

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

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DATE: FEB 29 1980

SUBJECT: Assessment of Hazards to Shrimp Fisheries Resulting from use of Aldicarb on Citrus Groves in Texas.

FROM: John J. Bascietto, Wildlife Biologist, EEB/HED *John J. Bascietto*  
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TO: Patricia Critchlow, Emergency Response Section, RD. *Norman Cook for C.B.*

THRU: Clayton Bushong, Chief, Ecological Effects Branch, HED

Attached is EEB's assessment of hazards to the Laguna Madre shrimp fishery due to aldicarb's proposed use on grapefruit in Texas.

We would like to add three additional points for your consideration:

1. The point source of aldicarb runoff, i.e., the Arroyo Colorado, drains directly into the waters of the Laguna-Atacosa National Wildlife Refuge.
2. The estimated environmental concentration within the Laguna Madre Bay used in this risk assessment is considered by our scientists to be extremely conservative with regard to environmental safety. If time allows, HED scientists would like to make a complete computer simulation of the estimated environmental concentration.
3. Any monitoring program initiated in the Texas Gulf citrus area should include measurement of chloride ion concentration and distribution in irrigation runoff water (tile drain system included). This will enable us to better assess the degradation of aldicarb residues.

cc: Susan Sherman, HED  
Bob Carsell, EEB/HED



Assessment of Hazard to Gulf Coast shrimp fisheries due to aldicarb use on Citrus Groves in Texas.

Introduction

The proposed section 18 is for use of (TEMIK, 15G) aldicarb to control nematodes on grapefruit orchards in Cameron, Willacy, and Hidalgo counties, Texas. The section 18, if granted, will be in addition to the registered use of TEMIK, 15G on oranges in the same areas. The grapefruit acreage will be 24,000 acres. The orange acreage in these counties amounts to 28,000 acres. The grapefruit use will employ label directions for oranges, and be applied at the rate of 10 pounds active ingredient per acre (see EEB review of Bascietto, 2/6/80). The Environmental Fate Branch has already determined that the parent compound will leach in the sandy soil of the treated citrus groves in this locale. These fields are tile-drained. A previous EFB assessment (B. Carsell 2/27/80) of this section 18 demonstrates that the tile drainage system will effectively result in point source pollution discharge somewhere near Harlingen, Texas. This discharge, containing the aldicarb residues will drain directly into the Laguna Madre Bay and ultimately, into the Gulf of Mexico. The same EFB assessment estimates the half life of the parent, the toxic sulfoxide and sulfone to be 160 - 200 days at the reported pH of Texas groundwater in this area (pH=8). Amount of leaching will of course depend on amount of irrigation, rainfall, and adsorption capacity of the soils. The EFB assessment concludes that the aldicarb will leach under the conditions of the proposed section 18 use pattern. Majority of the residues will be carried away from the treated fields via the tile system, and hence eastward into the Laguna Madre Bay and Gulf of Mexico. For purposes of this incremental hazard assessment it is assumed that the same applies to the use on oranges, already registered. It is further assumed that aldicarb residues leaching will be effectively doubled by the grapefruit use (i.e. 28,000 acres oranges + 24,000 acres grapefruit).

The resulting discharge of aldicarb residues may be considered as a point source, in this case, from the communal drainage basin near Harlingen, Texas (Arroyo Colorado).

The Laguna Madre Bay is a narrow strip of water isolated between the Texas (southeast) coastline and the barrier, Padre Island. It therefore can be expected to have a very low flushing rate, thereby favoring longer retention of residues discharged into it. Very large marshy areas exist on Padre Island allowing some exchange between the Gulf and the Bay.

Shrimping and effects to shrimp

The Laguna Madre Bay is of particular concern to this section 18 action as it supports a substantial shrimp fishery (see U.S.D.I., BLM map of Gulf of Mexico-Penaeid shrimp, visual #5, 1972). A Dr. Allison of the Pan-American University informed EEB (phone conversation, 2/27/80) that the area in question is not a particularly important spawning or nursery ground for brown shrimp (the species most abundant in the area). However, according to Dr. Allison, shrimping does occur there. Newly spawned shrimp will not be exposed as spawning occurs later in the year (August-Dec.). More sensitive juveniles and also adults on the nursery grounds will be exposed, however.



Table 1 provides a summary of toxicity data for estuarine organisms tested. Penaeid shrimp (Brown shrimp are one type) are particularly sensitive to aldicarb, with typical LC50 values ranging from 27-72 ppb.

