Department of Pesticide Regulation
Environmental Monitoring and Pest Management Branch
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Simazine and Bromide Movement Under Drip Irrigation In Sandy Soils
STUDY #175
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I. INTRODUCTION

Preemergent herbicide residues associated with citrus and grape production have been detected in several hundred Fresno and Tulare County domestic wells. Many of the detections are located in coarse soil areas. Previous EHAP studies in coarse soil have shown that evapotranspiration-based irrigation scheduling can effectively mitigate downward movement of herbicides under furrow, basin, or sprinkler irrigation regimes (Troiano et al., 1990). However, much less is known about the downward movement of herbicides and tracers under drip emitters; potential problems with drip irrigation include very high water throughput directly beneath drip emitters leading to leaching (Hillel, 1980). Rapid downward water movement under drip emitters is greatest in coarse soils such as sands (University of California, 1980), so that coarse soils are the most vulnerable to rapid leaching under drip irrigation. Consequently, the effectiveness of water management for mitigating downward herbicide movement under drip irrigation in coarse soils is unknown.

Troiano et al. (1990) investigated the movement of bromide and atrazine under drip emitters in a coarse Fresno County soil. However, recoveries of both atrazine and inorganic tracer were extremely low, and they concluded that "more frequent and detailed sampling of soil located both beneath and between drip emitters is needed in order to adequately describe solute movement in low volume systems....". In recent University of California studies, simazine and chloride concentrations both under and around drip emitters in a Fresno County vineyard were measured. In those studies, simazine recoveries were very low, but the extent to which simazine either degraded or leached below the sampling depth could not be accurately determined. The chloride data indicated a marked reduction in surface chloride levels immediately under the emitter (figures 1 & 2), indicating chloride movement to the subsurface. However, the confounding effect of "naturally occurring" background chloride prevented an accurate determination of chloride lateral movement versus movement to deeper depths.

Drip irrigation has become increasingly popular in San Joaquin Valley grape production over the last several years. The potential for rapid downward water movement during drip irrigations is greatest in coarse soils, and a large portion of Fresno and Tulare

County grape acreage is located in such soils. Additional information on the movement of water, tracers, and pesticides under drip irrigated coarse soil conditions is needed to further develop and evaluate mitigation measures for pesticide movement to ground water.

II. OBJECTIVES

The objective of this study is to evaluate the potential for downward and lateral simazine movement under drip irrigation emitters in coarse soil by using a bromide tracer at three different water application methods.

III. PERSONNEL

This study will be conducted by the Environmental Hazards Assessment Program (EHAP) under the general direction of Don Weaver, Senior Environmental Research Scientist. Key personnel are listed below:

Project Leader:	Frank Spurlock
Field Coordinator/Lab Liason:	Cindy Garretson
Senior Staff Scientist:	John Troiano

Authorship of the final report should include, but not be limited to, Frank Spurlock, Cindy Garretson, and John Troiano. Questions concerning this monitoring program should be directed to Mark Pepple at (916) 324-4086, facsimile (916) 324-4088.

IV. STUDY DESIGN

This study will be conducted in a fallow area on the Fresno California State University farm. Bromide and simazine will be applied in a 5 foot wide swath under drip irrigation lines at a rate of 100 pounds $acre^{-1}$ and 2 lbs $acre^{-1}$, respectively. The treatment factor will be volume of irrigation water applied, and 3 levels will be replicated 3 times: 10 liters, 25 liters, and 40 liters total water applied. There will be 9 total emitter sites (3 levels x 3 replicates), and emitter flow rates will be 4 l hr^{-1} (nominal).

Soil sampling at each emitter site will be performed 48 hours after irrigation water application is completed at that site. Figure 3 illustrates the sampling regime around each emitter. Additionally, two 152 cm x 15.2 cm segment cores for soil moisture and texture background will be taken at each site immediately prior to water application.

Samples from cores 1-13 will be homogenized and split, with one portion of each sample to analyzed for moisture content and bromide tracer by DPR Fresno office personnel using a previously developed ion-specific electrode method. The remaining portion of each sample will be frozen for possible simazine analysis by ELISA depending on the bromide analytical results. These data will be used to determine the extent of lateral and downward movement of the surface applied tracer in response to the applied water. Samples from cores 14-17 will be frozen for possible future bromide analysis if needed in the event that core 1-13 bromide tracer analysis indicates lateral movement beyond 45 cm from the drip emitter location.

