Long-term simulations of water and isoproturon dynamics in a heterogeneous soil receiving different urban waste composts

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INTRODUCTION

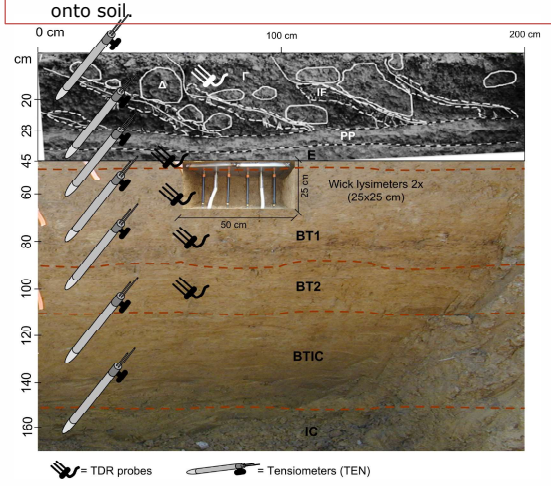
- Compost addition to soil affects soil physical properties and impact pesticide transport in soil.
- Pesticide fate in soil is controlled by sorption and degradation processes which can have a large spatial variability in the soil at the field scale.
- Combining compost addition with moldboard plowing may create compacted soil zones next to non-compacted soil zones containing large amounts of organic material with contrasting hydraulic properties.
- Isoproturon (IPU) is one of the most detected herbicide in surface and ground waters (EU).

OBJECTIVE

A modeling study was carried out using **HYDRUS-2D** for the **2004-2010 period** to confront the effects of two different compost types combined with the presence of heterogeneities due to tillage in terms of **water** and **IPU dynamics** in soil. A municipal solid waste compost **(MSW)** and a co-compost of sewage sludge and green wastes **(SGW)** have been applied to experimental plots and compared to a control plot without any compost addition **(CONT).**

MATERIALS AND METHODS

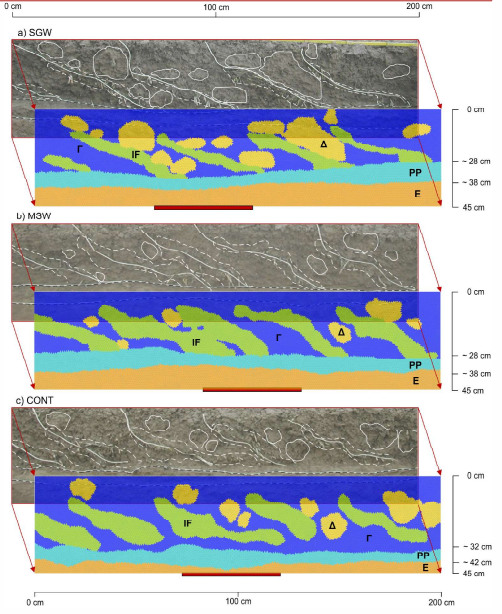
- Long-term field experiment "QualiAgro" https://www6.inra.fr/qualiagro_eng/; Albeluvisol (WRB); Crops: winter wheat (Triticum spp.); maize (Zea mays L.); barley (Hordeum vulgare L.)
- Water and IPU monitoring: 2 wick lysimeters, 5 TDR probes, and 7 tensiometers per plot.
- Ploughed layer structural description: compacted clods (Δ), non-compacted soil (Γ), interfurrows (IF), and the plough pan (PP).
- Different structural zones were implemented into HYDRUS-2D using optimized soil hydraulic properties.
- Water flow was solved using Richards equation while solute transport was modeled using advection–dispersion equation assuming first order kinetics for solute degradation in the liquid phase, and instantaneous linear sorption onto soil.



Soil profile description with different structural zones and installed equipement.

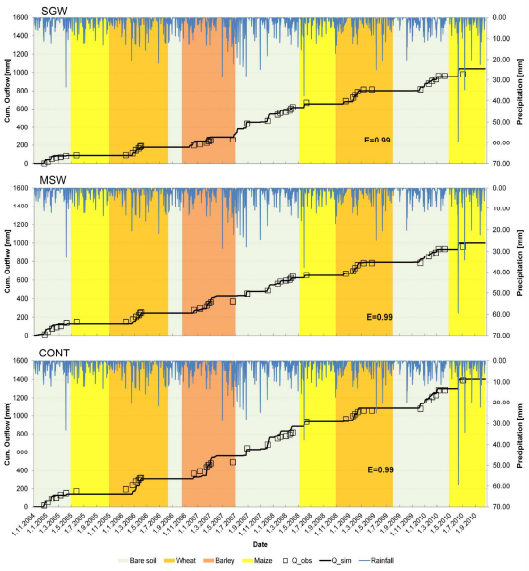
Basic average properties of applied compost SGW and MSW.

