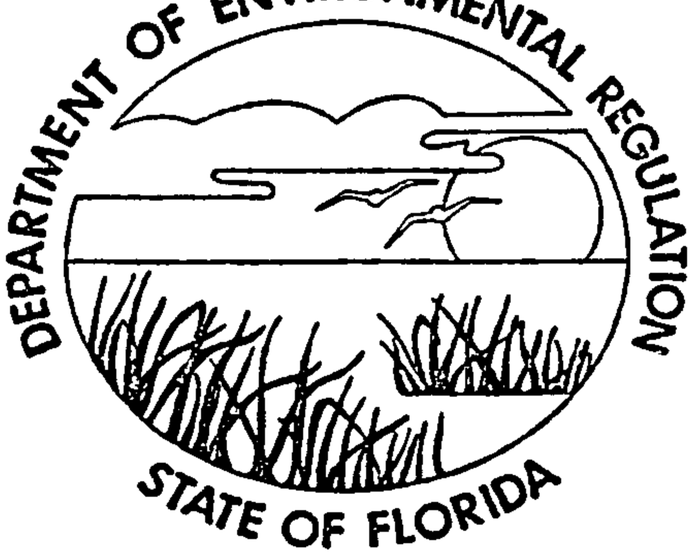


BIOASSAYS OF CHEMAIR SPRAY

PESTICIDE DISCHARGE TO WEST PALM BEACH CANAL

PALM BEACH COUNTY, FLORIDA

NO NPDES PERMIT

SAMPLED 1/14/1985

FEBRUARY 25, 1985

Biology Section
Division of Environmental Programs

BIOASSAYS OF CHEMAIR SPRAY

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PALM BEACH COUNTY, FLORIDA

NO NPDES PERMIT

Biology Section
Bureau of Laboratories
February 25, 1985

EXECUTIVE SUMMARY

Chemair Spray, No NPDES number, Palm Beach County, Florida, on 15 to 17 January, 1985.

The sample of ditch water suspected of being contaminated by Chemair Spray pesticide pits was not toxic to either Daphnia pulex or Notropis leedsi. An earlier screening bioassay (delayed in transit) performed in December, 1984, on this same facility resulted in an LC_{50} of 56.6% for N. leedsi but no toxicity to D. pulex. The differences in these bioassay results can probably be attributed to varying levels of the pesticide toxaphene found in the two samples. A concentration of 12 µg/l of toxaphene was detected in the December, 1984, samples. This concentration is known to be toxic to many fish species. Chemical analysis of the more recent January, 1985, samples indicated that only 2 µg/l of toxaphene was present. This concentration was apparently below the toxic threshold for the organisms tested. The level of toxaphene entering the West Palm Beach Canal from the contaminated ditch is probably related to rainfall events and subsequent storm water run-off from the Chemair Spray pits. District personnel report that there had been rain previous to the December, 1984, sampling, but not before the January, 1985, sampling.

Since toxaphene is a persistent chemical with a half-life of 10 years and is known to be bio-concentrated, even sublethal discharges of this substance may pose severe environmental and health risks (Brooks 1974).

INTRODUCTION

Chemair Spray Company is located on U.S. Highway 98, about 8 miles southeast of Pahokee, Palm Beach County, Florida (Figure 1). The company is engaged in the aerial spraying of pesticides on crops. According to district sources, several pesticides may be discharged into unlined pits as a result of chemical storage, loading, and cleaning the aircraft, etc. During rain events it is suspected that the contents of these pits will flow directly into the surface water of adjacent drainage ditches and thence to the West Palm Beach Canal (L-10).

Mr. Terry Davis of DER's Southeast District Branch Office requested bioassays to determine the existence and extent of the toxicity from Chemair Spray. On 4 to 6 December, 1984, the Biology Section conducted bioassays on two samples from Chemair Spray, using Daphnia pulex and Notropis leedsi as the test organisms. One sample was taken where a ditch drained run-off from the Chemair spray area through a culvert into the West Palm Beach Canal (L-10). The other sample was taken upstream in L-10 and was used as a background control. The background sample was not toxic to either the water flea or the fish. The "culvert" sample, however, was toxic to N. leedsi, producing a 48 hour LC_{50} of 56.6%. This same sample, howver, was not toxic to D. pulex.

The bioassay samples, however, were delayed in transit past the 24 hour limit imposed for starting a "definitive" acute toxicity test and were, therefore, considered legally invalid according to strict bioassay protocols. Therefore, the results were reported as being probably representative of the toxicity of Chemair Spray's discharge.