The 15.2 cm deep surface soil cores (open circles in figure 3) will be analyzed only for bromide. These data will be used to determine the quantity of applied chemical and/or areal extent of application susceptible to downward movement under the drip irrigation water applications.

Based on bromide distribution around the drip emitters, 100 samples will be selected for simazine analysis to verify the extent to which simazine movement is related to bromide movement. Simazine was chosen because of the availability of the inexpensive ELISA analytical method for the compound, and because previous storage stability studies have shown that simazine is stable in frozen soils for several months.

Total soil samples taken will be:
(3 treatments x 3 replicates x 17 152cm cores x 10 samples/core) +
(3 treatments x 3 replicates x 16 15cm surface cores) =1674
samples

Soil samples analyzed for bromide will be:
(3 treatments x 3 replicates x 13 152cm cores x 10 samples/core) +
(3 treatments x 3 replicates x 16 15cm surface cores) =1314
samples

Soil samples analyzed for simazine will be 100 samples.

V. CHEMICAL ANALYSIS

All simazine samples will be analyzed by the California Food and Agriculture Analytical Chemistry Laboratory in Sacramento using a previously developed ELISA. Bromide samples will be analyzed by DPR Fresno staff, using a previously developed specific ion electrode method.

VI. DATA ANALYSIS

Three-dimensional spatial statistical analysis of the concentration data will be used to determine the lateral and vertical movement of bromide as a function of water applied, and the effective surface transmission zone under the emitter as a function of total water applied. The simazine data will be used to determine the movement of simazine relative to bromide, and to infer the potential for simazine movement under these drip irrigation conditions.

References

Troiano, J., C. Garretson, C. Krauter, and J. Brownell. 1990. Atrazine leaching and its relation to percolation of water as influenced by three rates and four types of irrigation water application. California Dept. Food Agric., Environmental Hazards Assessment Program, Pub. 90-7.

University of California. 1981. Drip Irrigation Management. Division of Agricultural Sciences, Leaflet 21259.

