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T. S. Ramanarayanan, *Organizer*

ABSTRACTS

AGRO 108

A new PRZM algorithm for predicting bi-phasic degradation of pesticide in soil using coupled time-dependent sorption and degradation kinetics: Model theory and conceptualization

Wenlin Chen, *wenlin.chen@syngenta.com*, Syngenta Crop Protection, Inc, P.O. Box 18300, Greensboro, NC 27419-8300, Fax: 336-632-7846, and Mark Cheplick, *cheplickm@waterborne-env.com*, Waterborne Environmental, Inc, 897-B Harrison Street, Leesburg, VA 20175

Many studies have shown that adsorption of pesticide by soil is time-dependent and that desorption from the sorbed phase limits the rate of bio-degradation. In this paper, we present a set of physically-based mathematical approaches to describe the coupled, time-dependent sorption and degradation kinetics as well as their implementation into the Pesticide Root Zone Model (PRZM). The newly developed PRZM version (PRZM4) is compared to other regulatory models that have similar environmental fate routines. Physical implications of and relations between different mathematical approaches are also discussed. Analysis with laboratory and field experimental data is provided to elucidate the rate-limiting effect of time-dependent sorption on degradation and transport in soil. This is the first part of a two-paper series. In the second paper, PRZM4 is evaluated against a wide range of field-observed data obtained from different geographical locations under different environmental conditions.

AGRO 109

Incorporating effect of vegetative filter strip in pesticide aquatic exposure assessment

George J. Sabbagh, *george.sabbagh@bayercropscience.com*, Environmental Research, Bayer CropScience, 17745 South Metcalf, Stilwell, KS 66085, Fax: 913-433-5389, **Garey Fox**, *garey.fox@okstate.edu*, Department of Biosystems and Agricultural Engineering, Oklahoma State University, 120 Ag Hall, Stillwater, OK 74078, **Rafael Munoz-Carpena**, *carpena@ufl.edu*, Agricultural and Biological Engineering, University of Florida, 287 Frazier Rogers Hall, PO Box 110570, Gainesville FL 32611, and **Mark Lenz**, *Mark.Lenz@BayerCropScience.com*, Bayer CropScience, 17745 South Metcalf Avenue, Stilwell, KS 66085

Vegetative filter strips (VFS) are mitigation practices that have proven to be effective in reducing runoff, sediment and pesticide loading from agricultural fields to adjacent non-target areas and water bodies. Studies have shown that VFS effectiveness in reducing pesticide loading is directly related to reduction in runoff and sediment loading. Recently, an empirical pesticide trapping equation has been linked with a numerical simulation model (VFSmod) capable of predicting both runoff reduction (*i.e.*, infiltration) and sediment trapping. The integrated model, called VFSmod-wq, is capable of predicting hydrology, sediment transport and pesticide trapping through VFS in numerous hydrologic settings. In this research, VFSmod-wq was interfaced with the models PRZM and EXAMS. The modeling system was used to simulate pesticide loading from a corn field in Illinois and an orchard field in Michigan to an adjacent pond, and to estimate the effect of VFS on water exposure concentrations. This presentation will provide a background on VFSmod-wq, describe the PRZM/VFSmod-wq/EXAMS modeling system, and discuss the results from the application of the modeling system to the Illinois corn and Michigan orchard scenarios.

AGRO 110

Modeling pesticide total residues of toxicological concern

Mohammed Ruhman, *ruhman.mohammed@epa.gov*, Office of Pesticide Programs, United States Environmental Protection Agency, 1200 Pennsylvania Avenue, N.W, Ariel Rios Building, Washington, DC 20460, **James Hetrick**, *hetrick.james@epa.gov*, Environmental Fate and Effects Division, Office of Pesticide Programs, Environmental Protection Agency, 2777 Crystal Dr, Arlington, VA 22202, and **R. David Jones**, *Jones.Rdavid@epamail.epa.gov*, Office of Pesticide Programs, United States Environmental Protection Agency, 2777 Crystal Drive, Arlington, VA 22202

The Office of Pesticide Programs (OPP) of the U.S. EPA is required to estimate exposure concentrations for parent pesticides and their degradation products. The modeling approach for estimating pesticide concentrations is dependent on the type of

environmental fate data available for the pesticide and its degradation products. A complete environmental fate database is required for estimating the decline rate of the parent compound as well as formation and decline rates of degradation products. In the absence of a complete environmental fate database, total toxic residue exposure modeling approaches can be used to estimate the concentration of combined residues. Three modeling approaches have been applied for estimating pesticide and degradation product concentrations in aquatic environments. These methods include: (1) the formation/decline kinetics method, (2) the residue summation method, and (3) the total residue method. This paper will describe these methods, their strengths and weaknesses, and their application in exposure modeling.

