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. 2A), 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 time lag 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. 2B). 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.
Island, 16.5 miles seaward from Rio Vista, reached a maximum concentration of 281 ng/L. Diazinon concentrations detected at Chipps Island, 14.5 miles seaward from Chipps Island, on February 18 (107 ng/L) 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 a 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 or February 20-25 after the peaks of diazinon concentration. The bioassay mortality corresponded with diazinon concentration.

**SELECTED REFERENCES**


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