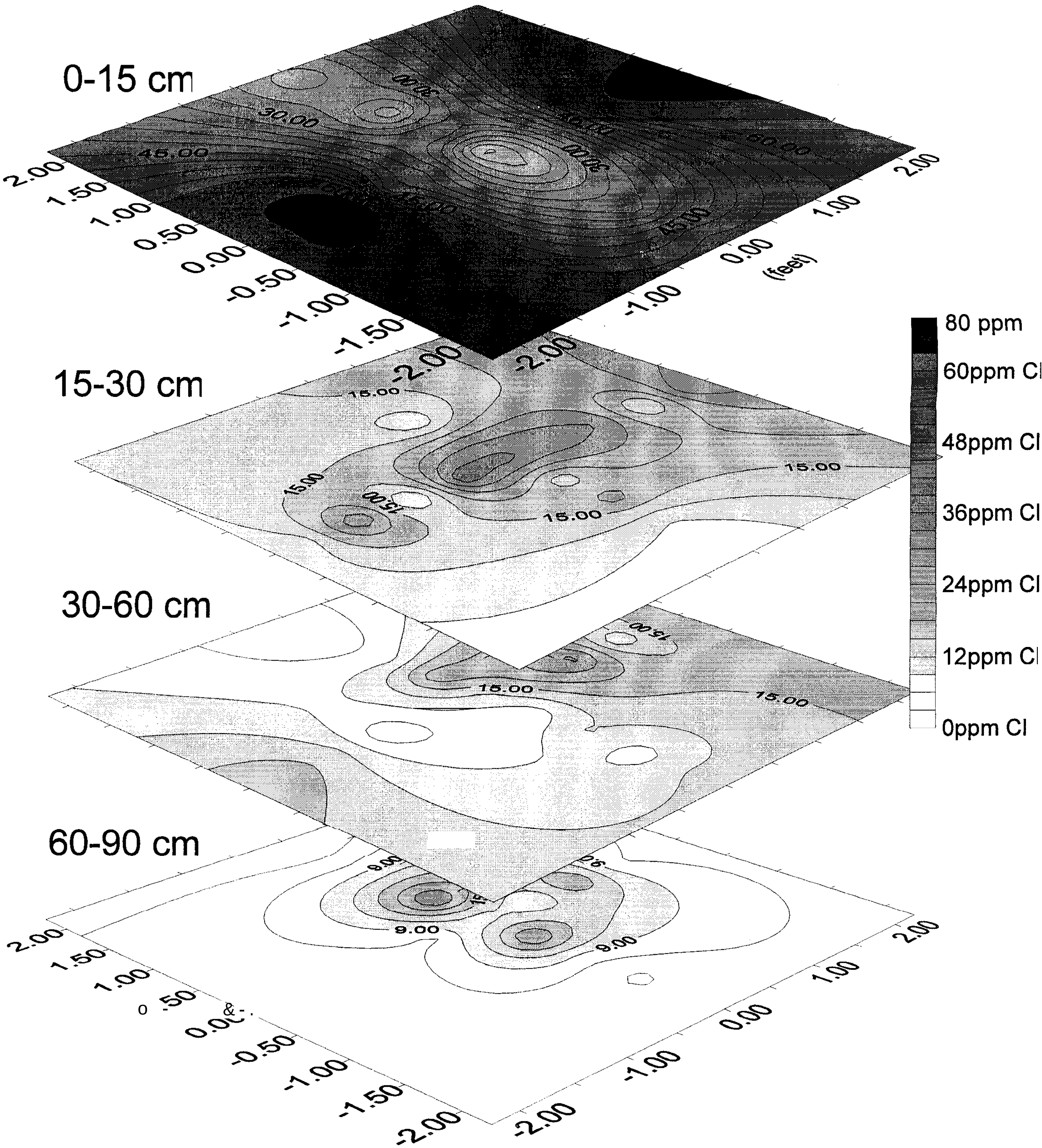


Fig 1. Distribution of applied chloride tracer after a single drip irrigation event. Emitter was located directly above coordinates (0,0).

Fig 2. Mean chloride recovery vs. distance from emitter after a single drip irrigation event.