Due to upcoming enforcement actions against Chemair Spray by DER, Mr. Terry Davis requested further toxicity testing be performed. On 15 to 17 January, 1985, the Biology Section again performed acute toxicity tests on a sample from the Chemair Spray contaminated ditch. The results of these latest tests are reported here. Those involved in conducting the tests and in preparation of this report were: Craig Dye, Marshall Faircloth, Russel Frydenborg, Manitia Moultrie and Martin Roll.

State of Florida
DEPARTMENT OF ENVIRONMENTAL REGULATION

INTEROFFICE MEMORANDUM

For Routing To District Offices And/Or To Other Than The Addressee		
To: _____	Loctn.: _____	
To: _____	Loctn.: _____	
To: _____	Loctn.: _____	
From: _____	Date: _____	
Reply Optional [ ]	Reply Required [ ]	Info. Only [ ]
Date Due: _____	Date Due: _____	

TO: Mr. Terry Davis

THROUGH: Mr. Randy Armstrong, Chief, Laboratories and Special Programs

FROM: Russel Frydenborg RF

DATE: December 7, 1984

SUBJECT: Bioassays - Chemair Spray; Results of screening tests

Samples from Chemair Spray were delayed in transit past the 24 hour limit imposed for starting a definitive acute toxicity test. However, believing that any toxicity information on this discharger would be useful to you, we conducted four screening bioassays, consisting of three test concentrations each, using Daphnia pulex and Notropis leedsi as the test organisms.

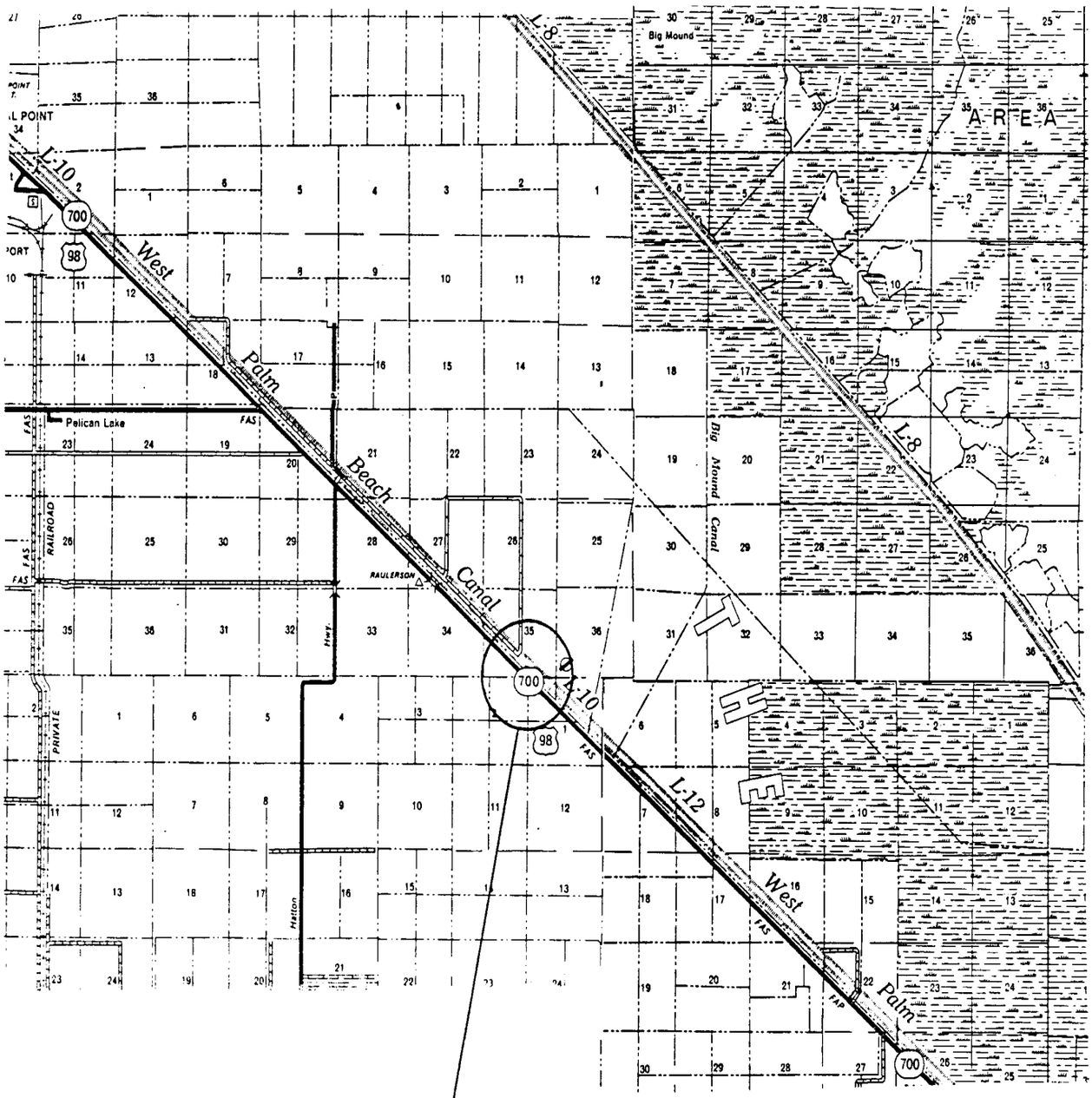
The sample collected "upstream" was not toxic. Only one D. pulex, and one N. leedsi died in their respective 100% concentration test chambers. The sample collected downstream in the "drainage culvert" was also not toxic to D. pulex, however, it was lethal to all the fish in the 100% concentration, resulting in a 48 hour LC_{50} of between 32% and 100%.

