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不同温度下热裂解芒草生物质炭的理化特征分析

Physio-chemical characterization of biochars pyrolyzed from miscanthus under two different temperatures

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中文摘要:

芒草是一个极具潜力的生物质能源作物，为了研究了解芒草生物质炭的特征，评价其农业和与环境领域应用价值与潜力，该研究分别在和下制备生物质炭，测定其基础理化性质，以期了解芒草生物质炭特征及其随裂解温度变化的规律。结果表明，裂解温度显著地影响芒草生物质炭物理与化学性质，低温生物质炭含有比较高的水溶性成分，而高温生物质炭具有比较高的pH值、C/N比、芳香化结构、持水量和比表面积；但裂解温度对生物质炭δ值没有显著的影响。该文还讨论了芒草生物质炭在化肥利用率提高，以及污染土壤和水体修复等领域的潜在价值与工业应用前景，研究结果可为芒草生物质炭在土壤改良、固碳减排等方面的应用提供基础数据。

英文摘要:

Abstract: Miscanthus is a perennial rhizomatous grass and originates from the tropics and subtropics. The remarkable adaptability of miscanthus to different environments makes this novel crop suitable for establishment and distribution under a range of climatic conditions in China. Yields of Miscanthus have been reported to reach 30 t ha?1, thus it is considered as one of the most important potential biomass energy crops. To use miscanthus as the raw material to produce biogas, bio-oil and biochar are produced at the same time as by-products.Biochar is the charred byproduct of biomass pyrolysis, the heating of plant-derived material in the absence of oxygen in order to capture combustible gases. Its key characteristics are related to carbon sequestration. Due to its relative inertness, biochar contributes to the refractory soil organic carbon pool, and thus can decrease atmospheric CO2 concentrations by sequestering carbon when added to soil. Therefore, applying biochar to soil may contribute to decreasing, or slowing the increase in, global warming. In addition, it can be used as a soil conditioner, not only having potential in improving soil fertility, but also in remediating polluted soil.So far, we have understood little about miscanthus biochar, which becomes a bottleneck for applying the biochar as a soil conditioner. In this paper, miscanthus giganteus straw was dried at 105° C for 24 h, milled to<1 mm, and pyrolysed in a Carbolite CWF 1 200 furnace with a sealable retort (Carbolite, Hope, UK), flushed with argon. The furnace was initially heated to 100° C. The temperature then increased to 350 (BC350) or 700° C (BC700) at 1° C min?1, and finally held at 350 or 700° C for 30 min. The resulting biochars were subsequently cooled to room temperature overnight, while maintaining the argon flush, and were collected and then their characteristics were determined with different methods. The aim was to investigate the nature of the biochar and its changes with temperature.The results showed that the physio-chemical properties of the biochar were largely determined by the carbonization temperature. The miscanthus biochar produced at 350℃ (BC350) contained more water-soluble components, indicating it giving higher soil fertility if applied in soil. For example, as biochar was added to soil at application rates equivalent to 5 % of total soil organic C, this gave 222 and 16 μg water-extractable C g-1 soil for biochar350 and biochar700, respectively. The latter C concentration is clearly negligible. The same trend was found for NH4+-N, but on a much smaller scale: 1.75 and 0.18 μg NH4+-N g-1 biochar, equivalent to 0.09 and 0.01 μg N g-1 soil, for biochar350 and biochar700, respectively. BC700 had higher pH, C/N ratio, water-holding capacity (WHC), and surface area. The δ13C value, however, showed no difference between BC350 and BC700, while extractable NO3?-N was not detected in the water extracts from both biochars.The paper also discussed the potential value and its prospects of industrial application of miscanthus biochar, with current biochar producing equipment development, in improving soil fertility, soil remediation, and water purification in China.