HIGHER TIER MODELLING OF GROUNDWATER CONCENTRATIONS FROM PESTICIDES USED ON RICE

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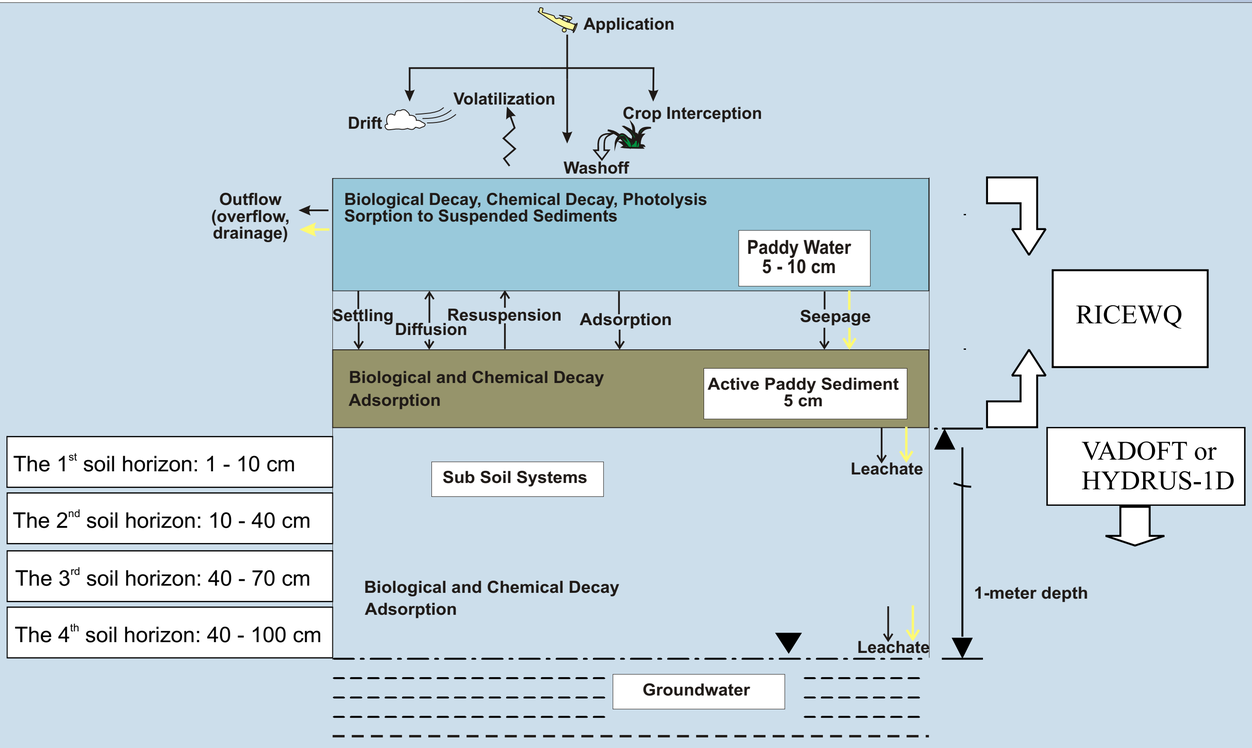
INTRODUCTION

The Med-Rice model is used to determine Predicted Environmental Concentrations in groundwater (PECgw) for pesticides used on rice. Higher tier approaches have not been established under EU guidance to address situations when the Med-Rice model generates a PECgw greater than 0.1 ug/L. This poster compares several options for conducting higher tier modelling of PECgw by linking the RICEWQ (a pesticide fate and transport model developed to simulate the seepage, flooding conditions, overflow, and controlled releases of water associated with rice production) with several leaching and/or groundwater models including VADOFT (Vadose Zone Flow and Transport model) and HYDRUS-1D (unsaturated flow and solute transport model).

MATERIALS AND METHODS



The RICEWQ-VADOFT and RICEWQ-HYDRUS modeling packages were validated to simulate chemical runoff, leaching, and dissipation observed in a 2-year field monitoring study in northern Italy (Karpouzas, et al., 2005; Miao, et al., 2003; Fragoulis, et al., 2009).

RICEWQ simulates pesticide transport from rice paddies based on water and pesticide mass balance (Williams, et al., 2008). VADOFT uses Richards' equation to simulate one-dimensional, single-phase moisture and solute transport in unconfined, variably saturated porous media (Suárez, L.A., 2005). HYDRUS-1D is a finite element model for simulating the one-dimensional movement of water and multiple solutes in variably saturated media (Simunek, et al., 2008). HYDRUS uses the Richards' equation for simulating variably-saturated flow and Fickian-based convection-dispersion equations for solute transport.