The samples for the pesticide extractable scan were forwarded to the Chemistry Section for analysis. They will send the chemical results to you in a few weeks.

Since only screening tests were performed because of the time limit invalidation, no official report will be issued. If you believe this discharger should be tested again for toxicity, an emergency response bioassay may be scheduled at a later date.

RF:jg

cc: Mr. Richard Reis, Southeast Florida District



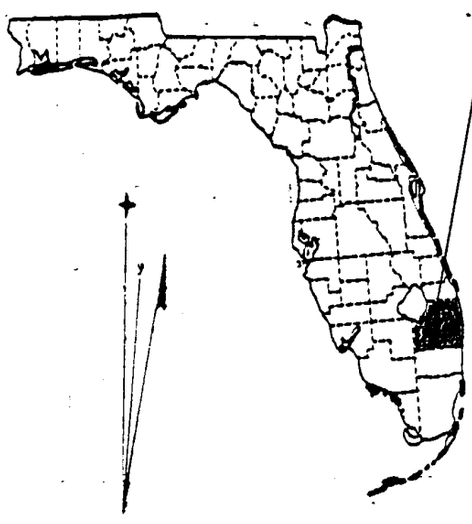


Figure 1. Portions of West Palm Beach County including the study area.

METHODS AND MATERIALS

Test methods used to conduct these static bioassays are extensively described by Peltier (1978) and the FDER Biology Section (1983). The organisms selected for this study include a species recommended by Peltier (1978), the U.S. EPA (1978), and the FDER Biology Section (1983). Additionally, the Biology Section maintains cultures of several species of organisms indigenous to the State of Florida. One of these indigenous species was also selected for testing. Life histories of these test organisms and maintenance procedures used to culture them are detailed below.

History and Maintenance of Bioassay Organisms

Daphnia pulex (water flea) - A breeding culture of Daphnia pulex was obtained from the EPA laboratory in Athens, Georgia, in March, 1979. This culture has been maintained since its arrival in 2 1/2 gallon all-glass aquaria, filled with unchlorinated DER well water, under a 16:8 hour light-dark cycle. Organisms are fed a liquified blend of Purina Trout Chow® and Cerophyl® twice daily, once daily on weekends, and are kept at a constant temperature of 22° plus or minus 2°C. The aquaria are cleaned weekly by siphoning off half the water along with the detritus and excess organisms, and then refilling with fresh aerated well water. Additional measures are taken and/or new cultures started in the event of abnormal circumstances such as: declining populations, ephippia formation, or excessive fungal or bacterial growth.

