UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
PREVENTION, PESTICIDES
AND TOXIC SUBSTANCES

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MEMORANDUM

FROM: Arnet W. Jones, Acting Chief
Science Analysis and Coordination Staff
Environmental Fate and Effects Division (7507C)

03/26/97

THROUGH: Elizabeth Behl, Acting Chief
Environmental Fate and Ground Water Branch
Environmental Fate and Effects Division (7507C)

TO: George LaRocca, PM 13
Insecticide/Rodenticide Branch
Registration Division (7505C)

SUBJECT: Lambda-cyhalothrin (Karate) New Use on Rice - Environmental Fate Data Requirements and Spray Drift Mitigation Language

CONCLUSIONS

1. To support lambda-cyhalothrin use on rice (aquatic food crop), the following environmental fate data are needed: aerobic aquatic metabolism (162-3), anaerobic aquatic metabolism (162-4), and aquatic field dissipation (164-2). The registrant indicated that these studies are in progress and will be submitted in 1997 and 1998 (see Discussion). All environmental fate data requirements needed to support terrestrial uses are satisfied.

2. The current label contains language that is intended to reduce Karate spray drift into aquatic areas. This language apparently does not protect some of the unique aquatic areas which may be adjacent to rice fields. See Discussion item 3 for details.

3. The interim spray drift measures for cotton are adequate interim measures for rice. EFGWB recommends strongly that these measures be re-evaluated and possibly revised following review of the Spray Drift Task Force data.

4. The buffers of 150 ft (aerial sprays) and 25 ft (ground sprays) may be incompatible with the common cultural practice of treating only the outside perimeter of rice fields for rice water weevil. Also, the buffer zones may not be practical in that areas directly adjacent to rice fields often are aquatic and harbor sensitive aquatic organisms. EFGWB emphasizes the importance of these interim buffer zones in

protecting aquatic environments from potential exposure to lambda-cyhalothrin.

5. The registrant proposed a 4-day holding period before flood water treated with lambda-cyhalothrin could be released from rice fields. In the absence of supporting environmental fate data, it is not clear whether this is sufficient time to allow degradation of the parent compound and reduce exposure to nontarget organisms which are present in receiving waters. If the rice use is granted, EFGWB believes it prudent to extend the holding period significantly to enable degradation and reduce potential exposure to nontarget aquatic organisms.

6. The label for rice and other uses of lambda-cyhalothrin should specifically prohibit the use of ultra-low volume (ULV) sprays. (Some labeling provided with the new use petition included a ULV buffer of 450 ft.).

7. The minimum length of the vegetative buffer strip intended to mitigate aquatic exposure due to runoff should be increased from 10 feet to 25 feet.

BACKGROUND

Karate has been proposed for use on rice to control armyworms, aphids, rice water weevil, rice stink bug, grasshoppers and leafhoppers. A maximum of three applications @ 0.04 lb ai/A (total 0.12 lb ai/A/yr) would be allowed.

Because rice and cotton are cultivated in the same general region in the Mississippi Delta and because the maximum application rate for rice is the same as for cotton, the registrant (Zeneca) has proposed that the spray drift mitigation language currently used for cotton be adapted for rice. Other factors supporting the registrant's position include:

- there would be only one application of karate on rice for 80% of the rice crop; multiple applications on cotton are more common.
- because about 7 million acres of cotton are treated with insecticides vs. 0.5 million acres of rice, there would be potentially less aquatic exposure to karate from the rice application.
- because the spray volume used for rice (5 gal/A) is greater than for cotton (2 gal/A), droplet size is likely to be greater for rice, hence drift potential may be lower.
- ultra-low volume (ULV) applications will be prohibited on rice.

DISCUSSION

1. The registrant indicated that the environmental fate data needed to support the rice (aquatic food crop) use (aerobic and anaerobic aquatic metabolism - 162-3 and 162-4; aquatic field dissipation - 164-2) are in progress. The final reports for the aerobic and anaerobic aquatic metabolism and an interim report for the aquatic field dissipation study are due to be submitted in May 1997. The final

report of the field study is scheduled for early 1998. EFGWB will have greater confidence in its ability to assess the fate of Karate when used on rice after these data have been submitted and reviewed. (Note: Some preliminary results from these studies were submitted. However, because only a summary of results was available and a thorough scientific review was not possible, these interim data were not included in this assessment.)

2. The buffers of 150 ft (aerial sprays) and 25 ft (ground sprays) may be incompatible with the common cultural practice of treating only the outside perimeter of rice fields for rice water weevil. Also, the buffer zones may not be practical in that areas directly adjacent to rice fields often are aquatic and harbor sensitive aquatic organisms. EFGWB emphasizes the importance of these interim buffer zones in protecting aquatic environments from potential exposure to lambda-cyhalothrin.

3. The current label for Karate includes the following language which is intended to reduce spray drift into aquatic areas: "Do not apply by ground within 25 feet, or by air within 150 feet of lakes; reservoirs; rivers; permanent streams, marshes, or natural ponds; estuaries and commercial fish ponds. Increase the buffer zone to 450 feet when ultralow volume (ULV) application is made." This language does not include ditches, canals, and other water bodies which are often closely associated with rice fields. Drift into these areas could have adverse effects on aquatic organisms or could affect organisms in larger downstream water bodies into which these unique rice water bodies drain.

4. In its letter of Nov. 23, 1994 (copy attached), the registrant indicates that EFGWB agreed that field dissipation data submitted for the emulsifiable concentrate formulation can be bridged to support the CS (capsule suspension or microencapsulated) formulation.

