



# Department of Pesticide Regulation



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## MEMORANDUM

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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,  
OCTOBER 1999 (STUDY 183)

### SCOPE OF THIS MEMORANDUM

This memorandum reports results of water sampling conducted by the Department of Pesticide Regulation (DPR), under the interagency agreement with the Department of Food and Agriculture (CDFA), for the Red Imported Fire Ant (RIFA) control project. Data included here are from the October 26 and 27, 1999 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 1999 pesticide use report becomes available.



## Sample and Data Collection

On October 26 and 27, 1999, surface water samples were collected at eight creeks within the Orange County treatment area including one rinse blank (Table 1 and Figure 1). Samples from sites I and J were collected on October 26, all others were collected on October 27. There was no runoff at site C or H, so no samples were taken. No rain runoff occurred during these sampling dates.

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	Central Irvine Channel at Bryan St.	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 between 3.0 to 3.5. Diazinon rapidly degrades under acidic conditions and 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.

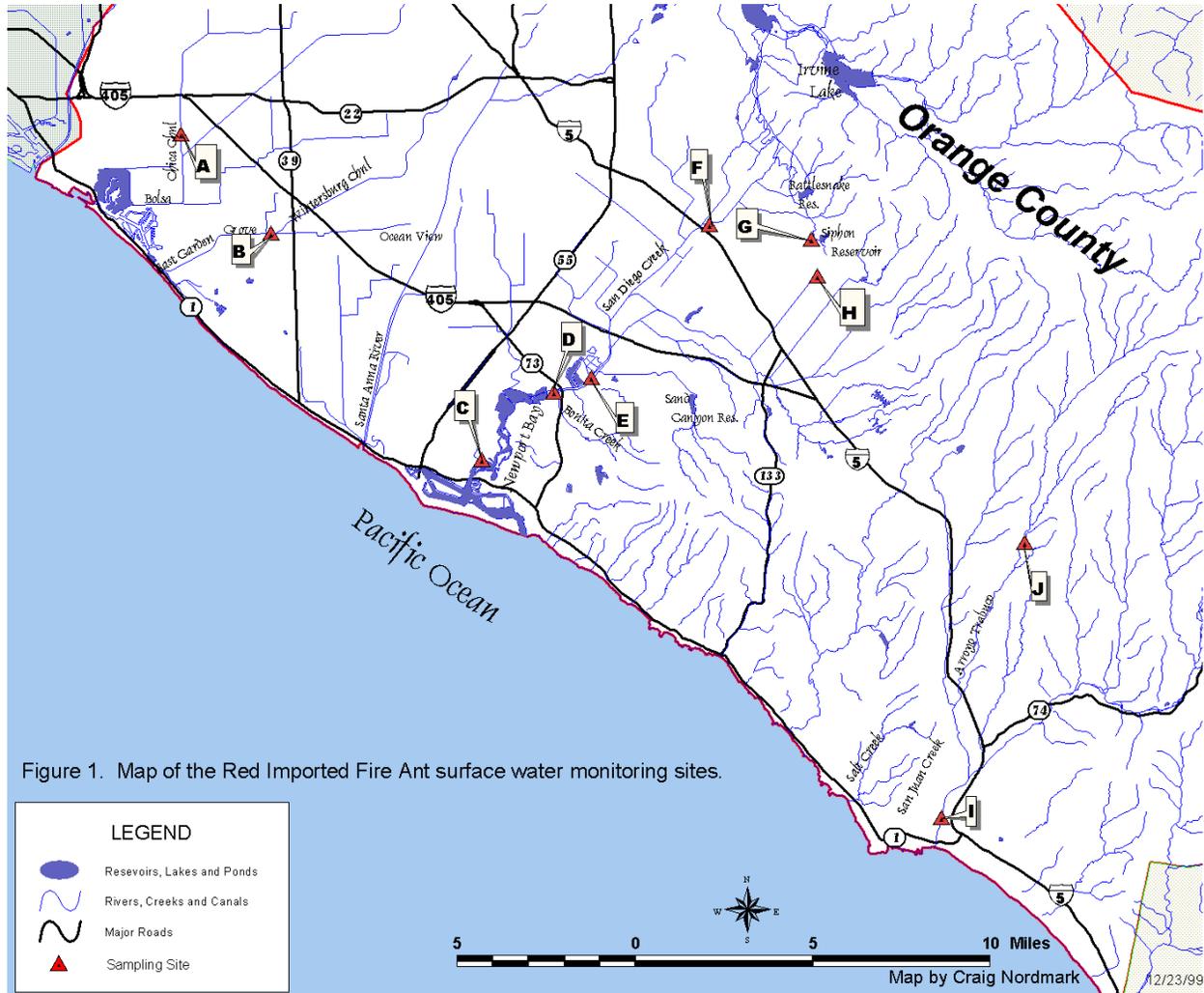


Figure 1. Map of the Red Imported Fire Ant surface water monitoring sites.

## **Environmental Measurements**

Water quality parameters measured *in situ* included temperature, pH, electrical conductivity (EC), and dissolved oxygen (DO). Water pH was measured using a Sentron® (model 1001) pH meter. EC was measured using an Orion® conductivity-salinity meter (model 140). Water temperature and DO were measured using an YSI® dissolved oxygen meter (model 57). Additionally, the DFG Aquatic Toxicity Laboratory upon the delivery of the toxicity samples measured alkalinity, hardness, and ammonia.

