WATER FACT SHEET

U.S. GEOLOGICAL SURVEY, DEPARTMENT OF THE INTERIOR

DIAZINON CONCENTRATIONS IN THE SACRAMENTO AND SAN JOAQUIN RIVERS AND SAN FRANCISCO BAY, CALIFORNIA, FEBRUARY 1993

INTRODUCTION

The effects on aquatic biology of dormant spray pesticides used on orchards in the Central Valley are an important environmental concern, but little is known about pesticide sources and transport in the river-estuary system. This report describes the dissolved concentrations and movement of diazinon, one of the major dormant spray pesticides, through the Sacramento-San Joaquin Delta and the adjacent part of San Francisco Bay (fig. 1) during February 1993. This study was done in cooperation with the California Regional Water Quality Control Board--Central Valley Region, and is part of the U.S. Geological Survey's San Francisco Bay-Estuary Toxic Contaminants Study of the sources, transport, and fate of pesticides in the river-estuary system.

RIVERINE DIAZINON PULSES

Diazinon was applied primarily at the end of January 1993 during 2 weeks of dry weather. A series of rainstorms began in early February. Pulses of diazinon were observed in the Sacramento and San Joaquin Rivers in February following the rainfall. Observed riverine pulses were well defined, with elevated concentrations measured for a few days to weeks at a time. Figure 2 shows the relations among rainfall, daily mean discharge, and diazinon concentrations in the Sacramento and San Joaquin Rivers.

A few days following the rainfall (February 6, 8, and 9), the daily mean discharge of the Sacramento River at Freeport and diazinon concentrations at Sacramento began to increase (fig. 2*A*), with diazinon concentrations reaching a maximum of 393 ng/L (nanograms per liter) on February 12. It rained again on February 20, and the daily mean discharge and diazinon concentrations increased immediately. Diazinon concentrations peaked on February 21 at 194 ng/L and at 186 ng/L on February 22. After each rainfall, a pulse of diazinon moved past Sacramento with a timelag of 1 to 3 days between rainfall and measured maximum diazinon concentration.

In the San Joaquin River, daily mean discharge and diazinon concentrations at Vernalis began to increase immediately after the first rainfall on February 8 (fig. 2*B*). Two well-defined peaks of diazinon concentrations were detected; the first maximum of 773 ng/L occurred at 2400 hours on February 8 and the second maximum of 1,071 ng/L occurred at 1900 hours on February 11. Two other rainfalls (February 19-20 and 26-27) also were followed the next day by a maximum diazinon concentration at Vernalis.