5. A larger spray volume (5 gal/A) proposed for aerial applications to rice is greater than the 2 gal/A volume typically used for cotton. Although this may result in the use of larger droplets (and hence reduce drift potential) increases in spray volume are not always directly correlated with larger droplet size.

<u>Environmental Fate Assessment</u>

The major route of lambda-cyhalothrin dissipation appears to be adsorption to soil (Freundlich K_{ads} = 261-4649) followed by microbial-mediated soil metabolism ($t_{1/2}$ = 7-30 days in aerobic and anaerobic conditions). Abiotic processes appear to play a minor role in the insecticide's dissipation under most environmental conditions (stable to hydrolysis at pH 5 and 7, $t_{1/2}$ = 7 days at pH 9; $t_{1/2}$ = 34 days for photodegradation on soil). Acceptable and supplemental field dissipation half-lives of 12-40 days were reported. Lambda-cyhalothrin residues could reach surface waters via spray drift or adsorbed to soil particles transported with runoff. Bioaccumulation factors of up to 7340X were reported for fish viscera; depuration was ≥77%.

APPENDIX 3- Copy of Letter to Mr. Adam Heyward, EPA, November 23, 1994.

November 23, 1994

Adam Heyward
Product Manager (13)
Insecticide-Rodenticide Branch
Registration Division (7505C)
U.S. Environmental Protection Agency
401 M Street, SW
Washington, D.C. 20460

Dear Mr. Heyward:

Re: Karate® Insecticide -
Microencapsulated Formulation

I am writing this letter to provide a summary of the my telephone conference call with Paul Mastradone (EFGWB) and yourself on September 9, 1994. The purpose of the discussion was to establish if field soil dissipation studies would be required to support registration of a microencapsulated formulation of Karate. Similar discussions were held with Mike Flood in CBTS in August regarding the need for field residue trials. I submitted a letter in September summarizing that discussion for the Agency records.

Telephone Conference Call Summary

Participants: Jim Wagner, Zeneca
Adam Heyward and Paul Mastradone, EPA

Background and Use Pattern

Zeneca has developed a new microencapsulated formulation (CS or capsule suspension) of Karate Insecticide. This formulation is intended for registration on cotton and for all crops pending registration (vegetable, grain and cereal crops). The CS formulation offers advantages over the EC formulation such as reduced eye toxicity and higher flash point. The use rates and reapplication intervals for the EC and CS will be very similar if not identical.

The CS was developed as a thin coat, quick release formulation with average particle size of about 3 microns. Conventional microencapsulated formulations are much larger (approx. 40 microns) and usually slowly release the active ingredient. The CS formulation was developed to be quick release to achieve efficacy equivalent to the currently registered EC formulation.

Residue Decline Data - Plants

Zeneca has generated data from studies designed to compare the foliar dissipation of the EC and CS formulations. The study objective was to demonstrate that the residue decline from the EC and CS formulations are equivalent.

Three decline studies were conducted on mustard greens. The locations were California, MIssissippi and North Carolina. Each study had 3 treatments, one EC and two CS formulations, using a single application of 0.03 lbs ai/acre, with crop samples taken at 0, 1, 3, 5, 7 and 14 days after application. The samples were analyzed for lambda-cyhalothrin and its epimer.

The results of all three trials showed no difference in residue decline between the EC and CS formulations. The data also showed similar residues at each time interval irrespective of formulation applied. The comparative residue levels indicate that at equivalent use rates, the CS formulation will not increase the crop residues found for the EC formulation.

These data were submitted to the Agency in September.

Residue Decline Data - Soil

Zeneca has generated data from a study designed to compare the soil persistence of the EC and CS formulations of Karate. This data is reported in a technical letter, copy enclosed.

Since the soil half-life of lambda-cyhalothrin is typically in the range of 12-40 days, the present study was conducted over a period of 56 days. The study used a UK loamy coarse sand which has previously been shown to be similar to US soils. The two formulations were applied to the soil at a nominal rate of 0.5 ppm of active ingredient (equiv. to 50 g ai/ha). The soil was stored in the dark and samples of soil for extraction and analysis taken at 0, 4, 7, 14, 28 and 56 days after treatment.

The chemical recoveries from soil gave half-lives of lambda-cyhalothrin of 11 days for the EC formulation and 10.5 and 11.5 days for the CS formulations. Comparison of the decay curves of each formulation shows that the rate and pattern of degradation of the ai in the three formulations is very similar. The short half-lives are typical of previous soil studies with this product.

Discussion and Conclusion

Given that

(1) the use rates and reapplication intervals are the same for the EC and CS formulations and

(2) the CS is a quick release formulation as demonstrated by the foliar residue decline curves and the soil persistence data,

Paul Mastradone concluded that existing field soil dissipation studies with the EC would be supportive of registration of a CS formulation and that new studies with a CS formulation would not be required to support its registration.

Please file a copy of this letter, together with the letter submitted in September for field residues, in the Karate registration file for future reference. Thank you.

Sincerely,

/S/

James M. Wagner
Regulatory Manager

enc.

cc: Paul Mastradone

ATTACHMENT II EEB Review

Ecological Effects Branch Review

Lambda-cyhalothrin (KARATE)

100.0 Submission Purpose and Label Information

100.1 Submission Purpose and Pesticide Use

Zeneca is requesting registration of Karate on rice to control the adult rice water weevil and various other rice insect pests. At the present time, granular carbofuran is the only insecticide registered for control of rice water weevil in rice.

