CONFERENCE PROCEEDINGS | YORK (UK)

Pesticide behaviour in soils, water & air

Conference Organising Committee

Professor Colin Brown	University of York, UK
Mr Dave Arnold	Independent Consultant, UK
Dr Gary Bending	University of Warwick, UK
Dr Sabine Beulke	The Food and Environment Research Agency, UK
Dr Jos Boesten	Alterra, The Netherlands
Professor Ettore Capri	Università Cattolica del Sacro Cuore, Italy
Dr Mélanie Kah	The Food and Environment Research Agency, UK
Dr Christopher Leake	Bayer CropScience, Germany

Sponsors

We are greatly indebted to the following organisations for their generous support:

BASF The Chemical Company

Bayer CropScience

Exponent International Limited

MONSANTO imagine

syngenta

SCORZA JÚNIOR, R.P.; RIGITANO, R.L.O. Simulation of pesticide leaching in a Brazilian heavy clay soil using PEARL and MACRO models. In: CONFERENCE ON PESTICIDE BEHAVIOUR IN

Simulation of pesticide leaching in a Brazilian heavy clay soil using PEARL and MACRO models

Scorza Júnior, R.P.[1*]; *Rigitano, R.L.O.*[2]

[1] Embrapa Western Region Agriculture, P.O. Box 661, 79804-970 Dourados-MS, Brazil
[2] Entomology Department, Federal University of Lavras, P.O. Box 3037, 37200-000 Lavras-MG, Brazil
* romulo@cpao.embrapa.br

Introduction

Environmental fate of pesticides in Brazilian agricultural areas has become a major concern due to increasing problems of groundwater contamination. Models have been developed to simulate pesticide leaching at field scale and thus assess the risk of groundwater contamination. Additionally, these models have also supported the governmental decisions regarding pesticide registration in USA and Europe but not in Brazil. There is lack of studies to test pesticide leaching models for Brazilian agricultural scenarios and thus to conclude about the feasibility of using them as a tool for risk analysis. This work aimed at testing the PEARL (Leistra et al., 2002) and MACRO (Larsbo & Jarvis, 2003) models against field measurements of moisture profiles and the leaching of a tracer and two pesticides with contrasting mobilities in a very clayey Oxisol in Dourados, Mato Grosso do Sul State, Brazil.

