



Department of Pesticide Regulation



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MEMORANDUM

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DATE: April 7, 2000

SUBJECT: PRELIMINARY RESULTS OF PESTICIDE ANALYSIS AND ACUTE
TOXICITY TESTING OF MONTHLY SURFACE WATER MONITORING
FOR THE RED IMPORTED FIRE ANT PROJECT IN ORANGE COUNTY,
JANUARY 2000 (STUDY 183)

SCOPE OF THIS MEMORANDUM

This memorandum reports results of water sampling conducted by the Department of Pesticide Regulation (DPR), under interagency agreement with the California Department of Food and Agriculture (CDFA), for the Red Imported Fire Ant (RIFA) control project. Data included here are from the January 17 and 18, 2000, monitoring and encompass results from both chemical analyses and aquatic biotoxicity testing. This memorandum summarizes results for bifenthrin, fenoxycarb, hydramethylnon, pyriproxyfen, and eight organophosphorus insecticides: chlorpyrifos, diazinon, dimethoate, fonofos, malathion, methidathion, methyl parathion, and phosmet. Only bifenthrin, fenoxycarb, hydramethylnon, pyriproxyfen, and chlorpyrifos are used in the RIFA control program. The other seven organophosphates are in our multiresidue analytical method and are included in this report to assist in the interpretation of the toxicity results. Acute toxicity results using *Ceriodaphnia dubia* are also included. An in-depth interpretation of data is not included here, but will be provided in the final report when the 2000 pesticide use report becomes available.

Reports of the monthly surface water sampling events will continue through the conclusion of the study. This memo is the sixth in the monthly sampling series. You can request previous sampling results memos by calling the number above or you may download them from DPR's website at <www.cdpr.ca.gov>.



Sample and Data Collection

On January 17 and 18, 2000, surface water samples were collected at nine creeks within the Orange County treatment area and a commercial nursery holding-pond (Table 1 and Figure 1). There was no water flowing at site H during this sampling event, so no samples were taken. This sampling event did not coincide with any measurable rainfall.

Table 1. Sampling site descriptions in Orange County, California

Site #	Description	Coordinates
A	Bolsa Chica Channel at Westminster Ave.	N 33°45'35", W 118°02'36"
B	East Garden Grove Channel at Gothard St.	N 33°43'03", W 117°59'59"
C	Westcliff Park	N 33°37'25", W 117°54'02"
D	Bonita Creek at San Diego Creek	N 33°39'00", W 117°51'48"
E	San Diego Creek at Campus Dr.	N 33°39'23", W 117°50'43"
F	Hines Channel	N 33°42'04", W 117°45'24"
G	Drain at Bee Canyon and Portola Parkway	N 33°42'37", W 117°44'13"
H	Marshburn Slough at Irvine Blvd.	N 33°41'45", W 117°44'02"
I	San Juan Creek at Stonehill Dr.	N 33°28'31", W 117°40'43"
J	Arroyo Trabuco at Oso Parkway	N 33°35'06", W 117°38'09"

All water samples were collected at center channel using a 10-liter stainless steel bucket and divided into one-liter amber sample bottles using a Geotech® 10-port splitter. Samples designated for organophosphate chemical analysis were preserved by acidification with 3N hydrochloric acid to a pH of 3.0 to 3.5. Because diazinon rapidly degrades under acidic conditions, it was analyzed from a separate, unacidified sample. Samples designated for toxicity testing were delivered to the testing laboratory within 36 hours of collection. All samples were stored on wet ice or in a 4°C refrigerator until transported to the appropriate laboratory for analysis.

Toxicity Tests

Acute toxicity testing was conducted by the Department of Fish and Game (DFG) Aquatic Toxicity Laboratory following current U.S. Environmental Protection Agency (U.S. EPA) procedures using a cladoceran, *Ceriodaphnia dubia*, (U.S. EPA, 1993). Acute toxicity was determined using a 96-hour, static-renewal bioassay in undiluted sample water. Data were reported as percent mortality.

Environmental Measurements

Water quality parameters measured *in situ* included temperature, pH, electrical conductivity (EC), and dissolved oxygen (DO). Water pH was measured using an IQ Scientific Instruments® (model IQ 150) pH meter. EC, water temperature, and DO were measured using an YSI® multi parameter meter (model 85). Additionally, the DFG Aquatic Toxicity Laboratory measured alkalinity, hardness, and ammonia on the samples to be tested for toxicity. Totals of alkalinity and hardness were measured with a Hach7 titration kit. Ammonia was determined using an Orion® 95-12 ammonia selective electrode attached to an Orion® specific ion meter (model 290A).