According to the USA Rice Federation, rice production in the United States (AR, CA, LA, MS, MO, and TX) was a little over 3 million acres in the year 1995. Of this total acreage, about 850,000 acres were treated with an insecticide (Zeneca's estimates based on Doane, Maritz and USDA-NAPIAP). The predominate use is in CA and LA, accounting for about 85% (EPA BEAD estimates). Zeneca projects that with registration of Karate on rice, the rice insecticide market in year 2000 will be changed from a 1995 market of carbofuran (350,000 to 0 A), methyl parathion (390,000 to 250,000 A), malathion (50,000 to 20,000 A), carbaryl (60,000 to 30,000 A), and lambda-cyhalothrin (600,000 A).

According to Zeneca, one application would be necessary to control the adult rice water weevil, with two applications occurring mainly in the water-seeded areas of the warmer rice growing regions, typically LA and TX, following a mild winter. In these 2 states, Zeneca projects that about 120,000 A would be treated for rice water weevil and 30,000 of these acres would receive a second treatment for this pest. Zeneca defines a typical application rate as 0.03 lb ai/a.

100.2 Formulation Information

ACTIVE INGREDIENT;

Lambda cyhalothrin:
1 a(S*)-3a(Z) ±-cyano-(3-phenoxyphenyl)methyl(±)-cis-3- (2-chloro-3,3,3-trifluoro-1-propenyl-2,2-dimethylcyclopropanecarboxylate................ 13.1%

INERT INGREDIENTS:... 86.9%

(EPA Reg. No. 10182-96)

100.3 Application Methods, Direction, Rates

Excerpted from proposed draft labeling received July 31, 1996:

Rate: 0.025 to 0.04 lb ai/a (3.2 to 5.1 fl oz/A)

Maximum seasonal use: 0.12 lb ai/A; 3 applications allowed

Do not apply more than 0.08 lb ai/A within 28 days of harvest or more than 0.04 lb ai/A within 21 days of harvest.

Ground or aerial application

Apply as required by scouting. Timing and frequency of application should be based on local economic thresholds. Determine the need for repeat applications, usually at intervals of 5-7 days, by scouting.

Rice water weevil (dry seeded rice)- make a foliar application as indicated by scouting for the presence of adults, usually within the time frame of 0-5 days after the permanent flood establishment. Application must be made within 10 days from starting permanent flood.

Rice water weevil (water seeded rice)- make a foliar application after pinpoint flood when rice has emerged 0.5 inch above the water line. Under conditions of prolonged migration into the field, scout the field for rice water weevil adults 3-5 days after the initial treatment and, if needed, apply a second application within 7-10 days. Determine the need for repeat applications, usually at intervals of 5-7 days, by scouting.
Green bug is known to have many biotypes. Karate may only provide suppression. If satisfactory control in not achieved with the first application of Karate, a resistant biotype may be present. Use alternate chemistry for control.

Karate can safely be used when propinil products are being used for weed control.

100.4 Target Organisms

The draft label lists the following insect pests: rice water weevil (adult), rice stink bug, true armyworm, fall armyworm, yellow-striped armyworm, chinch bug, grasshopper species, leafhopper species, oat birdcherry aphid, and green bug.

100.5 Precautionary Labeling

Excerpted from proposed draft labeling received July 31, 1996:

This pesticide is extremely toxic to fish and aquatic organisms and toxic to wildlife. Do not apply directly to water or to areas where surface water is present or to intertidal areas below the mean high water mark. Do not apply when weather conditions favor drift from treated areas. Drift and runoff from treated areas may be hazardous to aquatic organisms in neighboring areas. Do not contaminate water when disposing of equipment washwaters.

Do not use treated rice fields for the aquaculture of edible fish and crustacea.

This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees are visiting the treatment area.

Do not release flood water within 4 days of an application.

Spray drift precaution: Observe the following precautions when spraying in the vicinity of aquatic areas such as lakes; reservoirs; rivers; permanent streams, marshes, or natural ponds, estuaries and commercial fish ponds. Do not apply by ground within 25 feet, or by air within 150 feet of lakes, reservoirs, rivers, permanent streams, marshes, potholes or natural ponds; estuaries and commercial fish farm ponds.

When applying by air, apply in a minimum of 5 gallons of water.

Karate is a restricted use pesticide due to toxicity to fish and aquatic organisms.

101.0 Hazard Assessment

101.1 Discussion

Zeneca seeks to register lambda-cyhalothrin as a replacement for carbofuran for control of a major rice pest, the rice water weevil. To date, carbofuran is the only insecticide registered for control of this major pest. Two Section 18 have been previously granted for Karate on rice:

o Texas (1993)- estimates of total acreage to be treated 100,000 acres, or about 34 percent of the Texas rice acreage for control of fall armyworm; maximum of two applications applied at max. of 0.04 lb ai/A; apply only before permanent flood when rice stands are threatened; no application within 500 feet of moving water or public fish-bearing waters, either moving or standing (W. Rabert review dated 2/1/94; D193208).

o Louisiana (1996)- estimates of total area to be treated 50,000 to 200,000 acres for control of rice water weevil; maximum of two applications applied at rate of 0.03 lb ai/a; apply only after signs of rice water weevil infestations as evidenced by the presence of feeding scars on rice foliage (J. Edwards review dated 6/28/96; D225814). According to LA researchers, this Section 18 was granted too late in the season to be used.

