Geophysical Research Abstracts
Vol. 19, EGU2017-16349, 2017
EGU General Assembly 2017

Copper toxicity management in Mediterranean agricultural soils

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Copper contamination in soils is worldwide problem, and of special concern in agricultural areas due to the influence on production and human nutrition. The natural input of Cu to soils due to pedogenic processes has been exceeded in some areas by human input, and toxic concentrations of different metals in soils can be reached and exceeded because of this. Especially relevant are the accumulation processes that take place in agricultural soils, where high concentrations can be reached due to inadequate agricultural practices and contamination processes associated to urban-industrial uses. On one hand, agricultural soils can reach these concentrations due to the continued use of Cu-based fungicides and Cu-enriched fertilizers. On the other hand, high concentrations of bioavailable Cu in soils can be obtained due to point pollution sources or nearby mining activities. Therefore, an adequate identification of Cu-contaminated sites along with the establishment of appropriate management strategies becomes crucial for the conservation of the resource soil.
The study carried out tried to address these issues for Cu-contaminated Mediterranean agricultural soils, through the analysis of the current soil quality standards for different Mediterranean regions and proposing new criteria for their establishment based on the influence of soil properties and type of crop. Also, the potential use of lettuce (Lactuca sativa L.) and tomato (Solanum lycopersicum L.) in these contaminated soils was also analysed. These were assessed by evaluating the effect of Cu and its interaction with soil properties on biomass production; and its absorption, translocation and accumulation in the different parts of the plant. Different assays were carried out in seven different types of Mediterranean agricultural soils (from Europe and Australia) contaminated with several Cu concentrations. When lettuce was grown, similar toxic effects and accumulation values were obtained for both agricultural areas under analysis and for both, the soil having the highest pH and clay content underwent the least severe effect, independently of the soil type. For tomato, toxicity values calculated were higher, and translocation of Cu to the fruit was constantly low, independently of the Cu dose. Again, the soil having the highest pH and clay content underwent the least severe effect. Moreover, tomato showed an important phytoremediation potential, extracting Cu from highly (>1700 mg/kg) Cu-contaminated basic agricultural soils, and having low translocation rates to fruits. Therefore, soil properties and type of crop are aspects that should be considered when establishing appropriate soil quality standards and proposing adequate soil management practices.