Insecticide Analyses

All water samples were analyzed for bifenthrin, fenoxycarb, hydramethylnon, pyriproxyfen, chlorpyrifos, diazinon, dimethoate, fonofos, malathion, methidathion, methyl parathion, and phosmet. The CDFA Center for Analytical Chemistry performed all analysis using gas chromatography and a flame photometric detector for the eight organophosphorus insecticides; a high performance liquid chromatography and a ultra violet detector for fenoxycarb, hydramethylnon, and pyriproxyfen; and gas chromatography with an electron capture detector confirmed with a mass selective detector for bifenthrin. The reporting limit (reliable detection levels) for chlorpyrifos and diazinon is 0.04 parts per billion (ppb), 0.1 ppb for fenoxycarb and pyriproxyfen, 0.2 ppb for hydramethylnon, and 0.05 ppb for the other insecticides.

RESULTS

Insecticide Concentrations

Table 2 shows chemical analysis results. A total of ten samples were analyzed for the eight organophosphorus insecticides, bifenthrin and the three RIFA insecticide baits. Chlorpyrifos was detected in three samples with concentrations ranging from 0.078 to 0.079 ppb. Diazinon was detected in eight of the samples and ranged from 0.093 to 0.449 ppb. Malathion was detected in one sample with a concentration of 0.178 ppb. Bifenthrin was detected in three samples with concentrations ranging from 0.549 to 0.796 ppb. Fonofos was detected in three samples at concentrations ranging from 0.053 to 0.087 ppb. There were no detections of fenoxycarb, hydramethylnon, pyriproxyfen, dimethoate, methidathion, methyl parathion, or phosmet. Bifenthrin, chlorpyrifos, and diazinon detections recorded at site F, were collected from commercial nursery runoff, as were the bifenthrin, diazinon, and fonofos detections recorded at site G. Samples collected at a nursery holding-pond showed detections of bifenthrin, chlorpyrifos, diazinon, and malathion. Samples collected at site E in a creek downstream from sites F and G showed only detections of chlorpyrifos and diazinon. Diazinon was detected in all

samples except for the two southern sites. Of the twelve insecticides tested, only chlorpyrifos, bifenthrin, fenoxycarb, hydramethylnon, and pyriproxyfen were allowed use in nurseries for treatment of fire ants to comply with U.S. Department of Agriculture quarantine requirements. All of the organophosphorus insecticides listed are registered for uses in commercial agriculture, nurseries, golf courses or parks for the control of other insect pests. Malathion, diazinon, and chlorpyrifos are widely available for homeowner use.

Table 2. Insecticide concentrations and acute toxicity in surface water samples, January 17 and 18, 2000, Orange County, California.

Site	Concentration (pbb)												% Acute Mortality ¹
	bifenthrin	fenoxycarb	hydramethylnon	pyriproxyfen	chlorpyrifos	diazinon	dimethoate	fonofos	malathion	methidathion	m. parathion	phosmet	<i>C. dubia</i>
A	ND ²	ND	ND	ND	ND	0.63	ND	ND	ND	ND	ND	ND	100/0 ⁶
B	ND	ND	ND	ND	ND	0.128	ND	ND	ND	ND	ND	ND	5/0
C	ND	ND	ND	ND	ND	0.449	ND	0.053	ND	ND	ND	ND	100/0 ⁶
D	ND	ND	ND	ND	ND	0.049	ND	ND	ND	ND	ND	ND	100/0 ⁶
E	ND	ND	ND	ND	0.079	0.128	ND	ND	ND	ND	ND	ND	100/0 ⁶
F	0.549	ND	ND	ND	0.078	0.136	ND	ND	ND	ND	ND	ND	0/0
G	0.689	ND	ND	ND	ND	0.093	ND	0.087	ND	ND	ND	ND	0/0
H	NS ³	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
I	ND	ND	ND	ND	ND	ND	ND	0.054	ND	ND	ND	ND	100/0 ⁶
J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	100/0 ⁶
HP ⁴	0.796	ND	ND	ND	0.078	0.263	ND	ND	0.178	ND	ND	ND	NT ⁵

¹ Two numbers are reported for each toxicity test. The first number is the result from the sample; the second from the corresponding control.