101.2 Likelihood of Adverse Effects to Nontarget Organisms

101.2.1 Chemistry and Environmental Fate

Excerpted from EFGWB fate and transport assessment for rice:

The major route of lambda cyhalothrin dissipation appears to be from binding to soil particles (Freundlich K_{ads} = 261 - 4649) followed by microbial-mediated soil metabolism (t1/2 = 7-30 days in aerobic and anaerobic conditions). Abiotic processes appear to play a minor role in the insecticide's dissipation under most environmental conditions (stable to hydrolysis at pH 5 and 7, t1/2 = 7 days at pH 9; t1/2 = 34 days for photodegradation on soil). Acceptable and supplemental field dissipation half-lives of 12-40 days were reported. Lambda-cyhalothrin residues could reach surface waters via spray drift or adsorbed to soil particles transported with runoff. Bioaccumulation factors of up to 7340X were reported for fish viscera; depuration was $\geq$ 77%.

No aquatic environmental fate studies are available. According to Zeneca correspondence to RD dated 7/25/96 the required aquatic field dissipation and aerobic/anaerobic aquatic metabolism studies will be submitted by May, 1997.

Sediment adsorption and bioavailability need to be addressed by EFED. Pyrethroid aquatic sediment toxicity data and a vegetative filter strip literature review are currently in-house. The projected due date for the first review of these studies is early 1997. An ecological risk assessment review by Duluth, followed by review by the Science Advisory Panel, and then determining applicability to other pyrethroids, is projected to be completed by 10/97.

The EEB reviewed one sediment study (D188684, MRID 42676702) in which carp (Cyprinus carpio) and daphnids (Daphnia magna) were exposed to cyhalothrin with and without sediment. The results indicated that sediment would sorb some cyhalothrin or otherwise make it unavailable for assimilation by the test organisms. However, EEB determined that it would be difficult, if not impossible, to relate the results of these studies to actual field conditions.

101.2.2 Terrestrial and Aquatic Toxicity

All ecotoxicity guideline requirements are satisfied. Based on acceptable acute toxicity data, technical grade lambda-cyhalothrin is characterized as:

- o moderately toxic to mammals
- o practically nontoxic to avian species
- o highly toxic to honey bees; moderately repellent in the field
- o very highly toxic to aquatic animals

Toxicity to Terrestrial Animals

Birds

Results of avian acute oral toxicity studies using the technical grade of the active ingredient (TGAI) of lambda-cyhalothrin are tabulated below.

Avian Acute Oral Toxicity

Species	% ai	LD50 (mg/kg)	Toxicity Category	Citation	Study Classification
Mallard duck (*Anas platyrhynchos*)	96	>3950	practically non-toxic	00259807	Core

Because the LD50 falls in the range of >2000 mg/kg, lambda-cyhalothrin is categorized as practically non-toxic to avian species on an acute oral basis.

Results of two avian subacute dietary studies using the TGAI are tabulated below.

Avian Subacute Dietary Toxicity

Species	% ai	5-Day LC50 (ppm)	Toxicity Category	Citation	Study Classification
Northern bobwhite quail *(Colinus virginianus)*	96.5	>5300	practically non-toxic	00259807	Core
Mallard duck *(Anas platyrhynchos)*	96.5	3948	slightly toxic	00259807	Core

Because one of the LC50 values falls in the range of 1001 - 5000 ppm, lambda-cyhalothrin is categorized as slightly toxic to avian species on a subacute dietary basis.

Results of avian reproduction studies using the TGAI of lambda-cyhalothrin and the TGAI of cyhalothrin are tabulated below.

Avian Reproduction

Species	% ai	NOEC/LOEC (ppm)	LOEC Endpoints	Citation	Study Classification
Northern bobwhite quail *(Colinus virginianus)*	92.2 (cyhalothrin)	NOEC >50 highest dose tested	no endpoints effected	00073989 Roberts *et al* (1982)	Core[1]
Mallard duck *(Anas platyrhynchos)*	92 (cyhalothrin)	5/50	number of eggs laid	00073989 Roberts *et al* (1982)	Supplemental[1]
"	96.3 (lambda-cyhalothrin)	NOEC >30 highest dose tested	no endpoints effected	41512101 Beavers *et al* (1989)	Core

[1] Cyhalothrin, the parent compound, consists of two pairs of isomers; one of the two pairs is lambda-cyhalothrin. Lambda-cyhalothrin is expected to be more toxic because it is the biologically active portion. EEB accepted cyhalothrin bobwhite data in support of registration of lambda-cyhalothrin; however, a new mallard study was required with lambda-cyhalothrin.

[2] DER could not be located to determine reason for study supplemental status.

Based on the results of the mallard reproduction study, lambda-cyhalothrin's NOEC for chronic reproductive effects is >30 ppm (no endpoints effected).

Mammals

Rat toxicity values for lambda-cyhalothrin, obtained from the Agency's Health Effects Division (HED), are tabulated below.

Mammalian Toxicity

Species	% ai	Test Type	Toxicity Value	Effected Endpoints	Citation
laboratory rat (*Rattus norvegicus*)	92.6	acute oral	56 mg/kg (females) 79 mg/kg (males)	-	005104
"	96.5	90-day feeding	NOEC=50 ppm LOEC = 250 ppm	body weight gain reduction	005316

Because the LD50 values falls in the range of 51- 500 mg/kg, lambda-cyhalothrin is categorized as moderately toxic to mammalian species.

Insects

Results of honey bee acute contact studies using the TGAI and a formulated product are tabulated below.

Nontarget Insect Acute Contact Toxicity

Species	% ai	LD50 (µg/bee)	Toxicity Category	Citation	Study Classification
Honey bee (*Apis mellifera*)	96	0.909	highly toxic	40052409 Gough *et al* (1984)	Core
"	5.04	0.483	-	"	Core

Because the LD50 is <2 micrograms per bee lambda-cyhalothrin is categorized as highly toxic to bees on an acute contact basis.

