Executive Summary

The use of soil amendments is one of several best management practices (BMPs) to reduce edge-of-field P losses, which can impair water quality. Numerous amendment studies have been conducted throughout Florida over the years by several investigators, utilizing a wide variety of amendments. Interpreting the results of these studies is complicated by the wide variety of amendments, amendment rates, soils, P sources, and P loss mechanism(s) investigated. The purpose of our work was to conduct a systematic evaluation of numerous soil amendments using standardized protocols to provide directly comparable results upon which to judge amendment effectiveness. The protocols included standard total elemental analysis of each amendment, short-term lab equilibrations, small column leaching studies, and simulated rainfall studies. Amendments were applied to a composite soil, representing multiple samples of surface soil from an expected field demonstration site (Beaty ranch) in the Lake Okeechobee watershed. Amendments included water treatment residuals (Fe-, Al-, and Ca-based WTRs), industrial by-products produced or marketed in Florida (slag, silica-rich, and humate materials), and agricultural amendments (lime and gypsum).

Selection Summary

Results of the evaluation protocols allowed deselecting of most amendments, and identified the one or two amendments worthy of field investigation. A summary of the pertinent criteria used to select or deselect amendments is given below:

1. DuPont Fe-"humate" - deselected because of minimal P sorption capacity.
2. Coal slag - despite good adsorption and leaching control properties, the material was deselected because of troublesome trace element contents, especially Mo and As, and because the rates of coal slag required for P control could detrimentally affect plant growth through effects on soil salinity and pH.
3. Pro-sil - despite effective P sorption, effective leaching control, and moderate runoff control, the material was deselected because the rates required for P control can raise soil pH excessively which, when combined with a moderately high Mo content, could create an undesirable soil environment for pasture grass growth and grass quality that may threaten livestock health (molybdenosis).
4. Gypsum - very effective at controlling P leaching, but ineffective at P sorption and P runoff control. Also deselected because rates necessary for P control may result in soil salinities incompatible with good pasture grass growth.
5. Lime and Ca-WTR – behaved essentially the same in all protocols. Likely effective in initially acid soils requiring pH adjustment, but not in soils with pH values ≥7, where lime solubility is limited. In soils where soil pH is already near neutral (heavily manured Lake Okeechobee soils), little liming agent would be recommended for most pasture grasses. Both liming agents were, thus, deselected for field evaluation.
6. Vigiron (Fe-WTR) - moderately effective at sorbing P and reducing leaching, but only fair in controlling P runoff. Deselected because it contains moderately high concentrations of Mo and As, and may release immobilized P under reducing conditions.
7. dinoSoil - high rate (1%) only slightly effective at sorbing P and reducing leaching, but a top performer in runoff simulations. High cost (~$145/T), however, likely makes the amendment impractical for large scale use.

8. Manatee and Okeechobee Al-WTRs - effective P sorbers, but ineffective at controlling P leaching when soluble P is below the zone of amendment incorporation. Very effective at controlling P leaching when soluble P is made to contact WTRs (amendment incorporation, or soluble P added after amendment addition). The Al-WTRs dominated the best performers in runoff simulations. The Okeechobee material was uniformly better when applied at 1%, whereas the Manatee material requires rates ≥2.5%. The Okeechobee material is locally available, but its low solids content (~9%) creates handling and transportation problems. Additionally, annual WTR production is estimated at only 250-300 tons, which severely limits the acreage that can be amended. Relatively high rates (~25 T/A) of the Manatee material are needed, but the material’s dry condition makes handling/application easy, and annual production is much greater (~4000 Mg) than at Okeechobee. Either (or both) materials are suitable for field-testing: Okeechobee material at 0.1 and 1%, or Okeechobee at 1% and Manatee material at 2.5%, but the Manatee material is recommended. Method of WTR application – surface applied or soil incorporated - should be tested. Thus, the two treatments recommended for field testing are Manatee Al-WTR at 2.5%, surface applied and incorporated to 5 cm.