Notropis leedsi (bannerfin shiner) - Approximately 40 adult bannerfin shiners were obtained from an indigenous population in the upper Suwannee River during October, 1981. The breeding stock is maintained in 30 and 125 gallon all-glass aquaria equipped with a flow-through water exchange system. Water for this system is unchlorinated and is pumped from the DER deep well. The bannerfin shiners are reared at 22° plus or minus 2°C under a 16:8 hour light cycle and are fed Tetra-Min® and frozen Artemia (brine shrimp) twice daily, and once daily on weekends. Breeding and egg hatching are encouraged at 25°C. The eggs are laid between stacked red ceramic tiles separated by a 3mm bead of silicone. Most of the eggs adhere to the tiles and are easily removed to heated, aerated hatching tanks. The narrow space between the tiles eliminates egg predation by adult fish. New hatching tanks are started regularly to segregate fry into even age groups. Newly hatched fry are fed a liquefied blend of Purina Trout Chow® and Cerophyl® twice daily. After one week, feeding is augmented with newly hatched Artemia nauplii and finely crushed Tetra Min®. The fish used in this test were about 4 weeks old at the time of the test.

To ensure the uniform sensitivity of these test organisms to toxic substances, the Biology Section conducts monthly standard reference toxicant bioassays using sodium lauryl sulfate as the reference toxicant.

Test Methods

Two 48 hour static acute toxicity bioassays were performed on a sample of ditch water before it entered the West Palm Beach Canal. This ditch is suspected of being contaminated by the Chemair Spray pesticide pits. The tests were performed from 0900 hours on 15 January, 1985, to 0900 hours on 17 January, 1985.

The sample was collected by Ms. Randi Schwartz of DER's Southeast District Branch Office at 1135 hours on 14 January, 1985, using standard wastewater sampling procedures. Separate samples were obtained for pesticide analysis and biological testing. The samples were iced and transported to the DER laboratory in Tallahassee for analyses within 24 hours of collection.

Freshwater for dilution of the sample was obtained from the same DER deep well that is used to culture the test organisms. The concentration series selected for this study is shown in Table 1.

Two replicates, each with three concentrations and a control, were used to test with the water flea, Daphnia pulex. Flint glass jars of 250 ml capacity were used as test chambers, and 200 ml of the appropriate test concentration was placed in each chamber. Daphnia were siphoned into a large culture dish to isolate the proper size and age organisms (neonates). To accomplish this, the water fleas were siphoned through a stainless steel screen. The trapped adults were then discarded. These neonates were then transferred by glass pipette, examined for injury, and were loaded 10 per chamber, resulting in 20 per test concentration. Water fleas were not fed during this test.

Two replicates, of three concentrations and a control, were used for the Notropis leedsi (bannerfin shiner) bioassay. The fish were transferred individually or by twos, into wide mouth quart jars containing 500 ml each of the appropriate test concentration, and were loaded 5 per chamber, resulting in 10 per concentration. Fish were not fed during this test.

Dissolved oxygen (YSI Model 57 oxygen meter), pH (Corning Model 7 pH meter with Orion Ross® combination electrode), temperature (NBS calibrated glass thermometer), and the number of live organisms were recorded for each test concentration at 0 hours, 24 hours, and 48 hours. Total alkalinity and total hardness (measured as $CaCO_3$ using HACH Chemical Company reagents) were recorded at the beginning of the test for the controls and the 100% concentration. The specific conductance (YSI Model 33 S-C-T meter) of each test concentration was recorded at the beginning and end of the test. All instruments were calibrated daily according to manufacturer's recommendations. These values were recorded on the bioassay data forms and are presented in Tables 2 and 3.

Table 1. Concentration Series and Volumes Used for These Static Bioassays

Daphnia pulex (water flea)

Concentration	Dilution Water	Effluent	Total Volume
Control	200.0 ml	--------	200 ml
10.0%	180.0 ml	20.0 ml	200 ml
50.0%	100.0 ml	100.0 ml	200 ml
100.0%	--------	200.0 ml	200 ml

Notropis leedsi (bannerfin shiner)

Concentration	Dilution Water	Effluent	Total Volume
Control	500 ml	------	500 ml
10.0%	450 ml	50 ml	500 ml
50.0%	250 ml	250 ml	500 ml
100.0%	------	500 ml	500 ml

Table 2. Data recorded during 48 hour, Daphnia pulex, static acute toxicity bioassay of Chemair Spray, Palm Beach County, Florida, on 15 to 17 January, 1985.