Although bees are highly sensitive to Karate, studies have demonstrated that bees are also moderately repulsed by the chemical. Results of a honey bee toxicity of residues on foliage study in which Karate 1E was applied aerially to seed alfalfa at application rates of 0.0075 and 0.015 lb ai/a showed significant mortality for caged bees (89.2% morality at 0.015 lb ai/A, 50.47% mortality at 0.0075 lb ai/A), but for uncaged bees, visitation was suppressed 41 to 54% for 2 days, indicating repellency. EEB has concluded from the results of this test that Karate is moderately repellent to honey bees in the field, thus significantly reducing residual toxicity hazard.

Toxicity to Aquatic Animals

[NOTE: Toxicity values are expressed in terms of parts per trillion]

Freshwater Fish and Invertebrates

Results of freshwater fish toxicity studies using the TGAI are tabulated below.

Freshwater Fish Acute Toxicity

Species	% ai	96-hour LC50 (ppt)	Toxicity Category	Citation	Study Classification
Rainbow trout *(Oncorhynchus mykiss)*	98	240	very highly toxic	00259807 R.W. Hill (1984)	Core
Fathead minnow *(Pimephales promelas)*	96.7	360	very highly toxic	41519001 J.F. Tapp *et al* (1990)	Supplemental[1]
Bluegill sunfish *(Lepomis macrochirus)*	98	210	very highly toxic	00259807 R.W. Hill (1984)	Core

[1] This LC50 value was derived from a range-finding test for the chronic study.

Because the LC50 values are less than 0.1 ppm, lambda-cyhalothrin is categorized as very highly toxic to freshwater fish on an acute basis. Results of formulated product testing have been cited in previous reviews (bluegill and rainbow trout LC50 values for a 12.9% formulation = 2,200 ppt and 3,400 ppt, respectively).

Results of a full life-cycle test using the TGAI and formulated products are tabulated below.

Freshwater Fish Life-Cycle Toxicity

Species	% ai	NOEC/LOEC (ppt)	MATC[1] (ppt)	Endpoints Effected	MRID Citation	Study Classification
Fathead minnow *(Pimephales promelas)*	96.7	31/62	43.8	adult growth; young survival and growth	41519001 J.F. Tapp *et al* (1990)	Supplemental[2]

[1] defined as the geometric mean of the NOEC and LOEC.

[2] For study deficiencies see EEB file and Data Evaluation Record. In memo dated 4/15/93, EEB determined study was adequate for risk assessment purposes.

Based on the results of the fish life-cycle study, lambda-cyhalothrin's MATC is 43.8 ppt for the endpoints adult growth and young survival/growth.

Results of freshwater aquatic invertebrate toxicity testing using the TGAI are tabulated below.

Freshwater Invertebrate Acute Toxicity

Species	% ai	48-hour LC50 (ppt)	Toxicity Category	Citation	Study Classification
Waterflea *(Daphnia magna)*	96.5	230[1]	very highly toxic	000259807 E. Farrell *et al* (1984)	Core
"	12.9	65[2]	-	"	Core
"	5.54	40[2]	-	"	Core
amphipod *(Gammarus pulex)*	94	6.68	very highly toxic	00073989 M.J. Hamer *et al*	Supplemental[3]

[1] Previous EEB reviews indicated an acute toxicity value of 360 ppt for this study. This valuo, 360 ppt, represented a mean of the results of two separate tests. The value cited in this table is the lower of the two values.

[2] These are EC formulations. For each concentration, two separate tests were run. The value cited in this table is the lower of two values.

[3] Although classified supplemental, this study is considered useful for risk assessment purposes. See DER for study discrepancies.

Because the LC50 values are less than 0.1 ppm, lambda-cyhalothrin is categorized as very highly toxic to aquatic invertebrates on an acute basis.

Results from a freshwater aquatic invertebrate life-cycle test using the TGAI are tabulated below.

Freshwater Aquatic Invertebrate Life-Cycle Toxicity

Species	% ai	21-day NOEC/LOEC (ppt)	MATC[1] (ppt)	Endpoints Effected	Citation	Study Classification
Waterflea *(Daphnia magna)*	92.8	8.5/18.3	12.47	Number of offspring per female	0073989 M.J. Hamer *et al.* (1985)	Supplemental[2]
"	98	1.98/3.5	2.632	adult survival; Number of young	41217501[1]	Supplemental[2]

[1] defined as the geometric mean of the NOEC and LOEC.

[2] Although both studies are classified as supplemental, EEB has determined that there is sufficient information to evaluate the chronic effects to invertebrates in a risk assessment (memo A. Maciorowski to G. LaRocca dated 4/12/93).

Based on the results of the freshwater invertebrate life-cycle study, lambda-cyhalothrin's MATC is 2.6 ppt for the endpoints adult survival and number of young produced.

Estuarine Fish and Invertebrates

Results of acute toxicity testing with an estuarine fish using the TGAI are tabulated below.

Estuarine/Marine Fish Acute Toxicity

Species	% ai	96-hour LC50 (ppt)	Toxicity Category	Citation	Study Classification
Sheepshead minnow *(Cyprinodon variegatus)*	96.5	807	very highly toxic	00073989	Core

Because the LC50 is less than 0.1 ppm, lambda-cyhalothrin is categorized as very highly toxic to estuarine/marine fish on an acute basis.

Results of an estuarine fish early life-stage test using the TGAI are tabulated below.

Estuarine/Marine Fish Early Life-Stage Toxicity

Species	% ai	NOEC/LOEC (ppt)	MATC[1] (ppt)	Endpoints Effected	Citation	Study Classification
Sheepshead Minnow *(Cyprinodon variegatus)*	96.6	250/380	308	reduced fry weight	00073989	Core[2]

[1] defined as the geometric mean of the NOEC and LOEC.

