

Effect of low dosage biochar amendment on plant physiology parameters of sunflowers

José María De la Rosa, Marina Paneque, Juan D. Franco-Navarro, José Manuel Colmenero-Flores, and Heike Knicker

Instituto de Recursos Naturales y Agrobiología de Sevilla (IRNAS-CSIC), Seville, Spain. (jmrosa@irnase.csic.es)

Four different biochars were used as organic ameliorants in a typical agricultural soil of the Mediterranean region (a Calcic Cambisol). This field study was performed with plants of sunflower (*Helianthus annuus* L.) at the experimental station “La Hampa”, located in the Guadalquivir river valley (SW Spain). The soil was amended with doses equivalent to 1.5 and 15 t ha⁻¹ of the four biochars in two independent plantations. In addition, un-amended plots were prepared for comparison purposes¹. This study showed that the amendment with 1.5 t biochar ha⁻¹ did not modify significantly soil properties, or the agronomic productivity of sunflowers. However, in spite of this low dose of biochar, positive effects on plant physiology were observed.

The efficiency of Photosystem-II (quantum yield (QYPSII)), is a stress marker, related to the water status of the plant, and is reduced under drought stress. The QYPSII values of the plants grown with 1.5 t biochar ha⁻¹ were higher than in the control and ranged between 72 and 77%. Values between 70 and 80% correspond to non-stressed (well-watered) sunflower plants.

Biochar reduced stomatal conductance (gs, leaf transpiration) in both treatments. Therefore, the dependence of agronomic productivity on biochar dose was not observed, since both doses resulted in similar gs reductions. In C3 plants, such as sunflower, an increase of leaf area (LA) is usually associated to a decrease of gs caused by a reduction of stomatal frequency and increases the water use efficiency and drought tolerance². However, here no clear correlation could be established between biochar-induced LA stimulation and gs response after application of biochar. Thus, gs reduction was evident but not a consequence of LA increase. We hypothesize that biochar addition to soils alters anatomical and/or physiological parameters of the plants that in turn reduces stomatal conductance and increases water use efficiency of sunflower plants. After the last rain, increasing drought and water deficit resulted in a progressive reduction of gs in control plants. The more efficient use of water increased drought tolerance of amended plants. Therefore, we propose that biochar amendment provides protection from water deficit stress, a finding that points to the agronomic relevance of biochar use for Mediterranean rainfed crops.

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References:

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