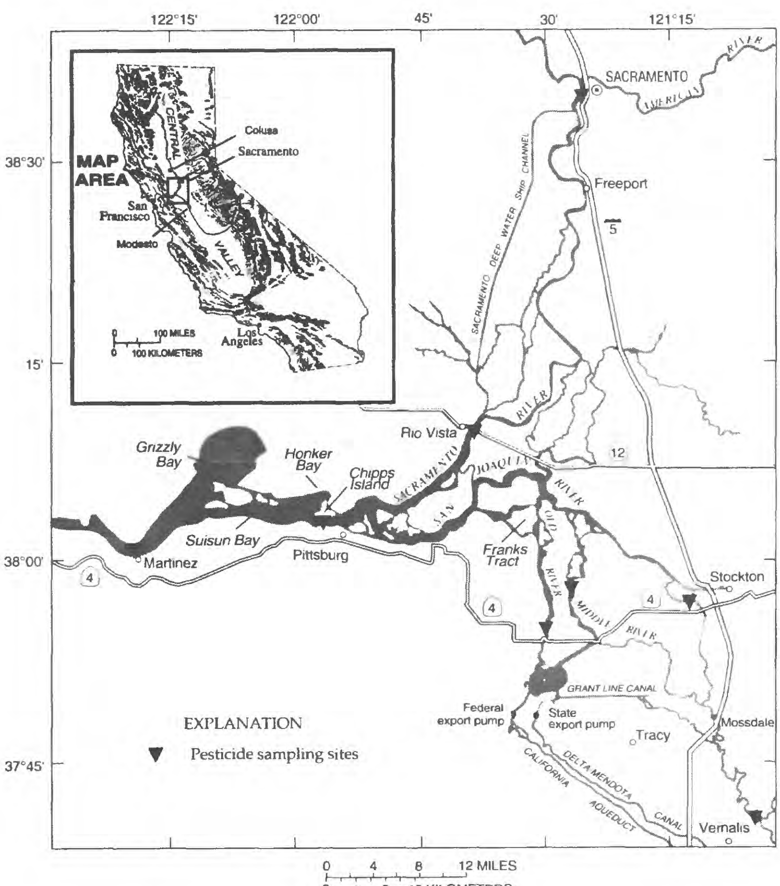

Figure 1. Study area

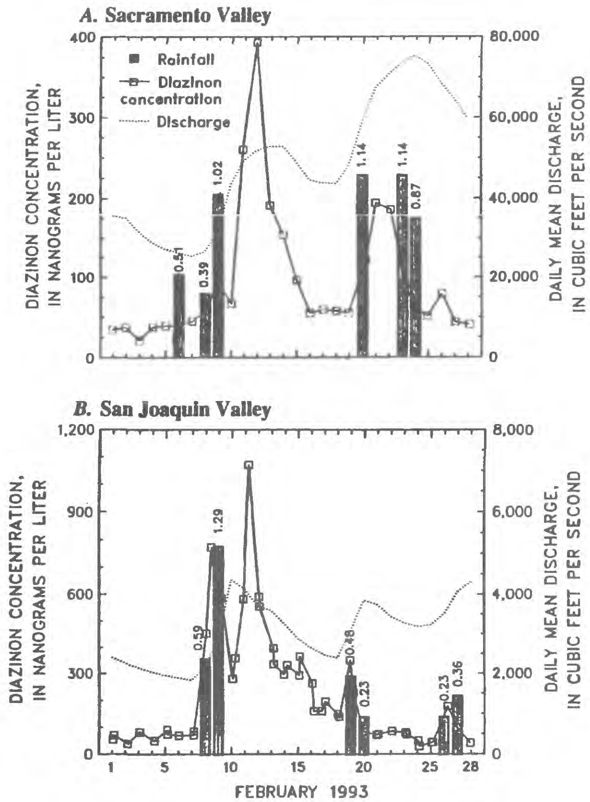

Figure 2. Rainfall (shown as bar with amount in inches per day above each bar), discharge, and measured diazinon concentrations for the Sacramento and San Joaquin Valleys. Concentrations analyzed by solid-phase extraction and gas chromatography-ion trap detection. The reporting limit for diazinon was 15 nanograms per liter. *A*. Sacramento Valley: Rainfall at Colusa, tidally filtered daily mean discharge at Freeport, and diazinon concentrations at Sacramento. *B*. San Joaquin Valley: Rainfall at Modesto, and daily mean discharge and diazinon concentrations at Vernalis. Rainfall is recorded from midnight to midnight; ticks represent noon of indicated day.

DIAZINON TRANSPORT INTO SAN FRANCISCO BAY

A major flowpath of water down the Sacramento River is along the ship channel past Rio Vista, Chipps Island, and Martinez (fig. 1). The first pulse of diazinon in the Sacramento River was followed from Sacramento through Suisun Bay, the eastward embayment of San Francisco Bay (figs. 1 and 3). Diazinon concentrations detected at Sacramento reached a maximum on February 12. The following day, the pulse reached Rio Vista, 43 miles downstream from Sacramento, with a maximum concentration of 281 ng/L. Diazinon concentrations detected at Chipps Island, 16.5 miles seaward from Rio Vista, reached a maximum (199 ng/L) on February 15. The peak was observed at Martinez, 14.5 miles seaward from Chipps Island, on February 18 (107 ng/L) and February 20 (122 ng/L). As the pesticide pulse moved seaward, the maximum concentration decreased and the temporal distribution broadened over time, largely because of the tide-induced mixing of water containing the pesticide.

DIAZINON CONCENTRATIONS IN THE DELTA

High concentrations of diazinon similar to those measured at Vernalis on February 8, 11, and 19 also were measured at Stockton 2 days later on February 10, 13, and 21 (data not shown). In the central delta, water from the Sacramento and San Joaquin Rivers converge in a series of complex, tidally influenced channels (fig. 1), and concentrations of diazinon were elevated in both rivers during this time period. Well-defined pulses of diazinon

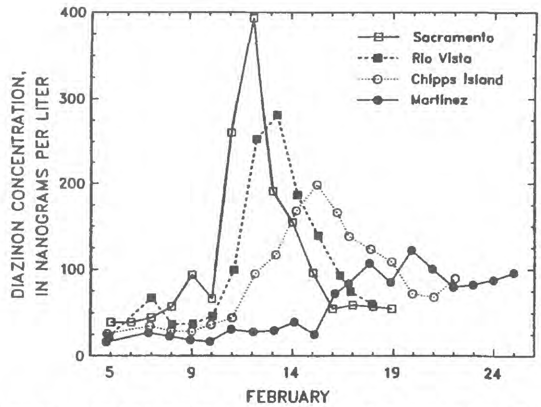

Figure 3. Concentrations of diazinon at Sacramento, Rio Vista, Chipps Island, and Martinez, February 1993. Samples were collected daily at slack after ebbtide. Ticks represent noon of indicated day.

were not observed at the Old and Middle River sites (fig. 1); instead, diazinon concentrations steadily increased from 35 up to 149 ng/L throughout February (data not shown).

POTENTIAL BIOLOGICAL EFFECTS IN THE DELTA

All concentrations of diazinon measured in the rivers and bay throughout this study were above the guideline recommended by the National Academy of Sciences (1973) for the protection of aquatic life of 9 ng/L for diazinon as a maximum concentration in surface water. Currently (1993), there is no U.S. Environmental Protection Agency aquatic-life criterion for diazinon.

Potential effects on the biology of the San Joaquin River water were estimated on the basis of 7-day bioassays using the water flea *Ceriodaphnia dubia* and following U.S. Environmental Protection Agency protocol (1989). *C. dubia* mortality was 100 percent in water samples (split of samples analyzed for pesticide concentration) collected for 12 consecutive days from February 8 to 19 from the San Joaquin River at Vernalis (data not shown). The bioassay mortality corresponded with diazinon concentration greater than or equal to 148 ng/L. Conversely, no toxicity was observed in water collected on February 5 and 7 before the peaks of diazinon concentration or February 20-25 after the peaks of diazinon concentration (values less than or equal to 84 ng/L). Other pesticides including chlorpyrifos, methidathion, and carbaryl were routinely detected in these water samples and may contribute to the toxicity.

SELECTED REFERENCES

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U.S. Environmental Protection Agency, 1989, Short-term methods for estimating the chronic toxicity of effluents and receiving water to freshwater organisms (2d ed.): Cincinnati, Ohio, Environmental Monitoring and Support Laboratory, EPA/600–4–89–001, 417 p.

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