Low-cost Biochar Production Technology to Improve Soil Quality for Crop Production

Dr. Abdullah Alshankiti & Dr. Shagufta Gill

International Center for Biosaline Agriculture, PO Box 14660, Dubai United Arab Emirates

What is biochar:

Biochar (BC) is a carbon-rich material produced via pyrolysis of biomass with limited oxygen that can be used as a soil conditioner and as a means to sequester carbon. It is produced by the pyrolysis of biomass, i.e. by heating biomass in an oxygen-free or low-oxygen environment so that it does not (or only partially does) undergo combustion. An advantage of this process is that it also produces gases that can be captured as bioenergy and fed back into the energy grid, making it a carbon negative process overall. Biochar is one of the most stable biologically produced carbon sources that we can add to soil.

Due to its chemical structure biochar is very difficult for microbes in the soil to break down, preventing the carbon sequestered in the char to be released quickly back into the atmosphere. This is a clear distinction between biochar and other organic matter, or pools of carbon, in the soil.

Why biochar?

Considering the importance of date palm production in the UAE and to handle the date palm green waste in a sustainable and eco-friendly way, an innovative on-farm biochar production technology has been developed. This low-cost farmer-friendly and affordable technology is ready to be deployed on a large scale not only to improve marginal soils but also to help farmers get better and more yields on a sustainable basis.

Benefits of biochar use:

- Improves nutrient availability
- Improve water retention in soil
- Carbon stability in soil for decades to millennia
- Wider C/N, N is not immobilized easily
- Adsorbed nutrients and metals

The low-cost biochar production technology (Figure 1) has been tested at the ICBA station to transform date palm feedstock into valuable biochar at 300-350^{o}C. The entire process took 2 hours to transform 30 kg of date palm feedstock into 10 kg biochar.

Testing biochar produced from date palm feedstock to improve health of UAE soils to enhance crop production.

Biochar in field data:

Biochar increases fresh biomass and 20 tons ha^{-1} seems optimum rate for sandy soils. The biochar from on-farm biochar production technology (using date palm feedstock) was used in field experiment (Pearl millet) at ICBA research station to evaluate the effect of different rates of biochar on the productivity and biomass yield of pearl millet. Three treatments (T1: Control + NPK , T2: Biochar at 20 tons ha^{-1} + NPK, and T3: Biochar at 30 tons ha^{-1} + NPK were used with complete randomization and each treatment with three replicates. A 9 m^2 (3m x 3m) plot size was used. The plots were irrigated through drip irrigation.

An increase in fresh biomass is very evident from above diagram, whereby fresh biomass increased from 4 tons ha^{-1} (control) to 6 tons ha^{-1} (50% increase over control) when biochar is added as 20 tons ha^{-1}. This shows 20 tons ha^{-1} is optimum rate for sandy soils. Same trend also recorded in increased number of tillers.

Improvement in plant growth and productivity due to biochar application has often been reported. The possible explanation for increase in biomass yield is due to improved physical, chemical and nutrient status of soil, which can be related to increased CEC values. Addition of biochar has shown promising results in improving available water for crop production, which ultimately will lead for water saving. The available water content (difference between water retention at 0.33 bar and 15 bars) increased by 16% and 40% over control when biochar was applied at 20 ton ha^{-1} and 30 tons ha^{-1} respectively.

Figure 1: Setup of the pilot scale facility fabricated at ICBA to produce biochar

