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Biochar Effects on Weed Management[1]

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Target Audience

The present document is intended to provide UF/IFAS Extension specialists, commercial growers, land managers, and gardeners with an overview of the impact that the use of biochar as soil amendment might have on weed management.

Introduction

Biochar is a carbon material produced by a method called *pyrolysis*. This method consists of the combustion of any plant residue under high-temperature and low-oxygen conditions. As a result oil, gas, and biochar (a type of charcoal) are generated, and these can be used as sources of energy. Biochar characteristics will change depending on the feedstock used and the temperature. Although biochar can be burned as regular charcoal, it can also be used as a soil amendment. In the soil, biochar behaves like a "sponge," retaining water and nutrients for plant uptake that could benefit crop growth. Biochar decomposition in the soil occurs very slowly, which means that the beneficial properties of this material can last for long periods of time. In addition, biochar binds pollutants or industrial wastes in the soil, reducing their risk of reaching ground water and mitigating their potential negative environmental impact.

Figure 1. (1) Biochar application at 2 ton/acre and (2) incorporation in an agriculture field commonly used for row-crop production (e.g. corn, cotton, peanut, soybean).
Credits: Neeta Soni, UF/IFAS

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Biochar Effect on Weed Germination and Growth

Biochar can potentially provide better conditions in the soil to increase plant growth. However, research has shown that weed species show minimal changes in germination and emergence patterns with the addition of biochar. Regardless, if biochar is used in the field it is important to monitor for changes in weed populations. This is especially important because biochar can decrease herbicide efficacy.

Weed Control

Preemergence herbicides are applied prior to crop emergence. These herbicides are sprayed directly on the soil and incorporated to ensure that weed seedlings are in contact with the herbicide. The action of preemergence herbicides can be affected by adsorption to soil organic matter or degradation by microorganisms, light, and temperature. Herbicide adsorption occurs when the herbicide is bound to soil particles or organic matter and is not available for plant uptake.

Experiments were conducted in four locations in west Florida. Soils of different textures and organic matter (OC) content (Table 1) were used in order to evaluate the effect that biochar incorporation into the soil (Figure 1) has on the activity of atrazine and pendimethalin—two widely used preemergence herbicides in crops such as corn, sugarcane, cotton, and peanut. The biochar used was rich in carbon and had small levels of nutrients such as nitrogen, calcium, and magnesium (Table 2). Following herbicide application, weed populations were monitored for four weeks. Regardless of the soil type, it was observed that where biochar was applied (2 ton/ac), herbicides provided no weed control (Figure 2). Doubling the label rate did not compensate for the loss of weed control as a result of biochar addition. This occurred because the herbicide was tightly bound to the biochar so that it was not available for uptake by the weed roots. Biochar soil incorporation can increase organic matter content in the soil, thus favoring herbicide adsorption. In addition, biochar provides a large surface area, where the herbicide can bind. Biochar characteristics are similar to those of activated carbon, which has been applied in planting rows to protect crops from herbicide injury.

If you are considering using biochar as a soil amendment on your farm or your garden, be aware that preemergence herbicides might not provide acceptable levels of weed control. This does not mean that biochar should be avoided. Instead, it means that when biochar has been applied to the soil, we might need to modify our current management practices in order to have adequate weed control. If the herbicide label allows it, the preemergence herbicide rate could be increased based on organic matter content to levels similar to those used in muck soils. However, most current herbicide labels will not allow rate increases high enough to compensate for biochar reduction of herbicidal activity. Therefore, alternative weed control practices should be considered. For example, preemergence herbicides can be replaced by early and frequent cultivation to mechanically remove weeds. In small areas and where the risk of mechanical injury to the crop or to desirable plants is high, hand weeding might be the safest way to compensate for the lack of preemergence herbicide control. Another alternative is to design specific weed control strategies that rely on the use of postemergence herbicides. This alternative will require the identification of postemergence herbicides and rates that are safe to the crop and to desirable plants but that will provide effective control of the weed community