Concentration or %	Number of Live Organisms			Dissolved Oxygen (mg/l)			pH			Temperature (°C)			Conductivity (umhos)		NH_3/N (mg/l)	
	0	24	48	0	24	48	0	24	48	0	24	48	0	48	0	48
Control	10	10	0 [a]	7.2	7.8	5.2	8.0	8.3	8.0	22.4	21.9	21.8				
Control	10	10	10	8.0	8.0	6.0	8.0	8.3	8.1				230	253		
10.0%	10	10	10	7.5	7.4	6.1	8.1	8.5	8.1	22.5	21.7	21.6				
10.0%	10	10	10	8.2	7.4	5.6	8.1	8.5	8.1				255	290		
50.0%	10	10	10	7.6	6.8	5.5	8.3	8.45	8.15	22.5	21.7	21.6				
50.0%	10	10	10	8.6	6.9	5.5	8.3	8.45	8.1				445	485		
100.0%	10	10	10	8.2	6.8	5.8	8.5	8.6	8.3	22.5	21.8	21.8				
100.0%	10	10	10	9.1	6.6	5.8	8.6	8.6	8.3				720	800		

Control Water

Total Alkalinity 45 (mg/l $CaCO_3$)

Total Hardness 118 (mg/l $CaCO_3$)

100% Sample

Total Alkalinity 128 (mg/l $CaCO_3$)

Total Hardness 230 (mg/l $CaCO_3$)

[a] Mortality caused by accidental contamination with new pH probe.

Table 3. Data recorded during 48 hour, Notropis leedsi, static acute toxicity bioassay of Chemair Spray, Palm Beach County, Florida on 15 to 17 January, 1985.

Concentration or %	Number of Live Organisms			Dissolved Oxygen (mg/l)			pH			Temperature (°C)			Conductivity (umhos)		NH_3/N (mg/l)	
	0	24	48	0	24	48	0	24	48	0	24	48	0	48	0	48
Control	5	5	5	8.0	5.0	5.4	8.0	7.9	8.0	22.0	22.0	21.8				
Control	5	5	5	8.1	5.0	5.2	8.0	7.9	7.9				188	305		
10.0%	5	5	5	8.2	4.7	4.7	8.1	7.85	7.9	21.9	21.7	21.6				
10.0%	5	5	5	8.2	4.8	4.7	8.1	7.85	7.85				230	342		
50.0%	5	5	5	8.7	5.0	4.8	8.3	8.05	7.9	22.0	21.6	21.5				
50.0%	5	5	5	8.7	4.7	4.8	8.3	8.0	7.9				440	600		
100.0%	5	4	4	9.2	4.8	4.2	8.6	8.2	8.0	22.3	21.9	21.5				
100.0%	5	5	5	9.2	4.5	4.4	8.6	8.15	8.1				740	890		

Control Water

Total Alkalinity 45 (mg/l $CaCO_3$)

Total Hardness 118 (mg/l $CaCO_3$)

100% Sample

Total Alkalinity 128 (mg/l $CaCO_3$)

Total Hardness 230 (mg/l $CaCO_3$)

RESULTS AND DISCUSSION

Results from the December screening bioassays (delayed in transit) indicated that the Chemair Spray contaminated ditch was toxic (48 hour LC_{50} = 56.6%) to the fish N. leedsi, but not toxic to the water flea, D. pulex. The January bioassays indicated that the Chemair Spray contaminated sample was not toxic to either of the above organisms. The results of these tests will be better understood when accompanied with the results from the concurrent chemical analyses. Chemical analysis indicated that 12 µg/l of toxaphene, a chlorinated hydrocarbon pesticide, were present in the December "culvert" sample. Reported LC_{50} values for toxaphene are as low as 3 µg/l, 4 µg/l, and 2.3 µg/l for brown trout, bluegill, and Pteronarcys sp. respectively (Kemp et al. 1973, Pimental 1971, Johnson and Finley 1980). Daphnia pulex are more resistant to the effects of toxaphene, as 15 µg/l only causes immobilization of that organism (Sanders and Cope 1966). Obviously, the concentration of the chemical suspected of causing the toxicity (toxaphene) fell in a range that would produce mortality in the fish but not in the invertebrate during the December tests. During the January bioassays, the concentration of toxaphene was only 2 µg/l. This amount of toxaphene was apparently below the toxic threshold for either organism.

However, since toxaphene has a half-life of 10 years and is bioconcentrated, even sublethal discharges of this substance pose severe environmental and health risks (Brooks 1974). Wilson and Connor (1973) have found that some lakes with previous toxaphene-related fish kills have remained toxic for 3 to 4 years. Additionally, according to district sources, extremely high levels (6000 mg/kg) of toxaphene have been found in the Chemair Spray pits, along with the pesticides methyl parathion, EPN, and atrazine.

Therefore, discharges from Chemair Spray may represent a long-term danger to the biota of the receiving waters.

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