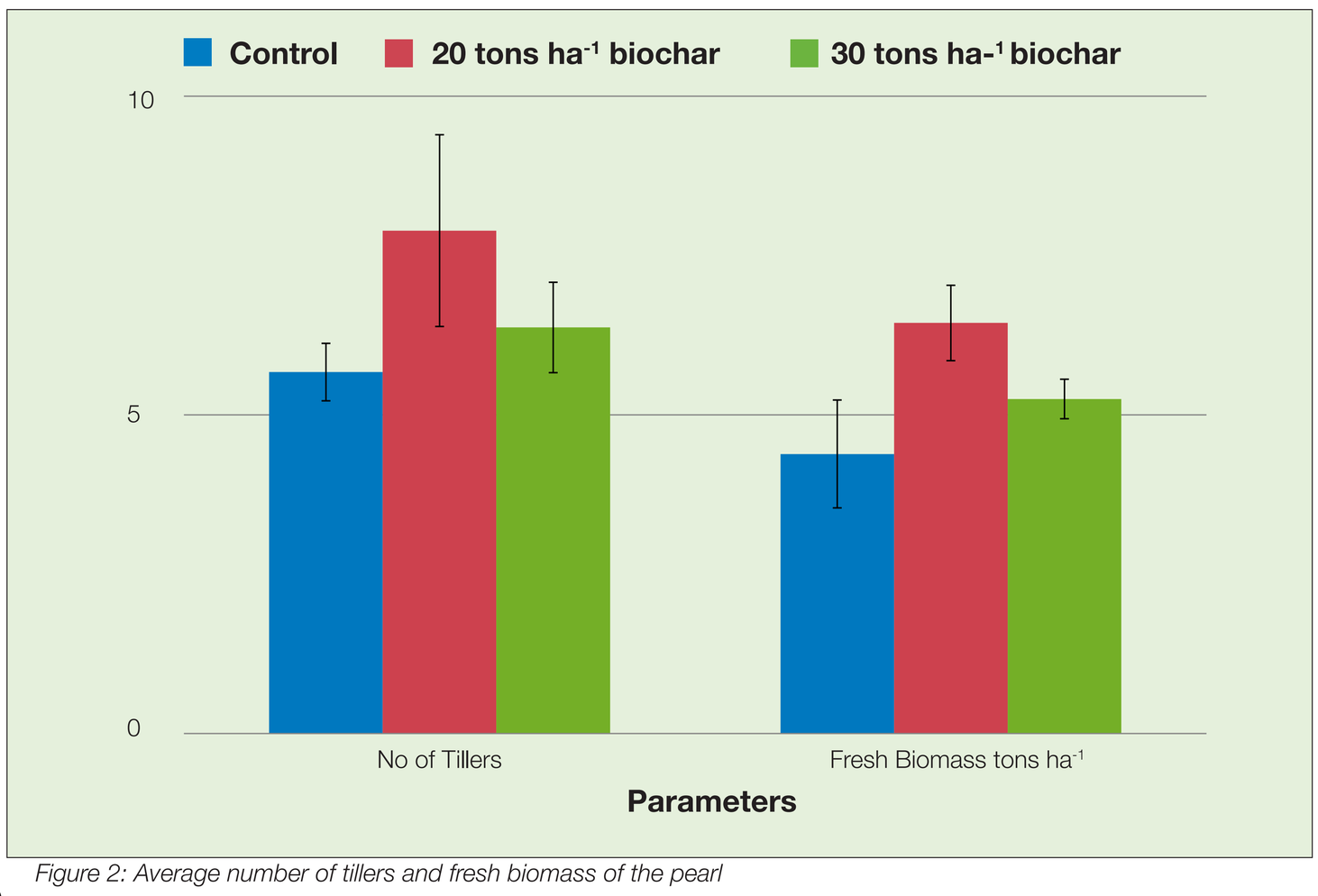

Figure 2: Average number of tillers and fresh biomass of the pearl

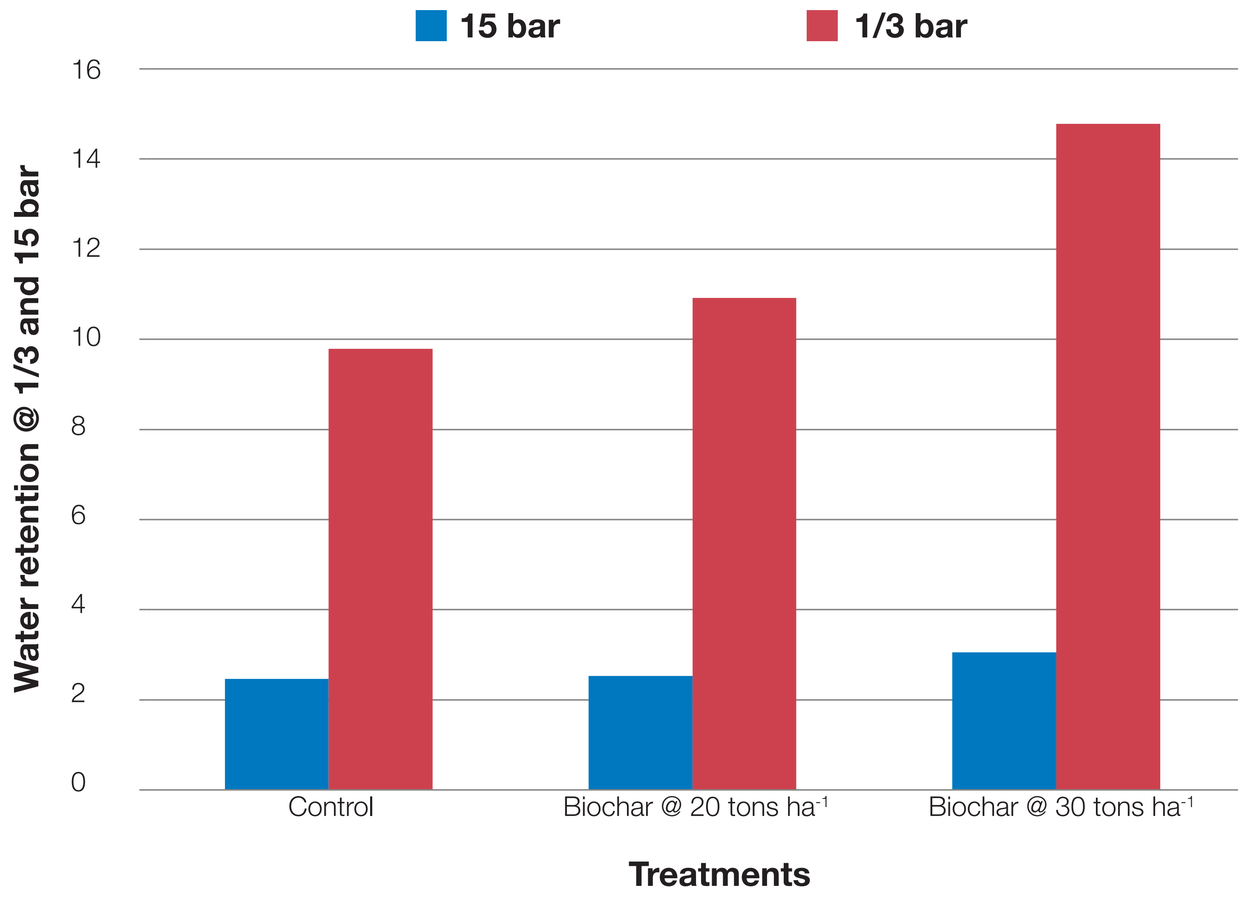

Figure 3: Effect of biochar on water retention