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 8 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 nine samples were analyzed for the eight organophosphorus insecticides, bifenthrin, and the three RIFA insecticide baits. Chlorpyrifos was detected in one of the samples with a concentration of 0.58 ppb. Diazinon was detected in five of the samples and ranged from 0.117 to 2.01 ppb. Malathion was detected in two samples with concentrations of 0.136 and 1.74 ppb. Dimethoate was detected in two samples at 0.091 and 0.451 ppb. Bifenthrin was detected in one sample with a concentration of 0.478 ppb. There were no detections of fenoxycarb, hydramethylnon, pyriproxyfen, fonofos, methidathion methyl parathion, or phosmet. Diazinon, dimethoate, and malathion detections, recorded at site F, were collected from commercial nursery runoff as were the bifenthrin, diazinon, and malathion detections recorded at site G. Samples collected at site E in a creek downstream from sites F and G showed no detections of bifenthrin, or malathion but did have a chlorpyrifos detection. 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, Orange County, California.

Site	Chemistry in pbb												% Acute Mortality <sup>1</sup>
	bifenthrin	fenoxycarb	hydramethylnon	pyriproxyfen	chlopyrifos	diazinon	dimethoate	fonofos	malathion	methidathion	m. parathion	phosmet	<i>C. dubia</i>
A	ND <sup>2</sup>	ND	ND	ND	ND	0.235	ND	ND	ND	ND	ND	ND	50/5 <sup>6</sup>
B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	10/5
C	NS <sup>3</sup>	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
D	ND	ND	ND	ND	ND	0.134	ND	ND	ND	ND	ND	ND	60/0 <sup>6</sup>
E	ND	ND	ND	ND	0.58	0.16	0.451	ND	ND	ND	ND	ND	100/5 <sup>6</sup>
F	ND	ND	ND	ND	ND	0.117	0.091	ND	0.136	ND	ND	ND	100/5 <sup>6</sup>
RB <sup>4</sup>	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NT <sup>5</sup>
G	0.478	ND	ND	ND	ND	2.01	ND	ND	1.74	ND	ND	ND	100/5 <sup>6</sup>
H	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
I	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5/0
J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	15/0

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

<sup>2</sup> ND = none detected at the reporting limit for that chemical.

<sup>3</sup> NS = no sample collected.

<sup>4</sup> RB = rinse blank.

<sup>5</sup> NT = not tested.

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

### Toxicity Data

Samples from sites E, F, and G were acutely toxic to *C. dubia* causing complete mortality (Table 2). Site E contained detectible residues of chlorpyrifos, diazinon and dimethoate; site F contained residues of diazinon, dimethoate, and malathion; and site G contained residues of bifenthrin, diazinon, and malathion. Sites A and D, both containing residues of diazinon, showed mortality of 50 and 60 percent, respectively. Samples from sites B, I, and J contained no detectible residues of any of the chemicals tested for, although the toxicity tests did show some mortality. Table 3 lists LC<sub>50</sub> values for rainbow trout, *D. magna*, and *C. dubia* and water quality criteria as comparisons to the concentrations detected.

Table 3. LC<sub>50</sub>'s of insecticides (ppb) for three aquatic species National recommended Water Quality Criteria

Pesticide	Rainbow trout <sup>1</sup>	<i>D. magna</i> <sup>1</sup>	<i>C. dubia</i>	Acute
Bifenthrin	0.15	0.16	ND <sup>2</sup>	ND
Chlorpyrifos	3	1.7	0.13 <sup>3</sup>	0.083 <sup>7</sup>
Diazinon	2600	0.96	0.51 <sup>4</sup>	0.090 <sup>8</sup>
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 <sup>5</sup>	400 <sup>6</sup>	ND	ND

<sup>1</sup> Data from Tomlin, C.D.S.

<sup>2</sup> ND= No Data

<sup>3</sup> Data from Menconi and Paul

<sup>4</sup> Data from Menconi and Cox

<sup>5</sup> Data from Bowman, Jane H.

<sup>6</sup> Data from Burgess, David

<sup>7</sup> Data from U.S. EPA, 1994.

<sup>8</sup> Proposed U.S. EPA data.

**Environmental Measurements**

Table 4 presents the data for DO, temperature, EC, ammonia, alkalinity and hardness. Water temperature ranged from 16.4 to 27.1°C; DO ranged from 3.77 to 10.98 mg/L; EC ranged from 906 to 3030 µS/cm; ammonia ranged from 5.3 to 839 ppm NH<sub>3</sub>; alkalinity ranged from 116 to 322 mg/L CaCO<sub>3</sub>; and hardness ranged from 310 to 746 mg/L CaCO<sub>3</sub>. 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. Sites G and I were above the maximum guideline temperature of 25.5°C; site G was above the maximum guideline pH of 8.5; and sites A and B fell below the water quality guideline for DO. No DO readings were taken at sites D and I.

Table 4. Water quality measurements at sampling sites, Orange County, Calif.

Site	Temperature	pH	Electroconductivity (µS/cm)	Dissolved	Ammonia	Alkalinity	Hardness
	(°C)			Oxygen (mg/L)	ppm NH <sub>3</sub>	mg/L CaCO <sub>3</sub>	mg/L CaCO <sub>3</sub>
A	17.6	7.68	2100	3.77	NT <sup>2</sup>	338	392
B	18	7.9	1530	4.48	NT	316	404
C	NS <sup>1</sup>	NS	NS	NS	NS	NS	NS
D	16.4	8.3	2990	NT	NT	322	746
E	20.6	8.5	2910	9.55	NT	236	732
F	22.6	7.6	1460	7.5	NT	138	532
G	26.8	8.7	1540	10.98	NT	116	516
H	NS	NS	NS	NS	NS	NS	NS
I	27.1	7.9	3030	NT	NT	182	947
J	20.7	7.8	906	8.2	NT	168	310

<sup>1</sup> NS = No sample collected.

<sup>2</sup> NT = Readings not taken.

## References

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