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Application of biochar amendments to Mediterranean soils: effects on vine growth and grape quality

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Introduction:

Biochar is intended to be applied to soil, as a mean to sequester carbon and improve soil properties. To present, studies on the use of biochar in Mediterranean soils are still scarce. In this study different biochar and compost amendments were applied to a vineyard in Tarragona (Spain) in order to determine their effects on vine growth and grape quality so that the suitability of biochar amendments as an alternative to conventional organic compost could be evaluated.

Materials and Methods:

This study was carried out from 2011 to 2013 in an experimental vineyard of 1050 m2, located in Poblet (Catalonia, Spain). The climate type is Mediterranean, with 500 mm of annual precipitation and 13.6 ^{o}C of annual mean temperature. The soil type is a Fluvic Cambisol, very deep (>120 cm), pH of 7, high coarse fragment content, low organic matter content (1.5 %) and without calcium carbonate. The studied plots were 20-year-old vines of Grenache, trained to an espalier-type canopy system, dry-land farmed and weeds controlled by ploughing.

Repeated applications of soil amendments took place in spring 2012 and 2013, following a randomized block design with three replicates per treatment. The treatments considered were biochar, compost and mixture compost x biochar. A control treatment without any organic amendment was also included. The biochar was produced by slow pyrolysis (550 ^{o}C of average temperature) of grapevine trunks from a vineyard close to the experimental plot. The compost was commercial certified organic compost. The application doses were 5 tons C · ha-1 per treatment.

The petiole analysis and leaf architecture sampling were undertaken during the veraison period (August). During grape ripening, berry composition was measured on a weekly basis (September). At the harvest date, yield parameters were also determined. It is worth noting that in 2013 these harvest data were highly perturbed by millerandage. Finally, in early winter, vegetative development analysis was performed.

Results:

Significant differences at the 0.05 level among treatments in the properties studied were only detected in the second year. The most remarkable differences were found in petiole analysis: the nitrogen content was significantly higher in (i) "compost" (0.98 $\pm$ 0.42 %) than in “control” (0.58 $\pm$ 0.03 %) or “biochar” (0.56 $\pm$ 0.03 %), and (ii) in the “biochar x compost” (1.69 $\pm$ 0.16 %) than the rest of treatments. Results thus indicate that the mixture of biochar with compost favored the vineyard nutritional status. No significant differences were found among treatments in the rest of variables investigated, except for pruning weight per vine, which ranged between 0.44 $\pm$ 0.01 kg in the “biochar” treatment and 0.62 $\pm$ 0.05 kg in the “compost” treatment.

Conclusions:

The results obtained show that the effects of the amendments applied to this vineyard soil are time-dependent, there being an improvement in the N nutrient status of vines of the “compost” and “compost x biochar” treatments in year two, and this effect being greater with the simultaneous application of both amendments. Results thus suggest the need to monitor changes in soil properties in future years. The fact that a considerable millerandage occurred in 2013 reinforces this need.

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