AGRO 111

Comparison of aquatic exposure assessment models for pesticide use on rice

Amy M. Ritter¹, rittera@waterborne-env.com, **W. Martin Williams**¹, williamsm@waterborne-env.com, **Jane Tang**², jane-zhenxu.tang@bayercropscience.com, **Tharacad S. Ramanarayanan**³, Tharacad.Ramanarayanan@BayerCropScience.com, **Dean Desmarteau**³, dean.desmarteau@bayercropscience.com, and **Stephen Anderson**⁴, andersons@waterborne-env.com. (1) Waterborne Environmental, Inc, 897-B Harrison Street, S.E, Leesburg, VA 20175, Fax: 703-777-0767, (2) Bayer CropScience, 17745 South Metcalf Avenue, Stilwell, KS 66085, (3) Bayer CropScience, Bayer Research Park, 17745 S. Metcalf Ave., Stilwell, KS 66085, (4) Waterborne Environmental, Inc, 701 Devonshire Drive, Suite B15, Champaign, IL 61820

An evaluation of six modeling approaches for estimating environmental concentrations associated with the use of crop protection chemicals on rice was conducted. A comparison of estimated environmental concentrations computed with all six approaches (EPA Tier 1, MED-RICE, Japanese regulatory spreadsheet "Ecotox2", PCPF-1, EXAMS-Rice, and RICEWQ) is presented along with the status of their regulatory acceptance for pesticide registration in the United States, European Union, and Japan. Of the six models, RICEWQ is better suited for higher tier risk assessment based on its ability to conduct probabilistic assessments and to simulate multiple pesticide applications, metabolites, and the flooding, overflow, and controlled releases of water associated with rice production. An important factor in model acceptance is the ability to reproduce observed data. Case studies validating the performance of RICEWQ are presented to support the acceptance of the model by the U.S. Environmental Protection Agency and other regulatory agencies.

AGRO 112

Cumulative tracking of pesticide drift in New Zealand

Andrew J Hewitt¹, hewitta@lvi.co.nz, **Robert J Connell**², connellr@lvi.co.nz, **Jerzy A Zabkiewicz**³, jaz@ppcnz.co.nz, and **Elizabeth Post**², postea@lvi.co.nz. (1) LVL, Lincoln Ventures and The University of Queensland, Engineering Drive, Lincoln University, Christchurch, New Zealand, Fax: 033253725, (2) CART, Lincoln Ventures Ltd, Engineering Drive, Lincoln University, Christchurch 7640, New Zealand, (3) PPCnz, Rotorua, New Zealand

A system (cumulative agrichemical residue tracking, CART) has been developed for tracking the off-target deposition of sprays applied to crops in New Zealand within a web-based Geographical Information Systems (GIS) environment. The effect of the sprayer setup and meteorological conditions define the initial spray release. Transport is assessed using the AGDISP code and modified through new algorithms on shelterbelt spray interception because most fields in NZ are surrounded by such vegetation. Deposition to aquatic or terrestrial areas is predicted based on model calculations. Examples are given of performance for model predictions relative to field study data using biomarker/ cation tracers. The fit of CART to field data requires improvement so this research is being extended through the development of new models for spray drift from ground-based application systems for row, tree and vine crops.

AGRO 113

Development and application of a minimal calibration approach for watershed-scale modeling of pesticides with SWAT

Michael F. Winchell, mwinchell@stone-env.com, Stone Environmental, Inc, 535 Stone Cutters Way, Montpelier, VT 05602, Fax: 802-229-5417, **Raghavan Srinivasan**, r-srinivasan@tamu.edu, Spatial Sciences Laboratory, Texas A&M University, College Station, TX 77843-2120, and **Natalia Peranginangin**, Environmental Fate, Syngenta Crop Protection, P. O. Box 18300, Greensboro, NC 27419-8300

Past applications of the Soil and Water Assessment Tool (SWAT) to simulate pesticide fate and transport nearly always include calibration to site specific data to achieve acceptable model performance. This site specific calibration is impractical if SWAT is to be used to efficiently evaluate large numbers of watersheds over varied geographical regions. This study focused on the development and application of a minimal calibration approach to the SWAT model for pesticide simulations in small watersheds of less than 100 square miles. First, an un-calibrated parameterization methodology was applied to simulate pesticide fate and transport in 20 watersheds across the Midwest corn belt. The un-calibrated model performance was evaluated based upon both measured pesticide concentration time series and frequency distributions for each watershed. Next, a minimally calibrated parameterization from a single representative watershed in

each region was developed and extended to all watersheds in the region. The approach has potential to enable the use of SWAT for national level assessments of pesticides in small watersheds.