² ND = none detected at the reporting limit for that chemical.

³ NS = no sample collected.

⁴ HP = Holding pond.

⁵ NT = not tested.

⁶ The difference in mortality between the sample and the corresponding control are significant using Wilcoxon two-sample test.

During the January 2000 sampling event several sites showed complete mortality. Samples from sites A, C, D, E, I, and J were acutely toxic to *C. dubia* causing 100% mortality (Table 2). Sites A and D contained residues of diazinon; site C showed residues of diazinon and fonofos; site E showed residues of chlorpyrifos and diazinon; site I had residues of fonofos; and site J had no detectable residues for the chemicals analyzed. The detection of diazinon at site D was below the LC₅₀ for *C. dubia* as were the detections of chlorpyrifos and diazinon at site E (Table 3). Two sites that drain nursery runoff showed no toxicity to *C. dubia*. Site F contained residues of bifenthrin, chlorpyrifos, and diazinon while site G contained residues of bifenthrin, diazinon, and fonofos. Site B showed 5% mortality to *C. dubia* and contained residues of diazinon below the LC₅₀ of *C. dubia* (Table 3). From the data collected, we could not determine why there was 100% mortality at sites I and J and 0% toxicity at sites F and G. Table 3 lists LC₅₀ values for rainbow trout, *D. magna*, and *C. dubia* and water quality criteria as comparisons to the concentrations detected.

Table 3. LC₅₀'s of insecticides (ppb) for three aquatic species and U.S. EPA fresh water quality criteria (ppb).

Pesticide	Rainbow trout ¹	<i>D. magna</i> ¹	<i>C. dubia</i>	Fresh Water Quality Criteria (Acute)
Bifenthrin	0.15	0.16	ND ²	ND
Chlorpyrifos	3	1.7	0.13 ³	0.083 ⁷
Diazinon	2600	0.96	0.51 ⁴	0.090 ⁸
Dimethoate	6200	4700	ND	ND
Fenoxycarb	1600	400	ND	ND
Fonofos	50	1	ND	ND
Hydramethylnon	160	1140	ND	ND
Malathion	170	1.8	ND	ND
Methidathion	10	3	ND	ND
Methyl parathion	2700	7.3	ND	ND
Phosmet	230	8.5	ND	ND
Pyriproxyfen	>325 ⁵	400 ⁶	ND	ND

¹ Data from Tomlin, C.D.S., 1997.

² ND= No Data

³ Data from Menconi and Paul, 1994

⁴ Data from Menconi and Cox, 1994

⁵ Data from Bowman, Jane H., 1989

⁶ Data from Burgess, David, 1989

⁷ Data from U.S. EPA, 1994.

⁸ Proposed U.S. EPA data.

Environmental Measurements

Table 4 presents the data for DO, temperature, EC, ammonia, alkalinity and hardness. Water temperature ranged from 13.9 to 23.3°C; DO ranged from 6.22 to 16.66 mg/L; EC ranged from 940 to 3100 µS/cm; ammonia was <1 ppb NH₃ for all samples; alkalinity ranged from 146 to 390 mg/L CaCO₃; and hardness ranged from 132 to 770 mg/L CaCO₃. The California Regional Water Quality Control Board, Water Quality Control Plan, Santa Ana River Basin (1995), and the Water Quality Control Plan, San Diego Basin, (1994), list the following water quality guidelines as acceptable: DO above 5.0 mg/L, pH between 6.5 and 8.5, and water temperature no higher than 78°F (25.5°C). The Santa Ana River Basin plan determines ammonia levels to be dependent upon water temperature and pH, while the San Diego Basin plan states that ammonia levels shall not exceed 0.025 mg/L. The plans do not provide an acceptable range for EC, alkalinity, or hardness. The pH at sites C, G and I were above the maximum guideline pH.

Table 4. Water quality measurements at sampling sites, January 2000, Orange County, California.

Site	Temperature (°C)	pH	Dissolved Oxygen (mg/L)	Electroconductivity (µS/cm)	Ammonia ppb NH ₃	Alkalinity mg/L CaCO ₃	Hardness mg/L CaCO ₃
A	14.2	8.18	6.68	2160	<1	146	132
B	14.3	8.1	6.22	1631	<1	390	440
C	23.3	9.6	NT ¹	1929	<1	160	240
D	13.9	8.17	10.4	1930	<1	240	430
E	16.1	8.21	13.11	2985	<1	310	770
F	16.2	8.1	7.51	2000	<1	188	604
G	14.1	8.6	10.5	1771	<1	190	582
H	NS ²	NS	NS	NS	NS	NS	NS
I	17.0	8.7	16.66	2735	<1	162	324
J	16.5	8.3	11.82	940	<1	242	770
HP	NT	6.6	3100	NT	NT	NT	NT

¹ NT = Readings not taken.