The Brown shrimp fishery of the Laguna Madre Bay has already been exposed to pesticide residues resulting from the orange use. The amount of damage to the fishery specifically due to aldicarb cannot be determined without an extremely detailed analysis of the relative contributions of spawning, natural mortality, predator, and fishing pressure to the population dynamics. An undetermined amount of residue-related mortality and/or sublethal effects (reproductive, predator-prey relationships) may have occurred in the Bay due to last year's orange use. Apparently, no reports of large shrimp kills or reductions of catch have been made at this point in time (Feb., 1980). The possible adverse effects to this fishery can be expected to (at least) double with the resulting residues from the grapefruit section 18.

#### Exposure levels

In consultation with Mr. Dave Petit, a hydraulics expert with the U.S. Army Corps of Engineers in Galveston, Texas, the following levels of exposure were calculated for aldicarb in the Laguna Madre Bay.

Area of Consideration: Laguna Madre Bay from Port Isabel North to Port Mansfield. This area was identified by Mr. Petit as the circulation area exposed to the aldicarb run-off.

Volume of water: 33.75 mi X 7.5 mi X 6 feet  
(average depth of Bay is 6 feet)

$$178,200' \times 39,600' \times 6' = \\ 4.23 \times 10^{10} \text{ ft.}^3$$

Weight of water:  $4.23 \times 10^{10} \text{ ft.}^3 \times 62.4 \text{ lbs/ft}^3 =$   
 $263.952 \times 10^{10} \text{ lbs. (H}_2\text{O)} =$   
 $2.63952 \times 10^{12} \text{ lbs.}$

Assume a 35% run-off rate of aldicarb to tile drain system (EFB concurrence, B. Carsell)

Weight of Aldicarb: 10 lbs/acre X 50,000 acres =  
500,000 lbs aldicarb

$$500,000 \text{ lbs} \times .35 = \\ 175,000 \text{ lbs run-off}$$

$$\frac{1.75 \times 10^5}{2.63952 \times 10^{12}} = .662999 \times 10^{-7}$$

$$= 0.00000006 \quad \text{lb pesticide/lb H}_2\text{O}$$



ppb conversion:  $\frac{.0000006 \text{ lbs. aldicarb/lb. H}_2\text{O} \times 10^9}{20} = 60 \text{ ppb}$

Estimated Environmental Concentration (EEC) Laguna Madre Bay = 60 ppb

The 60 ppb estimated environmental concentration (EEC) puts the exposure well above the LC50 (dynamic test) for penaeid shrimp (= 27ppb) and mysid shrimp (=16 ppb.). Static Tests have set LC50 levels at 72 ppb for penaeids and 13 ppb for mysids. In chronic tests the MATC levels were as low as 1ppb for mysid shrimp.

Since Brown shrimp are members of the penaeid group, the EEC for the Laguna Madre in this case (60 ppb) is well over the dynamic LC50 level and dangerously approaches the static LC50 level. Heavy mortality (50%) may be expected for the shrimp fishery of the Laguna Madre Bay if the section 18 is granted.

Dave Hansen of EPA's Gulf Breeze Lab reports that the EEC (60 ppb) for Laguna Madre is well within the range of LC50's for all estuarine organisms tested at Gulf Breeze against aldicarb. Heavy mortality (50% or greater) for estuarine fish and other aquatic invertebrates may be expected for this use (see Table 2).

Hansen's static LC50 data for pink shrimp: LC50 = 12 ppb (7.5-18 ppb) 95% c.i. This is about 1/2 the LC50 for penaeid shrimp tested in a flow through system by an independent lab (EG & G)

#### Populations and Toxicity

Of particular interest for the shrimp fishery here is that the grapefruit use would effectively double the residue load already attendant with aldicarb's use on oranges. The danger exists that the brown shrimp population can be sufficiently stressed by residue related mortality (in addition to natural mortality, predation, and fishing pressure, all of which are high) so that a "critical" lower limit (of density) is reached, and from which the population cannot recover (repopulate the fishery). When this occurs the Laguna Madre Bay shrimp fishery will experience a serious depletion of this valuable (renewable) protein resource. This will, of course, also adversely affect predation-prey relationships and other factors of the delicate estuarine system for an unpredictable period of time.