AGRO 114

Lessons learned from an exercise to evaluate watershed-scale pesticide fate and transport models

Michael Barrett, barrett.michael@epa.gov, Office of Pesticide Programs, USEPA, 1200 Pennsylvania Ave., Washington, DC 20460, and Ronald D. Parker, parker.ronald@epa.gov, Office of Pesticide Programs, U.S. Environmental Protection Agency, 1200 Pennsylvania Ave. N.W, Washington DC 20460

The U.S. Environmental Protection Agency, Office of Pesticide Programs has completed an evaluation of three watershed-scale simulation models for potential use in pesticide drinking water or aquatic ecological exposure assessments. Models selected for evaluation were the Soil Water Assessment Tool (SWAT), the Nonpoint Source Model (NPSM), a modified version of the Hydrologic Simulation Program-Fortran (HSPF), and the Pesticide Root Zone Model-Riverine Water Quality (PRZM-RIVWQ) model. The effort was challenging at several points. Investigations revealed that the poor performance in many of the statistics which were chosen to measure agreement between measured and modeled concentrations could be plausibly attributed to uncertainties in factors such as the exact timing of pesticide applications in various parts of the watershed, uncertainties in extrapolation of pesticide concentrations to non-sampling days, and to variability of soil, geographic features and weather.

AGRO 115

PRZM version 4.2 calibration, geospatial extrapolation, and model output query tool

Tammara L. Estes¹, tlestes@stone-env.com, Wenlin Chen², wenlin.chen@syngenta.com, Michael F. Winchell¹, mwinchell@stone-env.com, Barbara Patterson¹, bpatterson@stone-env.com, Adrian M. Wadley³, wadley@gmail.com, and Cecil Dharmasri², cecil.dharmasri@syngenta.com. (1) Stone Environmental, Inc, 535 Stone Cutters Way, Montpelier, VT 05602, Fax: 847-251-8656, (2) Syngenta Crop Protection, Inc, P.O. Box 18300, Greensboro, NC 27419-8300, (3) (formerly) Stone Environmental, Inc, 535 Stone Cutters Way, Montpelier, VT 05602

Observed soil data from several field studies are compared to predicted results from the soil sorption kinetics version of the Pesticide Root Zone Model (PRZMV4.2). The new PRZM algorithm predicts soil residues better and deals more accurately with bi-phasic degradation compounds in leaching assessment. For each calibration, an automated

algorithm was created to run PRZMV4.2 over a matrix of 21,000 varying combinations of K_{OC} , dissolved half-life in soil, rate of desorption, and fraction of pesticide residues available for instantaneous sorption from user-specified ranges. Calibration results were used to identify the best-fit environmental fate parameters which were then used in large geographical scale simulations with local soil and weather inputs identified with GIS databases. Predicted results were assembled into a database and integrated with a GIS-enabled decision-making query tool. This tool allows users to extract tables and generate maps of model predictions meeting user-defined combinations of geography, soils, and crop management conditions.

AGRO 116

Is the U.S. Environmental Protection Agency's pesticide aquatic risk assessment process protective?

W. Martin Williams¹, williamsm@waterborne-env.com, **Paul Hendley**², paul.hendley@syngenta.com, **Scott H. Jackson**³, scott.jackson@basf.com, **Amy M. Ritter**¹, rittera@waterborne-env.com, **J. Mark Cheplick**⁴, cheplickm@waterborne-env.com, and **Chris M. Holmes**⁵, holmesc@waterborne-env.com. (1) Waterborne Environmental, Inc, 897-B Harrison Street, S.E, Leesburg, VA 20175, (2) Syngenta Crop Protection, 410 Swing Road, P.O. Box 18300, Greensboro, NC 27410, (3) Regulatory Stewardship and Strategy, BASF Corporation, 26 Davis Drive, P.O. Box 13528, Research Triangle Park, NC 27709-3528, (4) Waterborne Environmental, Inc, 897B Harrison Street, SE, Leesburg, VA 20175, (5) Waterborne Environmental, Inc, 897B Harrison St. SE, Leesburg, VA 20175

The U.S. Environmental Protection Agency uses a tiered system to conduct risk assessments as part of the pesticide registration process under FIFRA. Many aquatic risk assessments, including those for endangered species, do not progress beyond the Tier 2 level that utilizes the Pesticide Root Zone Model (PRZM) and Exposure Analysis Modeling System (EXAMS). This presentation contains a critical review of the models, scenarios, and input parameter values used to estimate environmental concentrations at each tier. Case studies are presented that benchmark model predictions to monitoring data. The significance, sensitivity, and relative importance of assumptions imbedded in the methodology are discussed with respect to over- or under-predicting exposure in ecological and drinking water risk assessments.