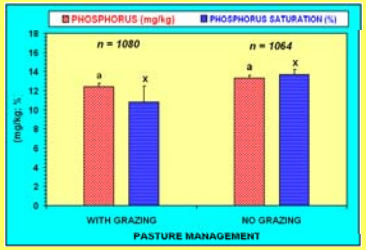
$$DPS\ (\%) = ([P] \times 100) / [Fe + Al])$$

RESULTS

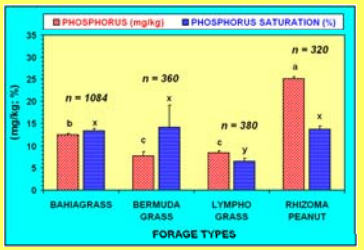
1. Effect of Pasture Location



2. Effect of Pasture Management

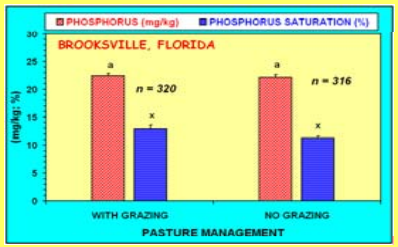


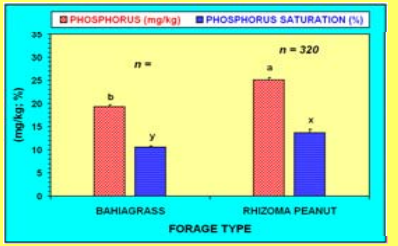
3. Effect of Forage Type



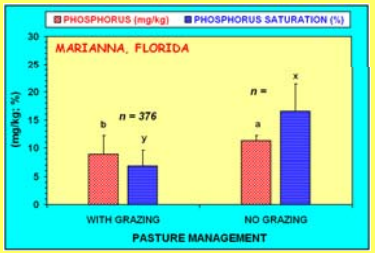
- Soil available P concentration and the degree of soil P saturation varied with pasture location ($P<0.0001$) and forage type ($P<0.0001$).
- Levels of Soil P at Pasture Location: Brooksville > Marianna > Ona.
- Levels of Soil P at Pasture with different Forage types: Rhizoma peanut > Bahiagrass > Bermudagrass = Lymphograss

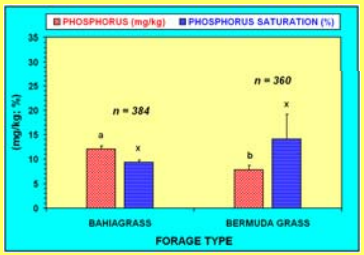
4. Pasture Location x Pasture Management Interaction Effects





- Soil P concentration at Brooksville did not vary between grazed and non-grazed pastures but soil P concentration varied with forage type (peanuts, 25.1 mg kg^{-1}; bahiagrass, 19.3 mg kg^{-1}) with an interaction between grazing management and forage type.
- At Marianna, soil P concentrations were greater in the non-grazed (11.3 mg kg^{-1}) than in the grazed (8.9 mg kg^{-1}) pastures.





CONCLUSIONS

- Based upon results from this study, pasture grazing by beef cattle appeared to have minimal (if any) effect on soil available P status.
- Average P in pasture locations did not exceed the crop requirement threshold of 50 mg P/kg while the degree of P saturation in the pastures were below the environmental threshold of P saturation (DPS = 60%), suggesting that P buildup and/or release is not a predicament in the pasture.