Compost type	pH (H_2O)	OM g/kg	Organic C g/kg	Total N g/kg	C/N ratio	$CaCO_3$ g/kg dry wt.	Water content %	Bulk density Mg/m^3
SGW	7.6	48.8	267.8	23.2	11.8	23.3	66.9	0.42
MSW	7.3	59.3	317.9	17.4	18.8	62.1	58.6	0.29

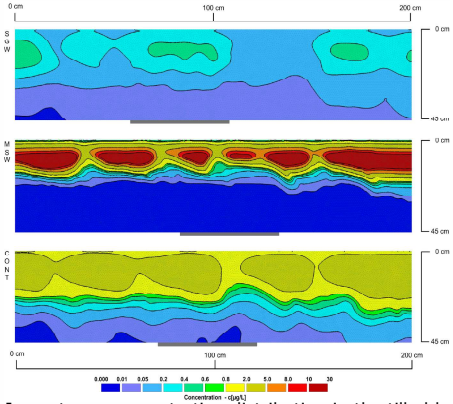


Field description of the SGW, MSW and CONT, showing the different soil structures observed in the first 45 cm depth together with their spatial distribution in the HYDRUS-2D model.

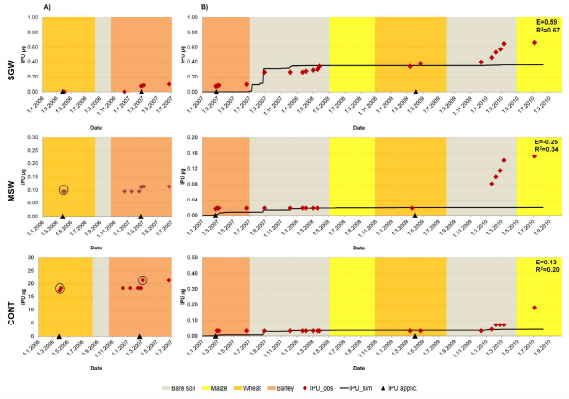
RESULTS



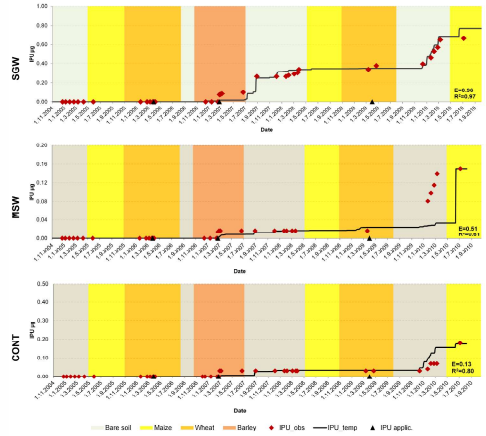
Observed vs simulated cumulative lysimeter water outflow in SGW, MSW, and CONT plots.



Isoproturon concentration distribution in the tilled layer on the 26th of August 2007 (186 days after the second application) for SGW, MSW and CONT plots.



Observed IPU mass leached through the lysimeter (symbols) with preferential flow events (circled) during 2006/07, and b) observed (symbols) vs simulated (line) IPU leached mass during the 2007–2010 period for SGW, MSW and CONT plots.



Observed (symbols) vs simulated (line) IPU leached mass during the 2004–2010 period excluding preferential flow events and assuming temporal variation of isoproturon degradation rate for SGW, MSW and CONT plots.

CONCLUSIONS

The model was able to reproduce in-field water flow and isoproturon leaching patterns except for the large preferential flow events that were observed in the MSW and CONT plots.

The timing of these preferential flow events could be reproduced by the model, but not their magnitude.

Modeling results indicate that spatial and temporal variations in pesticide degradation rate due to tillage and compost application play a major role in the dynamics of isoproturon leaching.

Both types of compost were found to reduce isoproturon leaching on the long-term (6 years) duration of the field experiment.

REFERENCES

Filipović, V., Coquet, Y., Pot, V., Houot, S., Benoit, P. (2016): Modeling water and isoproturon dynamics in a soil profile with different urban waste compost application considering local heterogeneities. *Geoderma* 268:29–40.

Filipović, V., Coquet, Y., Pot, V., Houot, S., Benoit, P. (2014): Modeling the effect of soil structure on water flow and isoproturon dynamics in an agricultural field receiving repeated urban waste compost application. *Science of the total environment* 499:546–559.

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