[2] Data Evaluation Record cannot be located. An estuarine/marine fish life-cycle test is not available, so results of the early-life stage study will be used for accessing chronic risk.

Based on the results of the estuarine fish early life-stage study, lambda-cyhalothrin's MATC is 308 ppt for the endpoint fry weight.

Results of acute toxicity testing with estuarine invertebrates using the TGAI are tabulated below.

Estuarine/Marine Invertebrate Acute Toxicity

Species	% ai.	96-hour LC50 (ppt)	Toxicity Category	Citation	Study Classification
Pacific oyster (embryo-larvae) *(Crassostrea gigas)*	96.5	>1,000,000 (nominal) >590,000 (mean measured)	practically non-toxic;see discussion below	00073989 R.W. Hill (1985)	Core
Mysid *(Americamysis bahia)*	>97	4.9 (mean measured)	very highly toxic	00073989 R.S. Thompson (1985)	Core

invertebrates, were essentially decimated after one or two treatments. Reduced numbers at all dose levels were evident even into the period after treatment had ended. These reductions caused indirect changes (i.e. reduction in biomass) to the fish population. The fish in each treatment group had statistically significant lower weights and lengths compared to the control fish. The weights were reduced 20% to 30% for all fish and 30% to 40% when only the first year, or young-of-the-year fish were considered.

101.3 Exposure and Risk Characterization

Risk characterization integrates the results of the exposure and ecotoxicity data to evaluate the likelihood of adverse ecological effects. The means of integrating the results of exposure and ecotoxicity data is called the quotient method. For this method, risk quotients (RQs) are calculated by dividing exposure estimates by ecotoxicity values, both acute and chronic.

RQ = EXPOSURE/TOXICITY

RQs are then compared to OPP's levels of concern (LOCs). These LOCs are criteria used by OPP to indicate potential risk to nontarget organisms and the need to consider regulatory action. The criteria indicate that a pesticide used as directed has the potential to cause adverse affects on nontarget organisms. LOCs currently address the following risk presumption categories: (1) **acute high** - potential for acute risk is high regulatory action may be warranted in addition to restricted use classification (2) **acute restricted use** - the potential for acute risk is high, but this may be mitigated through restricted use classification (3) **acute endangered species** - the potential for acute risk to endangered species is high regulatory action may be warranted, and (4) **chronic risk** - the potential for chronic risk is high regulatory action may be warranted. Currently, EFED does not perform assessments for chronic risk to plants, acute or chronic risks to nontarget insects, or chronic risk from granular/bait formulations to mammalian or avian species.

The ecotoxicity test values (i.e., measurement endpoints) used in the acute and chronic risk quotients are derived from the results of required studies. Examples of ecotoxicity values derived from the results of short-term laboratory studies that assess acute effects are: (1) LC50 (fish and birds) (2) LD50 (birds and mammals (3) EC50 (aquatic plants and aquatic invertebrates) and (4) EC25 (terrestrial plants). Examples of toxicity test effect levels derived from the results of long-term laboratory studies that assess chronic effects are: (1) LOEC (birds, fish, and aquatic invertebrates) (2) NOEC (birds, fish and aquatic invertebrates) and (3) MATC (fish and aquatic invertebrates). For birds and mammals, the NOEC value is used as the ecotoxicity test value in assessing chronic effects. Other values may be used when justified. Generally, the MATC (defined as the geometric mean of the NOEC and LOEC) is used as the ecotoxicity test value in assessing chronic effects to fish and aquatic invertebrates. However, the NOEC is used if the measurement end point is production of offspring or survival.

The ecotoxicity values used in the risk assessments for this chemical are listed below.

mallard LC50 >3948
mallard NOEC >30 ppm
male rat LC50 =79 ppm
rat NOEC =50 mg/kg
amphipod LC50 =6.7 ppt

daphnid LC50= 230 ppt
daphnid MATC =2.32 ppt
bluegill LC50 =210 ppt
fathead minnow MATC =43.8 ppt
sheepshead minnow LC50 =807 ppt
sheepshead minnow MATC =308 ppt
mysid shrimp LC50 =4.9 ppt
mysid shrimp =MATC 0.318 ppt

[Note: separate risk assessments were performed for daphnid and amphipod for acute effects, since results of acute laboratory studies show species sensitivity to be variable (30X difference in acute toxicity between the two.]

Risk presumptions, along with the corresponding RQs and LOCs are tabulated below.

Risk Presumptions for Terrestrial Animals

Risk Presumption	RQ	LOC
Birds		
Acute High Risk	EEC[1]/LC50 or LD50/sqft[2] or LD50/day[3]	0.5
Acute Restricted Use	EEC/LC50 or LD50/sqft or LD50/day (or LD50 < 50 mg/kg)	0.2
Acute Endangered Species	EEC/LC50 or LD50/sqft or LD50/day	0.1
Chronic Risk	EEC/NOEC	1
Wild Mammals		
Acute High Risk	EEC/LC50 or LD50/sqft or LD50/day	0.5
Acute Restricted Use	EEC/LC50 or LD50/sqft or LD50/day (or LD50 < 50 mg/kg)	0.2
Acute Endangered Species	EEC/LC50 or LD50/sqft or LD50/day	0.1
Chronic Risk	EEC/NOEC	1

[1] abbreviation for Estimated Environmental Concentration (ppm) on avian/mammalian food items
[2] $\frac{mg/ft^2}{LD50 * wt. of bird}$ [3] $\frac{mg\ of\ toxicant\ consumed/day}{LD50 * wt. of bird}$

Risk Presumptions for Aquatic Animals

Risk Presumption	RQ	LOC
Acute High Risk	EEC[1]/LC50 or EC50	0.5
Acute Restricted Use	EEC/LC50 or EC50	0.1
Acute Endangered Species	EEC/LC50 or EC50	0.05
Chronic Risk	EEC/MATC or NOEC	1

[1] EEC = (ppm or ppb) in water

Exposure and Risk to Nontarget Terrestrial Animals

The estimated environmental concentrations (EECs) of lambda-cyhalothrin on various food items following product application are compared to the chemical's LC50 values to assess risk. The predicted 0-day maximum and mean residues of a pesticide that may be expected to occur on selected avian or mammalian food items immediately following a direct single application at 1 lb ai/A are tabulated below.

