California Environmental Protection Agency
Department of Pesticide Regulation
P.O. Box 4015
Sacramento, CA 95812-4015

Study 217: Protocol to Demonstrate the Effectiveness of Farm Management Practices to Mitigate Pesticide Movement to Ground Water

March 13, 2003

I. Introduction

The California Department of Pesticide Regulation is proposing mitigation measures to prevent further contamination of ground water. A summary of the changes is available at: (http://www.cdpr.ca.gov/docs/empm/gwp_prog/gwp_prog.htm). The proposal is to permit practices based on predominant soils of vulnerable areas and to match the practices based on the pathway by which pesticides move to ground water for specific soil properties (Troiano et al., 2000). Two pathways of movement to ground water have been determined where in coarse, permeable soils residues leach with water during normal percolation processes and in less permeable soils with a hardpan layer residues are moved offsite in runoff water to sensitive sites (Braun and Hawkins, 1991).

Studies have been conducted in small plots to determine the effectiveness of proposed mitigation measures. In areas of low rainfall and for coarse soils where pesticides leach to ground water, management of percolating water produced as a result of irrigation has been shown to be effective in maintaining residues in the upper surface layers (Troiano et al., 1993). In contrast, for soils with low permeability, use of mechanical incorporation instead of rainfall is an effective method to decrease offsite movement of pre-emergence residues (Troiano and Garretson, 1998).

The management practices were developed to prevent simple substitution of known contaminants with those that have a high potential of moving to ground water. For example, most pre-emergence herbicides have similar properties in that they are long-

lived in soil and they are not sorbed tightly to soil. Concentrated use of bromacil, diuron, and simazine have resulted in numerous detections in domestic wells (Troiano et al., 2001). Norflurazon is a pre-emergence herbicide that is similarly long-lived and not tighly sorbed to soil. Norflurazon residues were recently detected in areas where simazine, bromacil, and diruon had been detected (Troiano et al., 1999). In order to break the cycle of substitution, growers should be made aware of the practices that have been developed. A proven method of change in the agricultural sector is the to introduce the change in practices to a small segment of growers willing to try and test them for effectiveness on their property. Demonstrations are then conducted focusing on the grower's experience with adoption of the practice. During the testing of the practice, environmental samples will be taken to demonstrate the effectiveness of the management practice, observations on plant growth will be made to assure that the practice does not adversely affect plant health, and observations on economic costs will be made to determine potential benefits or costs of adoption of the practice.

II. Study Objective

The objective of the study is to develop data on the adoption of management practices for mitigation of pesticide movement to ground water. Data will be collected on the effectiveness of the practice to mitigate contamination, on the effectiveness of the pesticide under the new management practice, and on potential economic impacts.

III. Personnel

Study personnel from the the Environmental Monitoring Branch of the DPR include:

Project Leader:	John Troiano
Field Coordinator:	Alfredo DaSilva
Senior Scientist:	Frank Spurlock
Laboratory Laison:	Carissa Ganapathy
Agency/Public Contact:	Mark Pepple

Questions concerning this monitoring program should be directed to Mark Pepple at (916) 324-4086, e-mail mpepple@cdpr.ca.gov, and FAX (916) 324-4088.

IV. Study Design

The exact management practice investigated will depend on the location of the cooperating grower and on the choice of mitigation measure that is matched to the soil condition. Identifying grower participation is the first phase. This is accomplished through meetings with grower groups that inform them of local ground water concerns, the regulatory measures taken to prevent further contamination, and lastly, the management practices developed that, if adopted, could prevent further contamination. The meetings will be facilitated through a local contact, who then acts as the contact for growers willing to adopt the mitigation measures. Upon identification of the mitigation measure to investigate, the field coordinator coordinates with the grower concerning exact implementation of the management practice, the timing of the practice, and the monitoring procedures with respect to need for construction of special apparatus or cultivation considerations.

For the runoff condition, management practices to investigate are better incorporation of residues into soil, limiting the area sprayed to tree rows, or chemigation of pesticides. For the leaching condition, management practices to investigate are adoption of efficient irrigation practices and placement of residues such that percolating water has very limited contact with the residues. Potential media for sampling in both conditions is soil and runoff water. Potential pesticides sampled are from the 6800(a) list of known leachers, most likely simazine, bromacil, diruon, and norflurazon.

V. Media Sampled and Itinerary

The exact number of samples taken will depend on the management practice investigated. In order to allow for specificity at each investigation and to provide guidance for the laboratory, the number of samples and media type will be determined in Attachment A. Attachment A will be filled-out for each management practice adopted by a grower. The

attachment will estimate the type of sample, the pesticide analyzed for, the date of the sampling, and the number of samples.

Sampling procedures will follow established SOPs as follows:
Soil:
SOP FSSO002.00 for soil sampling, including auger and surface soil procedures (Garretson 1999).
SOP FSSO001.00 for soil bulk density determination (Garretson 1999).
SOP METH001.00 for soil water content (Garretson 1999).