When the paddy soil moisture exceeds field capacity in RICEWQ, seepage to VADOFT or HYDRUS-1D occurs. When the paddy dries out, soil moisture can decrease from evapo-transpiration up to the wilting point. In the packages, the pesticide mass in leachate interacts with the bed sediment through sorption and degradation in the soil-water phase. With daily input data, the model packages operate at an hourly time step and integrate the hourly pesticide fate rate to obtain total decay, seepage, runoff, and leaching.

RICE SCENARIO RESULTS

Significant advances have been made by the FOCUS Working Groups in the past decade to identify and validate appropriate models and to develop standardized scenarios for determining PECs in ground water, surface water, and soil. To date, standardized higher tier scenarios have not been developed to address PECs associated with the use of pesticides on rice. Fragoulis, et al. (2009) presented potential EU scenarios for rice using RICEWQ-VADOFT or RICEWQ-HYDRUS to predict PECgw. Scenarios for Italy, Spain, and Greece were presented (Fragoulis, et al., 2009). The Average Italian scenario from that presentation with a dummy pesticide and 20 years of Piacenza weather is shown as an example in this poster.

Soil Parameters

Scenario	Soil Texture	Bulk Density (kg dm3)	Organic Carbon (%)	Infiltration rate (cm/d)
Med-Rice	Clay	1.5	1.8	0.1
Med-Rice	Sand	1.5	0.9	1.0
Avg Italian	Loam	1.4	1.4	0.3

Application Parameters

Appl. Rate:	0.1 kg/ha
Appl. Time:	Pre-emergent
No. of Appl:	1
Wet Sowing:	Apply to flooded
Dry Sowing:	Incorporated

Concentrations at 1-m Depth

Model	Scenario	Koc (L/kg)	Water Half-life (d)	Sediment Half-life (d)	Concentration (ppb)*
Med-Rice	Clay	300	100	150	0
Med-Rice	Clay	300	5	150	0
Med-Rice	Sand	300	100	150	0.29446
Med-Rice	Sand	300	5	150	0.15133
VADOFT	Wet Seed	300	100	150	0.00431
VADOFT	Wet Seed	300	5	150	0.00262
VADOFT	Dry Seed	300	100	150	0.00046
VADOFT	Dry Seed	300	5	150	0.00045
HYDRUS-1D	Wet Seed	300	100	150	0.00354
HYDRUS-1D	Wet Seed	300	5	150	0.00216
HYDRUS-1D	Dry Seed	300	100	150	0.00027
HYDRUS-1D	Dry Seed	300	5	150	0.00026

*80th Percentile for VADOFT and HYDRUS-1D

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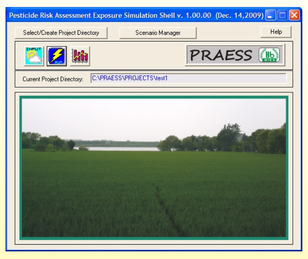
USER INTERFACE TOOL FOR RICE GROUNDWATER AND SURFACE WATER SCENARIOS

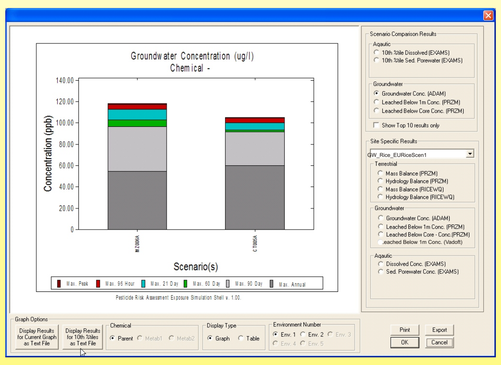
Pesticide Risk Assessment Simulation Shell (PRAESS)

PRAESS is a modeling platform designed to evaluate the potential for pesticides to occur in surface and ground water resources. The architecture of PRAESS allows seamless executions of several environmental fate and transport models including WINPRZM, RICEWQ, EXAMS, VADOFT and ADAM on the Windows® environment (TOXSWA and HYDRUS scenarios planned). A shared model input structure provides the flexibility for the user to create, update, and maintain databases on pesticide environmental fate properties and exposure scenarios. Model scenarios developed to date include cotton and corn for surface water and groundwater assessment and rice scenarios for surface water assessment.

PRAESS contains a number of features not available in similar modeling systems that are being used for pesticide exposure assessment in the European Union or the United States of America, including:

- The ability to conduct groundwater and surface water assessments within a single modeling system;
- The ability to simulate row crop and rice crop scenarios within a single modeling system;
- The inclusion of an aquifer model to estimate pesticide concentrations in leachate and in groundwater;
- The flexibility for the user to add scenarios over time; and
- The flexibility to simulate up to five receiving water systems with each combination of crop-soil-weather condition.





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