Estimated Environmental Concentrations on Avian and Mammalian Food Items (ppm) Following a Single Application at 1 lb ai/A

Food Items	EEC (ppm) Predicted Maximum Residue[1]	EEC (ppm) Predicted Mean Residue[1]
Short grass	240	85
Tall grass	110	36
Broadleaf/forage plants, and small insects	135	45
Fruits, pods, seeds, and large insects	15	7

[1] Predicted maximum and mean residues are for a 1 lb ai/a application rate and are based on Hoerger and Kenaga (1972) as modified by Fletcher *et al.* (1994).

For the purposes of risk assessment, three applications at 0.04 lb ai/A at 5 day intervals were assumed. Avian and mammalian risk assessments were performed using predicted maximum residues, except that, where LOCs were exceeded, predicted mean residues were also used. For assessing risk from multiple applications, EECs based on multiples of the 0-day Kenaga values were used.

Rationale For Assumptions: Zeneca says there will generally be one application per season (100% of CA rice should be treated this way because 99.9% of that rice is water seeded, so no treatment is required for terrestrial pests, and in the South, prediction is >80% of total rice treated will receive only one application). The rationale for selecting three applications (0.04 lb ai/a) at 5 day intervals is:

o the label allows up to three applications

o for one of the target pests, the rice water weevil, information received from the southern rice-growing states indicates more than one application would probably be necessary for control (in LA 9/96 comments on EPA's analysis of rice water weevil management alternatives it is stated that in LA 100% of the growers currently using carbofuran would have to make at least two applications using Karate, probably three, and in some cases, four for RWW control; if treatment for the other pests were to be added to this the number could go as high as 6-8 applications) o additional rice insect pests are listed on the proposed label, i.e. rice stink bug (late season control), grasshoppers (middle-to-late season control), and armyworms, chinch bugs and aphids (early season control)

o there were no directions on the draft label specifying when to apply at 0.03 lb ai/a and when to apply at 0.04 lb ai/A; therefore 0.04 lb ai./a was considered typical

o a 5-7 day re-application interval is specified on the draft labeling

Birds

The acute and chronic risk quotients for single broadcast applications of lambda-cyhalothrin products are tabulated below.

Avian Acute and Chronic Risk Quotients for Single Application of Lambda-Cyhalothrin on Rice Based on a Mallard LC50 of > 3940 ppm and Mallard NOEC of >30 ppm

Site/App. Method	App. Rate (lbs ai/A)	Food Items	Maximum EEC (ppm)	LC50 (ppm)	NOEC (ppm)	Acute RQ (EEC/ LC50)	Chronic RQ (EEC/ NOEC)
Rice aerial or ground	0.04	Short grass	10	>3948	>30	0.00	<0.33
		Tall grass	4	>3948	>30	0.00	<0.13
		Broadleaf plants/Insects	5	>3948	>30	0.00	<0.17
		Seeds	1	>3948	>30	0.00	<0.03

The results indicate that for a single broadcast application of lambda-cyhalothrin, no avian acute or chronic levels of concern are exceeded at the maximum proposed application rate.

The acute and chronic risk quotients for multiple broadcast applications of lambda-cyhalothrin products are tabulated below.

Avian Acute and Chronic Risk Quotients for Multiple Applications of Lambda-Cyhalothrin on Rice Based on a Mallard LC50 of >3950 ppm and Mallard NOEC of >30 ppm

Site/App. Method	App.Rate (lbs ai/A) No. of Apps.	Food Items	Maximum EEC[1] (ppm)	LC50 (ppm)	NOEC (ppm)	Acute RQ (EEC/ LC50)	Chronic RQ (EEC/ NOEC)
Rice aerial or ground	0.04 (3)	Short grass	30	>3950	>30	<0.01	<1.00
		Tall grass	12	>3950	>30	0.00	<0.40
		Broadleaf plants/Insects	15	>3950	>30	0.00	<0.50
		Seeds	3	>3950	>30	0.00	<0.10

1 EECs are based on multiples of 0-day Kenega values. Assumes no degradation.

The results indicate that for multiple broadcast applications of lambda-cyhalothrin, no avian acute or chronic levels of concern are exceeded at the maximum proposed application rate.

Because no avian acute or chronic LOCs were exceeded for single or multiple applications, the EEB concludes that minimal adverse effects are expected for avian species, including endangered and threatened species. The chronic risk quotient was close to exceeding the Agency's LOC for chronic effects (EEC/NOEC: 30 ppm/>30 ppm- highest dose level tested). Chronic risk is not anticipated, however, because (1) worst-case Kenaga values (short grass) were used; (2) the maximum number of applications, three, but no degradation assumed; (3) the NOEC was >30; and (4) the most sensitive species, mallard, was used in the risk assessment (bobwhite quail NOEC = >50 ppm). [Zeneca performed a risk assessment using unsubmitted mustard green data, with estimated foliar half-life of 6 days); their assessment yielded an RQ value of 0.28].

