Grasslands Partnership
CONSERVING OUR SOILS, FARMS, AND ENVIRONMENT
grasslandspartnership.org

Report No. 2023-7
October 2023

Authors:

Forbes Walker,[1]
Jason de Koff,[2] John Fike,[3]
Tim Sexton[4]

[1] University of Tennessee
[2] Tennessee State University
[3] Virginia Tech
[4] Virginia State University

Summary

This report, addressing soil amendments, is one of a set of seven describing practices supported by the Grasslands Partnership project. T*wo novel soil amendments, biochar and gypsum, have been shown to improve soil carbon balances and nutrient cycling among other benefits. Each material should be surface applied to pastures and neither requires incorporation. Guidelines for application rates and materials sources are provided.*

CLIMATE SMART PRACTICES –USE OF ALTERNATIVE SOIL AMENDMENTS: BIOCHAR AND GYPSUM

Two novel soil amendments, biochar and gypsum, will be used to slow soil N transformations and losses from the soil and increase rates of carbon sequestration. We will validate the effects of using these amendments on forage productivity and nutritive value, as well as carbon sequestration and the mitigation of greenhouse gases in grasslands.

Conditions For Use Of Practice

1. Established tall fescue-dominated and native warm-season grass pasture.
2. In addition to the parts of pastures amended with either biochar or gypsum, part of the pasture will be designated as a 'Control' section to enable comparison of the effects of the soil amendments, on forage productivity, as well as carbon sequestration and the mitigation of greenhouse gases.

Practices To Be Implemented

Biochar

- Biochar is a charcoal-like material that is produced from biomass decomposed at high temperatures in the absence of oxygen, often during renewable energy production. During the process, the physical and chemical properties of the plant material change into a highly porous, stable, carbon-rich material known as biochar. Recent research suggests when used as a soil conditioner, biochar can improve several soil physical, chemical and biological properties, such as increased cation exchange capacity (the ability to hold nutrients) and increased plant nutrient and water availability. Biochar can increase nitrogen-use efficiency, reduce nitrous oxide losses to the environment, and increase soil carbon sequestration.

This material is based upon work supported by the U.S. Department of Agriculture, under agreement number NR233A750004G086. Any opinions findings conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture. In addition, any reference to specific brands or types of products or services does not constitute or imply an endorsement by the U.S. Department of Agriculture for those products or services.

- The chemical and physical properties of biochar can vary greatly depending on the type of biomass being processed and the temperature used to produce it. In the Southeast, biochar has been be made from hard- and softwoods, rice hulls, switchgrass, pecan shells and even biosolids. Only commercially available biochar should be used. For this project, a local source of biochar should be used. If local, commercially available sources are not available, use biochars produced within the Southeast.
- Application rates of biochar should be based on state Extension guidelines, where available. If not, a rate of 3 to 5 tons per acre is suggested. Biochar should be surface applied over the pasture. Incorporation of the biochar is not required. A minimum of a 2-acre pasture is recommended for this practice.
- Biochar can be applied to either cool- or warm-season pastures. Biochar should not be applied prior to pasture establishment, as it may interfere with the efficacy of some herbicides.
- Biochar can be applied to many types of soils. Biochar generally increases nutrient and water holding capacity of poorer (for example, sandy) soils, that are prone to summer droughts, and it may help increase the pore space of dense clays. Biochar also has nutrients and, in some cases, can increase soil phosphorus, potassium, and pH levels.
- Producers are encouraged to follow the NRCS Conservation Practice Standard 336 (Soil Carbon Amendment) guidance on the use of biochar.
- Producers must keep records on the source, analyses, and application rates of biochar used.

Gypsum

- Gypsum or calcium sulfate is a soil amendment that has been marketed in the past as a “soil conditioner” for improving soil tilth. Other uses of gypsum have been to alleviate aluminum toxicity in acid soils, to supply calcium and sulfur for plant nutrition, to treat sodic soils, to assist pegging and reduce blossom end-rot in peanut systems, to reduce phosphorous runoff, and to reduce potential pathogens in surface runoff.
- Recent research from Brazil suggests that gypsum can increase carbon sequestration rates in perennial cropping systems.
- Gypsum can be mined from geological deposits, produced as a by-product from coal-fired electrical plants, or produced from recycled dry wall. Any of these sources are options for use on pastures.
- Application rates of gypsum should be based on state Extension guidelines, where available, or NRCS Conservation Practice Standard 333 (Amending soil properties with gypsum products). Where there are no state Extension guidelines, a rate of 1 to 2 tons per acre is suggested, although higher rates may be used.
- Gypsum should be surface applied over the pasture when cattle are not present. Cattle can be returned to the pasture after rainfall has removed any gypsum from the vegetation. Incorporation of gypsum is not required. A minimum 2-acre pasture is recommended.

- Gypsum can be applied to either cool- or warm-season pastures, either prior to or after pasture establishment.
- For cattle it is recommended that the maximum tolerable dietary concentration of sulfur is 0.4% of the ration on a dry matter basis. If used at the suggested rate of 1 to 2 tons per acre. sulfur concentrations will be within tolerable concentrations.
- Producers must keep records on the source, analyses, and application rates of gypsum used.