Geophysical Research Abstracts
Vol. 17, EGU2015-15367, 2015
EGU General Assembly 2015

Influence of biochar on the enantioselective behavior of the chiral fungicide metalaxyl in soil

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Chiral pesticides comprise an emerging and important class of organic pollutants currently, accounting for more than a quarter of used pesticides. Consequently, the contamination problems caused by chiral pesticides are concern matter and factors affecting enantioselective processes of chiral pesticides in soil need to be understood. For example, certain soil management practices, such as the use of organic amendments, can affect the enantioselective behavior of chiral pesticides in soils.

Recently, biochar (BC), i.e. organic matter subjected to pyrolysis, has been proposed as organic amendment due to beneficial properties such as its high stability against decay in soil environments and its apparent ability to influence the availability of nutrients. BC is considered to be more biologically inert as compared to otherforms of organic carbon. However, its side-effects on the enantioselectivity of processes affecting the fate of chiral pesticides is unknown. The aim of this study was to assess the effect of biochar (BC) on the enantioselectivity of sorption, degradation, and leaching of the chiral fungicide metalaxyl in an agricultural soil.

Amending the soil with BC (2% w/w) resulted in 3 times higher sorption of metalaxyl enantiomers compared to unamended soil, but no enantioselectivity in the process was observed. Moreover, both enantiomers showed some resistance to be desorbed in BC-amended soil compared to unamended soil. Dissipation studies revealed that the degradation of metalaxylwas more enantioselective in the unamended soil than in BC-amended soil. In unamended soil, R-metalaxyl(biologically active) and S- metalaxyl had half-lives (t1/2) of 3 and 34 days, respectively. BC enhanced the persistence of both enantiomers in the soil, with R-metalaxyl being degraded faster (t1/2=43 days) than S-metalaxyl (t1/2= 100 days). The leaching of both S-and R-metalaxyl was almost suppressed after amending the soil with BC; less than 10% of the fungicide applied to soil columns was recovered in leachates, in contrast to significantly higher percentages leachedin unamended soil, being the process more enantioselective in the latter case. Finally, total recoveries of both enantiomers were greater for BC-amended soil columns than for unamended soil columns, indicating reduced degradation in BC- amended soil.

Our findings illustrated the ability of biochar to modify the enantioselectivity behavior of metalaxyl in soil by its high sorption capacity. BC could contribute to reduce the current agronomic doses used for chiral pesticides to deplete the contamination problems associated with their use, and also to act as an immobilizing amendment in soil remediation strategies.

Acknowledgments: MINECO (AGL2011-23779), FACCE-JPI (Designchar4food), JA (AGR-264) and FEDER-FSE (OP 2007-2013).