Based on a literature review EEB can find no data to indicate that a specific level of aldicarb residue would cause such a population decline for Brown shrimp. However, aldicarb is the most acutely toxic pesticide to mammals registered for use on food crops in the U.S. An LD50 as low as 0.6mg/kg has been reported for rats. The slope of the lethality curve is very steep, with only a small difference between the LD10 (=0.46mg/kg) and the LD90 (=0.62mg/kg) (see Tox. Branch reviews). This indicates that the potential for a



~~precipitous mortality response over a small range of concentrations~~ is real. The action of aldicarb is that of a carbamate type pesticide, i.e., reversible inhibition of cholinesterase. The reversibility of this action may explain the taxonomic variability of sensitivity. As such it cannot be stated with certainty that population effects will be observed for shrimp. Preliminary data from EPA's Gulf Breeze Laboratory indicates that the mortality curve for pink shrimp is not as steep as that for mammals. Regardless, 50% residue-related mortality (or more) might be expected for brown shrimp if the section 18 is granted. A more definitive estimate of shrimp losses could be made if HED had time to make an estimate of Environmental concentration involving hydrologic parameters of the use pattern area.

### Recommendation

EEB urges that the section 18 for aldicarb use in Texas grapefruit orchards be denied due to unreasonable hazards to the brown shrimp fishery attendant with a 100% increase in aldicarb loading to the Laguna Madre Bay. This unreasonable hazard also exists for aquatic organisms in the Bay and its estuaries, which may be of lesser economic importance.

Should the section 18 be granted EEB recommends a monitoring program similar to the following:

#### Planning a Pesticide Monitoring Program

The drainage basin of choice should have:

1. A slope typical of the citrus - growing area
2. Soil types which have previously been studied in laboratory adsorption - desorption tests and typify the citrus soil
3. (If possible the drainage channel(s) which can be accurately monitored as to flow(s) should be monitored by the U.S.G.S. or some experienced agency)

Parameters to be monitored should include

1. Continuous rainfall monitoring.
2. Continuous temperature monitoring.
3. Monitoring of flow off of field per rainfall event.
4. Monitoring of concentrations of pesticide in runoff water per rainfall event.
5. Monitoring of concentration of sediment by weight (total kg/runoff event).



6. Percent soil cover monitoring by month.
7. Daily pan evaporation monitoring.
8. Caged fish study (refer to Bob Hitch/EEB/HED).

Further questions concerning monitoring program design could be directed to EFB and Charles N. Smith (Athens, ERL. phone 404-250-3565).

Table 1

Toxicity of Aldicarb to Estuarine

Organisms

Static Test :EC50 or LC50 (ppb)

Algae	-	5X104	(EPA, Gulf Breeze Data)
Oyster (Larval)	-	8,800	(EG & G data)
Mysid shrimp	-	13	(EPA, GBL data)
Penaeid shrimp	-	72	(" " ")
Pinfish (spot)	-	202	(" " ")
Sheepshead Minnow	-	168	(" " ")

Dynamic Test :LC50 (ppb)

Mysid shrimp	-	16	(EG & G data)
Penaeid shrimp	-	27	( " )
Pinfish (spot)	-	218	( " )
Sheepshead Minnow	-	111	( " )

Chronic Toxicity - MATC (ppb)

Mysid shrimp	-	1	(EG & G data)
Grass shrimp	-	>10	( " )
Sheepshead Minnow	-	50	( " )

Table 2

EPA, Gulf Breeze Laboratory - LC50 data - estuarine organisms vs.- Aldicarb - Most recent testing (as of 2/28/80).

<u>Species</u>	<u>LC50 (ppb)</u>	<u>95% c.i. (ppb)</u>
Mysid shrimp	16	(13 - 20)
Pink Shrimp	12	(7.5-18)



Sheepshead Minnow

41

(55-72)

Pinfish (spot)

80

(43 - 150)

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## REMARKS

Dene Hansen  
96 hr PIRK ship 20 ship

C

SC

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8.6

16.

27

41

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50%

45%

75%

80%

100%

LC  
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Circulate	For Your Information	See Me
Comment	Investigate	Signature
Coordination	Justify	

## REMARKS

*Dave Hansen - Aldrich*  
*LC 50 195/1*  
*Myriad 16 (13-20)*  
*Pink shrimp 12 (7.5-18)*  
*sheepshead 41 (55-72)*  
*Pinfish 80 (43-150)*

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