# EXECUTIVE SUMMARY
# Of Report EH 90-4 Entitled
# "Off-Field Movement and Dissipation of Soil-Incorporated Carbofuran from Three Commercial Rice Fields and Potential Discharge in Agricultural Runoff Water"

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## PURPOSE:

The behavior of carbofuran in the environment needs to be understood in order to develop regulatory strategies to control off-field movement. This study was undertaken since carbofuran studies published in the literature were conducted using various formulations and methods of application not used for rice or sugar beets, or under conditions different from those found in the rice growing regions of California.

The objectives of this study were:

* To compare the proportion of carbofuran discharged in runoff water from rice and sugar beet fields in a three-county area; and

* To examine the disappearance of soil-incorporated carbofuran from rice paddy soil and water.

## BACKGROUND:

The California Department of Food and Agriculture (CDFA) conducts an interagency program to monitor and control the discharge of rice pesticides into surface waters. As part of this program, the California Department of Fish and Game collected water samples in 1985, 1987, 1988 and 1989 which were analyzed for residues of the insecticide carbofuran (Furadan®) which is used in rice fields to control the rice water weevil. The first detections of carbofuran residues occurred in 1987 in agricultural drains in the Sacramento Valley and in the Sacramento River during this routine monitoring.

In 1987, carbofuran residues were found most often and at highest concentrations [13 parts per billion (ppb)] in May and early June in the Colusa Basin Drain. The Colusa Basin Drain, which flows through Colusa, Glenn and Yolo Counties, contributes a major portion of irrigation return flow to the Sacramento River. The highest measured concentration of carbofuran in the Sacramento River was 2.3 ppb.

Carbofuran was detected in the Colusa Basin Drain, but not in the

Sacramento River, at concentrations of 4.4 ppb in 1988 and 1.5 ppb in 1989.

These levels of carbofuran are well below the California Department of Health Services' proposed maximum contaminant level of 18 ppb for carbofuran in drinking water. Although these concentrations pose no threat to human health, they do impact aquatic organisms and have the potential to degrade the quality of the freshwater habitat. In its Basin Plan, the Central Valley Regional Water Quality Control Board has proposed an interim performance goal for 1991 of 0.4 ppb for carbofuran in the agricultural drains in the Sacramento Valley and the Sacramento River.

During the period carbofuran was detected in the Colusa Basin Drain in 1987, the only carbofuran applications in this three-county area were to rice, a flooded crop, and sugar beet, a row crop.

In California, most rice fields are flooded continuously from a few days prior to seeding until a few weeks before harvest. Typically, a water depth of three to four inches is maintained on the field through a combination of management practices, including irrigation, holding water on the field, and releasing water from the field. Excess water applied to the field either evaporates, percolates into the subsoil, or drains out the lower end of the field.

In contrast, sugar beet is not kept continuously flooded, but has several separate irrigations during its growing season. Therefore, the major portion of carbofuran residues found in agricultural drain water probably originated from rice, since the volume of runoff water is greater for rice and about 12 times more carbofuran was applied to rice than sugar beet fields in 1987.

**STUDY METHODS:**

The CDFA's Environmental Hazards Assessment Program conducted a research study in the spring and summer of 1988. The amount of soil-incorporated carbofuran discharged from three commercial rice fields in Colusa and Glenn Counties was measured.

Due to limited resources, estimates only (rather than measurements) were made of the amount of carbofuran discharged from three sugar beet fields. Estimates were determined by first measuring carbofuran concentrations in samples of runoff water, and then calculating the volume of water discharged using measurements of sugar beet field runoff water reported in the literature.

These values, measured for rice fields and estimated for sugar beet fields, were used to calculate the potential discharge of carbofuran into agricultural drains in Glenn, Colusa and Yolo Counties from rice fields and sugar beet fields. Potential discharges from these two sources were compared with each other.

Residue levels of soil-incorporated carbofuran were measured in rice

paddy soil and water several times during the period of the study. These measurements were taken when the rice fields were initially flooded, during the time water was held on the fields, and after water release was reinstated.

**MAJOR FINDINGS:**

The major findings were:

* The highest concentrations of carbofuran were detected in agricultural drain water in late April and early May, when little carbofuran had been applied to sugar beet fields.

* 1988 pesticide use reports from Colusa, Glenn and Yolo Counties showed that approximately eight times more carbofuran was applied to rice than sugar beet fields.

* Maximum concentrations of carbofuran in runoff water from rice fields occurred within 26 days after initial flooding.

* A total of 2 to 11% of the carbofuran applied was discharged in runoff water during about a three-month period after fields were first flooded.

* The potential amount of carbofuran discharged into agricultural drains in Colusa, Glenn and Yolo Counties was estimated to be 11 times greater from rice than from sugar beet fields during April through July of 1988, based on calculations in this study.

* Half-lives of carbofuran in soil in rice fields ranged from one and a half months to not measurable (i.e., there was no significant decline in the concentration), during the 70-day sampling period which followed flooding.

* Most of the carbofuran applied to the rice fields remained in paddy soil, not in the paddy water.

**CONCLUSIONS:**

Results from this study indicate that runoff waters from rice and sugar beet fields are potential sources of carbofuran found in agricultural drains and in the Sacramento River. Several of the major findings suggest that, of the two potential sources, runoff water discharged from rice fields contributes a much larger portion of carbofuran than runoff from sugar beet fields.

This study and information from the literature suggest that the amount of carbofuran released into paddy water is decreased when carbofuran is incorporated into the soil. Consequently, the amount released from the field in runoff water may be reduced, although direct comparisons with other application methods were not made.

The CDFA will continue to monitor surface water in agricultural drains in the Sacramento Valley and in the Sacramento River for carbofuran residues.

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