² NS = No sample collected.

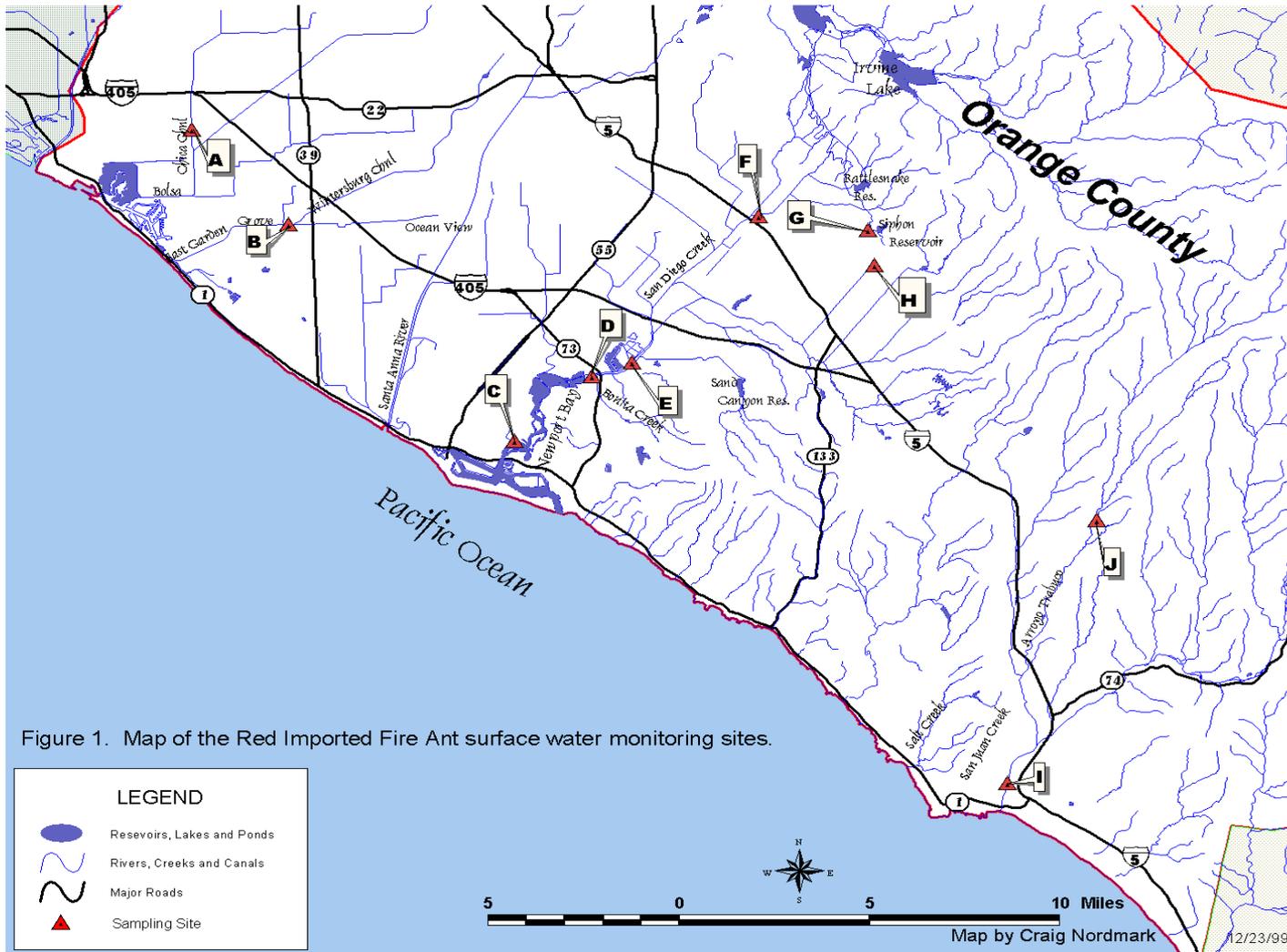


Figure 1. Map of the Red Imported Fire Ant surface water monitoring sites.

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