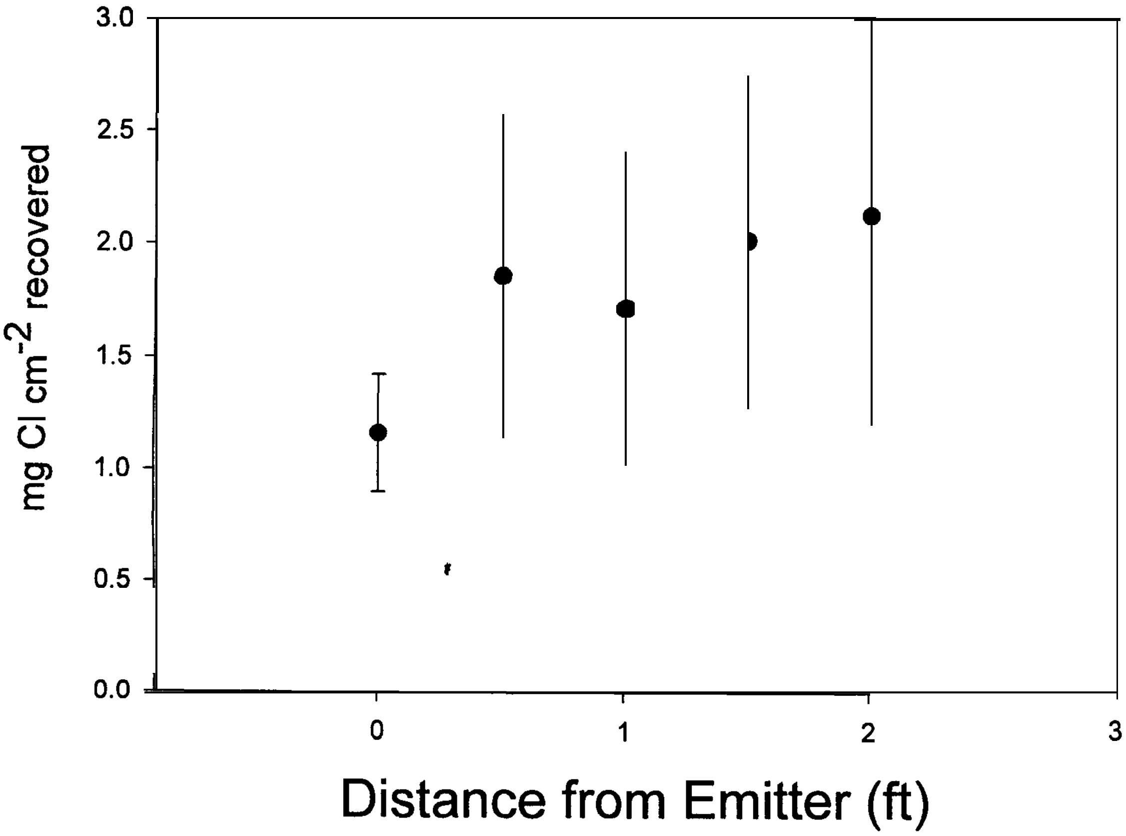
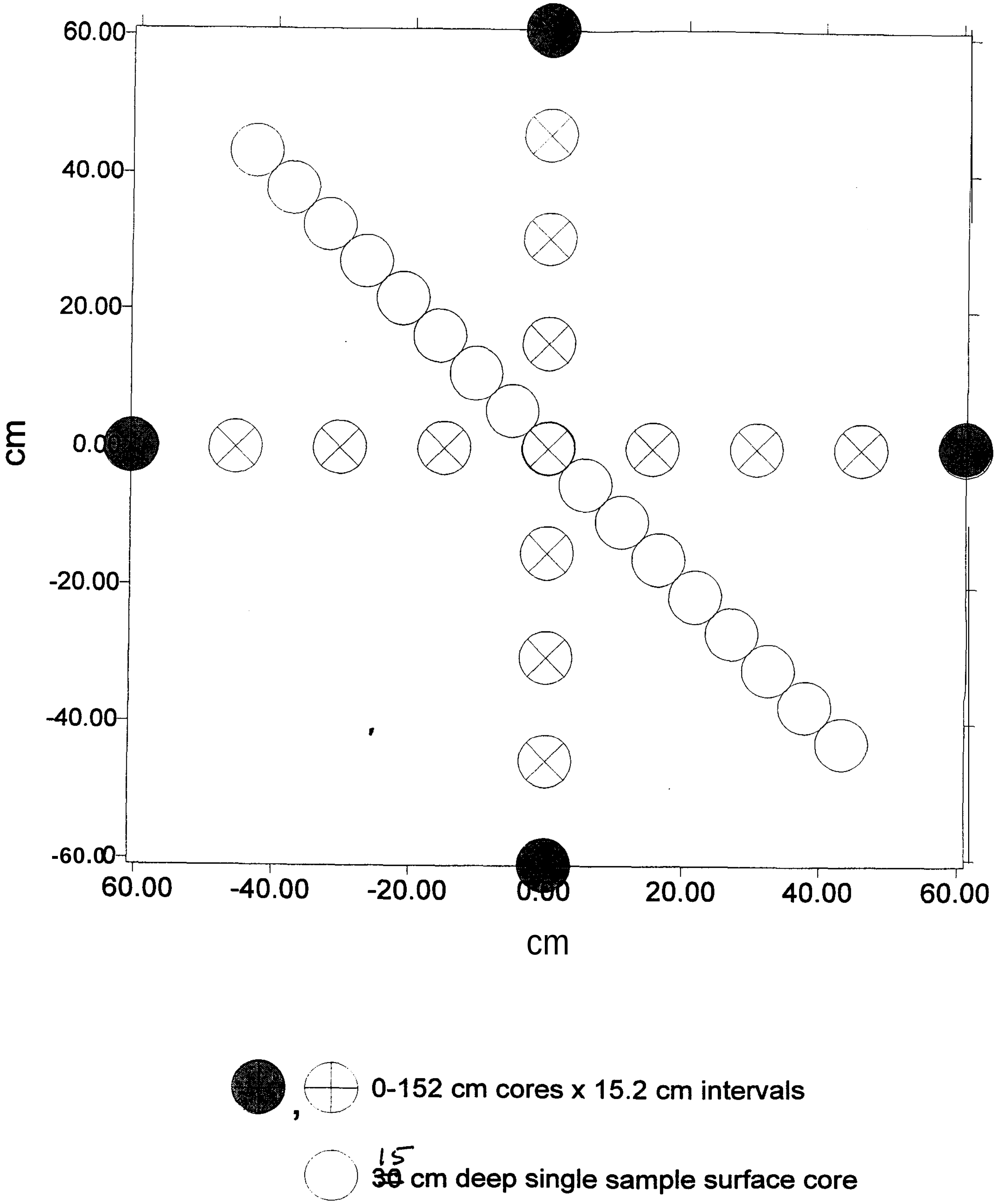


Figure 3. Sampling locations for each plot. Core #1 centered directly below drip emitter.



Document Review and Approval
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