Water:
SOP FSWA008.00 for Sampling for Surface Water Runoff in Agricultural Fields (Spurlock 1999).

VII. Chemical Analysis and Quality Control

The CDFA laboratory has developed analytical methods for these herbicides in both soil and water media. Quality control procedures will follow established SOP QAQC001.00 for Chemistry Laboratory Quality Control (Segawa 1995).

VII. Budget and Timetable

The number of investigations and the number of samples taken for each will be dependent on budgetary and laboratory constraints. A request for each study will be presented to the Branch Chief per Attachment A. An example is given of the information to be filled into Attachment A.

References

Braun, A. and L. S. Hawkins. 1991. Presence of Bromacil, Diuron, and Simazine in Surface Water Runoff from Agricultural Fields and Non-crop Sites in Tulare, California. Environmental Monitoring Branch, California Department of Pesticide Regulation, Sacramento, CA 95812-4015. PM 91-01. Available at: http://www.cdpr.ca.gov/docs/empm/pubs/ehapreps.htm.

Garretson, C. 1999. Soil Sampling, Including Auger and Surface Soil Procedures. SOP FSSO002.00. Environmental Monitoring Branch, California Department of Pesticide

Regulation, Sacramento, CA 95812-4015. Available at: http://www.cdpr.ca.gov/docs/empm/pubs/sop.htm.

Garretson, C. 1999. Soil Bulk Density Determination. SOP FSSO001.00. Environmental Monitoring Branch, California Department of Pesticide Regulation, Sacramento, CA 95812-4015. Available at: http://www.cdpr.ca.gov/docs/empm/pubs/sop.htm.

Garretson, C. 1999. Soil Water Content Determination. SOP METH001.00. Environmental Monitoring Branch, California Department of Pesticide Regulation, Sacramento, CA 95812-4015. Available at: http://www.cdpr.ca.gov/docs/empm/pubs/sop.htm.

Segawa, R. 1995. Chemistry Laboratory Quality Control. SOP QAQC001.00. Environmental Monitoring Branch, California Departme nt of Pesticide Regulation, Sacramento, CA 95812-4015. Available at: http://www.cdpr.ca.gov/docs/empm/pubs/sop.htm.

Troiano, J., C. Garretson, C. Krauter, J. Brownell, and J. Hutson. 1993. Influence of Amount and Method of Irrigation Water Application on Leaching of Atrazine. J. Environ. Qual. 22: 290-298. (PDF, 680 kb). Available at: http://www.cdpr.ca.gov/docs/empm/pubs/ehapref.htm.

Troiano, J. and C. Garretson. 1998. Movement of Simazine in Runoff Water from Citrus Orchard Row Middles as Affected by Mechanical Incorporation. J. Environ. Qual. 27: 488-494. Available at: http://www.cdpr.ca.gov/docs/empm/pubs/ehapref.htm.

Troiano, J., J. Marade, and F. Spurlock. 1999. Empirical Modeling of Spatial Vulnerabilitiy Applied to a Norflurazon Retrospective Well Study in California. J. Environ. Qual. 28:397-403. http://www.cdpr.ca.gov/docs/empm/pubs/ehapref.htm.

Troiano, J., F. Spurlock, and J. Marade. 2000. Update of the California vulnerability soil analysis for movement of pesticides to ground water: October 14, 1999. Environmental Monitoring Branch, California Department of Pesticide Regulation, Sacramento, CA 95812-4015. EH 00-05. Available at: http://www.cdpr.ca.gov/docs/empm/pubs/ehapreps.htm.

Troiano, J., D. Weaver, J. Marade, F. Spurlock, M. Pepple, C. Nordmark, D. Bartkowiak. 2001. Summary of Well Water Sampling in California to Detect Pesticide Residues Resulting from Nonpoint-Source Applications. J. Environ. Qual. 30:448-459. Available at: http://www.cdpr.ca.gov/docs/empm/pubs/ehapref.htm.

Attachment A

Ground Water Mitigation Study Request

1. Ground Water Process Studied: __ Leaching __Runoff __ Other _____

2. Management Practice Investigated: _____

3. Crop studied _____

4. Media sampled and projected timing of samples:

Sampling Date/Specification Type of Sample Number of Samples

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

EXAMPLE

Ground Water Mitigation Study Request

1. Ground Water Process Studied: __ Leaching _X_Runoff __ Other _____

2. Management Practice Investigated: _Mechanical Incorporation_____

3. Crop studied: Citrus_____

4. Media sampled and projected timing of samples:

Sampling Date/Specification	Type of Sample	Number of Samples
Background Nov 15 2003	Soil	15
Background Nov 2003_	Runoff Water	10
Application Nov 20, 2003	Soil	15
First Rainfall, Nov 2003 _____	Runoff Water	10
Second Rainfall, Nov 2003 _____	Runoff Water	10