Material and methods

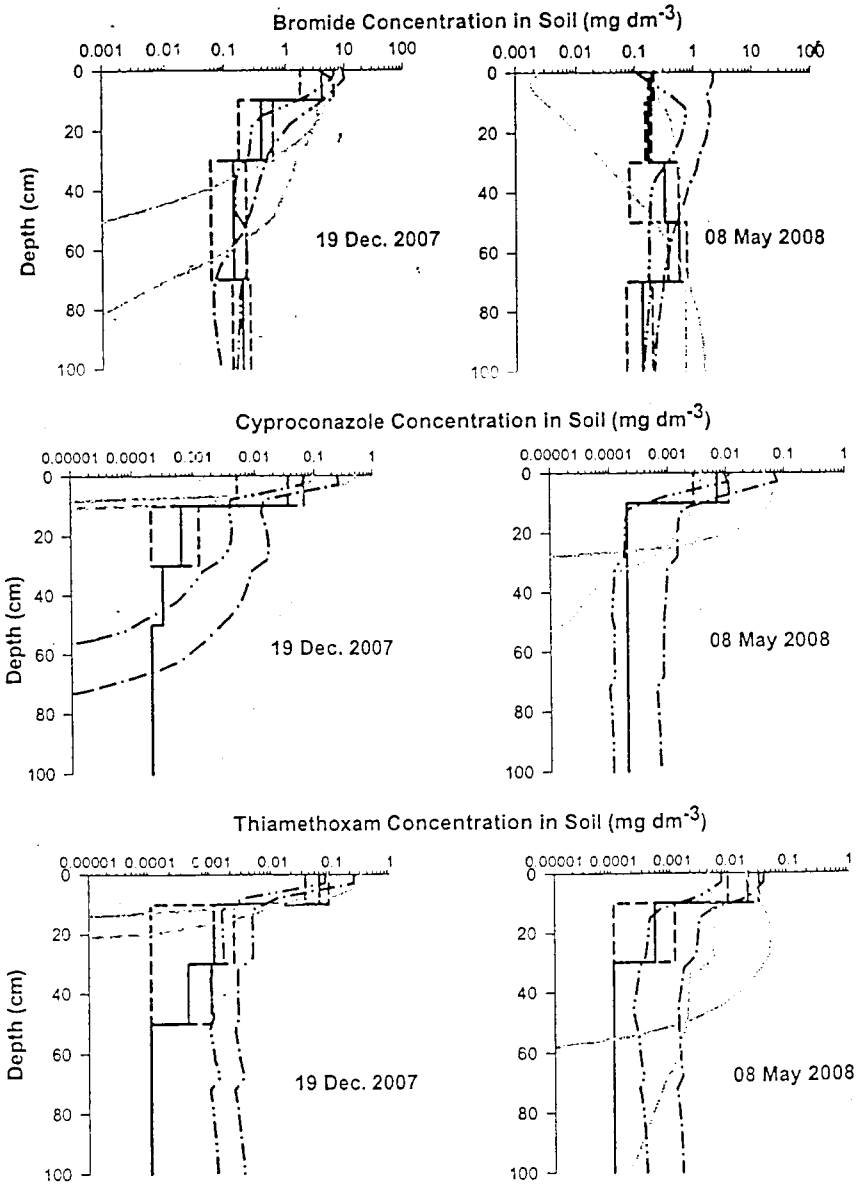
The field experiment was carried out in an area of 0.09 ha located at Embrapa Western Region Agriculture in Dourados, Mato Grosso do Sul State, Brazil (22° 16' 26" S, 54° 48' 50" W). The soil is a heavy clay Oxisol with about 70% of clay. Cyproconazole (240 g a.i. ha^{-1}), thiamethoxam (282 g a.i. ha^{-1}) and bromide (4 kg Br ha^{-1}) as a water flow tracer were applied separately on the same day (4th Dec. 2007), using a tractor-mounted boom sprayer. Soil profiles (0-100 cm depth) were sampled at four times (0, 15, 73 and 156 days after application) and 15 soil samples on each sampling date were individually analyzed for moisture, bromide and pesticide residues. Transformation and sorption of the two pesticides at 25°C and two depths (0-30 and 50-70 cm) were studied at laboratory. A stepwise approach was adopted for testing PEARL (version 3.3.3) and MACRO (version 5.1) using site-specific input parameters. Calibration of water flow and solute transport input parameters were carried out using automatic calibration.

Results

Uncalibrated simulations of water flow resulted in moisture profiles that were much drier than measured for PEARL between 10-100 cm depth and in a reasonably good simulation of moisture profiles for MACRO. After calibration of water retention curves for both models, a good simulation of moisture profiles was obtained for all sampling dates. Bromide was already found in the whole soil profile after 15 days of application (Fig.1). Considering a piston flow approach, it would be expected that bromide had leached to 14 cm depth. This may be considered an evidence of preferential transport in this Brazilian Oxisol. To obtain a good simulation of bromide leaching, it was necessary to calibrate the dispersion length and saturated hydraulic conductivities for PEARL and the boundary hydraulic conductivities and effective diffusion pathlength for MACRO. PEARL and MACRO tended to overestimate the persistence of both pesticides in soil even after calibration of half-lives. Good simulations of areic mass in soil for both pesticides and models were only possible after reduction of the amount applied used as input value. This was done to simulate

the rapid decrease of areic mass in soil just after application that may have been caused by volatilization. After this reduction, a good agreement between measured and simulated pesticide concentration profiles was obtained for both models. In conclusion, MACRO performance to simulate pesticide leaching in the studied soil was better than PEARL.

Figure 1. Measured and simulated bromide, cyproconazole and thiamethoxam concentration profiles for two sampling dates at the experimental field in Dourados, Mato Grosso do Sul State, Brazil. The area within the dashed black lines is the range of measured values plus and minus two times the standard deviations and the solid black lines are average measured values. Uncalibrated PEARL simulations are represented by solid gray lines and calibrated ones by dashed gray lines. Uncalibrated MACRO simulations are represented by dash-dot lines and calibrated ones by dash-dot-dot lines.



References

Larsbo M, Jarvis N (2003). MACRO 5.0. A model of water flow and solute transport in macroporous soil. Technical description. SLU, Uppsala, Sweden.

Leistra M, van der Linden AMA, Boesten JJTI, Tiktak A, van den Berg F (2002). PEARL model for pesticide behaviour and emissions in soil-plant systems: description of the processes. Alterra Report 13, Wageningen, The Netherlands.