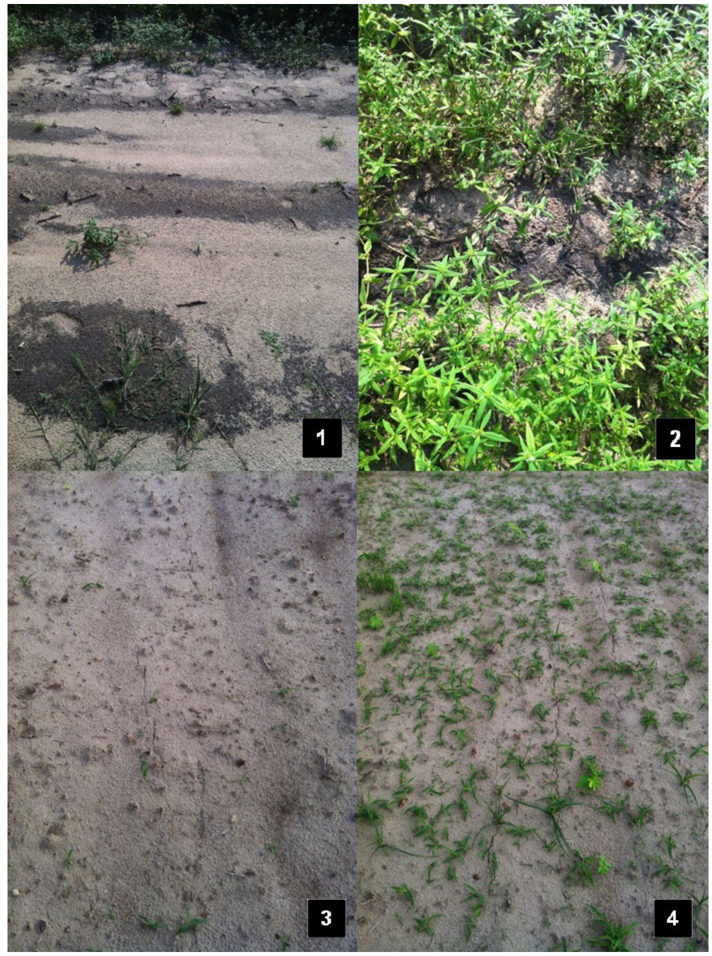

Figure 2. Atrazine at 8 pint/acre (label rate = 4 pt/ac) with (1) no biochar and with (2) biochar at 2 ton/ac.; and Pendimethalin at 4 pt/ac (label rate = 2 pt/ac) with (3) no biochar and with (4) biochar at 2 ton/ac.
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present in the area. For postemergence herbicides and for mechanical weed control, timing and weed size are critical for success. As a rule of thumb, postemergence herbicide applications and cultivation should be done to weeds that are no more than three inches in height or in diameter. A well-designed weed control strategy that accounts for reduced preemergence herbicide activity will help you maximize the benefits biochar can provide to your farm or garden.

Table 1. Soil type, texture composition, organic matter (OM) content, and pH of field experiment sites before biochar addition

Soil Types	Sand	Clay	Silt	OM	pH
	--------------------(%)-------------------				
Dothan sandy loam	36	30	34	2.3	6.5
Lakeland sandy	70	18	12	2.0	6.2
Angie variant clay	42	28	30	0.8	6.7
Fuquay sandy	68	26	6	2.5	6.1

Table 2. Characteristics of biochar used in the study. Biochar was produced from pine wood chips by pyrolysis at 800°C.

Characteristic[a]	Value
pH	9.2
EC (µS cm^{-1})	1775
Nitrogen (%)	0.53
Carbon (%)	62.5
P_2O_5 (%)	0.41
K_2O (%)	0.19
Sulfur (%)	0.12
Boron (%)	0.008
Calcium (%)	1.96
Magnesium (%)	0.49
Zinc (ppm)	2400
Manganese (ppm)	200
Iron (ppm)	1500

[a] Values were determined in aqueous solution, and concentrations are based on samples with 2% moisture content.