<u>Mammals</u>

Estimating the potential for adverse effects to wild mammals is based upon EEB's draft 1995 SOP of mammalian risk assessments and methods used by Hoerger and Kenaga (1972) as modified by Fletcher *et al.* (1994). The concentration of lambda-cyhalothrin in the diet that is expected to be acutely lethal to 50% of the test population (LC50) is determined by dividing the LD50 value (usually rat LD50) by the % (decimal of) body weight consumed. A risk quotient is then determined by dividing the EEC by the derived LC50 value. Risk quotients are calculated for three separate weight classes of mammals (15, 35, and 1000 g), each presumed to consume four different kinds of food (grass, forage, insects, and seeds). The acute risk quotients for broadcast application of lambda-cyhalothrin are tabulated below.

Predicted Maximum Kenaga Values for Mammalian Herbivore/Insectivore:

Mammalian (Herbivore/Insectivore) Acute Risk Quotients for Single Application of Lambda-cyhalothrin on Rice Based on a Male Rat LD50 of 79 mg/kg

Site/ Application Method/ Rate in lbs ai/A	Body Weight (g)	% Body Weight Consumed	Rat LD50 (mg/kg)	EEC (ppm) Short Grass	EEC (ppm) Forage & Small Insects	EEC (ppm) Large Insects	Acute RQ[1] Short Grass	Acute RQ Forage & Small Insects	Acute RQ Large Insects
Rice aerial or ground									
0.04	15	95	79	10	5	1	0.12*	0.06	0.01
0.04	35	66	79	10	5	1	0.08	0.04	0.01
0.04	1000	15	79	10	5	1	0.02	0.01	0.00

* exceeds LOC for endangered species (0.1)

[1] RQ = EEC (ppm) / LD50 (mg/kg)/ % Body Weight Consumed

Predicted Mean Kenaga Values for Mammalian Herbivore/Insectivore:

Mammalian (Herbivore/Insectivore) Acute Risk Quotients for Single Application of Lambda-cyhalothrin on Rice Based on a Male Rat LD50 of 79 mg/kg

Site/ Application Method/ Rate in lbs ai/A	Body Weight (g)	% Body Weight Consumed	Rat LD50 (mg/kg)	EEC (ppm) Short Grass	EEC (ppm) Forage & Small Insects	EEC (ppm) Large Insects	Acute RQ[1] Short Grass	Acute RQ Forage & Small Insects	Acute RQ Large Insects
Rice aerial or ground									
0.04	15	95	79	3.4	5	1	0.04	0.06	0.01
0.04	35	66	79	3.4	5	1	0.03	0.04	0.01
0.04	1000	15	79	3.4	5	1	0.01	0.01	0.00

[1] RQ = EEC (ppm) / LD50 (mg/kg)/ % Body Weight Consumed

Predicted Maximum Kenaga Values for Mammmalian Granivore:

Mammalian (Granivore) Acute Risk Quotients for Single Application of Lambda-cyhalothrin on Rice Based on a Male Rat LD50 of 79 mg/kg

Site/ Application Method/Rate in lbs ai/A	Body Weight (g)	% Body Weight Consumed	Rat LD50 (mg/kg)	EEC (ppm) Seeds	Acute RQ[1] Seeds
Rice aerial or ground					
0.04	15	21	79	1	0.00
0.04	35	15	79	1	0.00
0.04	1000	3	79	1	0.00

[1] RQ = EEC (ppm) / LD50 (mg/kg)/ % Body Weight Consumed

Predicted Maximum Kenaga Values for Mammalian Herbivore/Insectivore:

Mammalian (Herbivore/Insectivore) Acute Risk Quotients For Multiple Applications of Lambda-cyhalothrin on Rice Based on a Male Rat LD50 of 79 mg/kg

Site/ App. Method/ Rate in lbs ai/A (No. of Apps.)	Body Weight (g)	% Body Weight Consumed	Rat LD50 (mg/kg)	EEC (ppm) Short Grass	EEC (ppm) Forage & Small Insects	EEC (ppm) Large Insects	Acute RQ[1] Short Grass	Acute RQ Forage & Small Insects	Acute RQ Large Insects
Rice aerial or ground									
0.04 (3)	15	95	79	30	15	3	0.36**	0.18*	0.04
0.04 (3)	35	66	79	30	15	3	0.25**	0.13*	0.03
0.04 (3)	1000	15	79	30	15	3	0.06	0.03	0.01

* exceeds LOC for endangered species (0.1)

** exceeds LOCs for endangered species and restricted use (0.2)

[1] RQ = EEC (ppm) / LD50 (mg/kg)/ % Body Weight Consumed

Predicted Mean Kenaga Values for Mammalian Herbivore/Insectivore:

Mammalian (Herbivore/Insectivore) Acute Risk Quotients For Multiple Applications of Lambda-cyhalothrin on Rice Based on a Male Rat LD50 of 79 mg/kg

Site/ App. Method/ Rate in lbs ai/A (No. of Apps.)	Body Weight (g)	% Body Weight Consumed	Rat LD50 (mg/kg)	EEC (ppm) Short Grass	EEC (ppm) Forage & Small Insects	EEC (ppm) Large Insects	Acute RQ[1] Short Grass	Acute RQ Forage & Small Insects	Acute RQ Large Insects
Rice aerial or ground									
0.04 (3)	15	95	79	10.2	5.4	3	0.12*	0.06	0.04
0.04 (3)	35	66	79	10.2	5.4	3	0.09	0.05	0.03
0.04 (3)	1000	15	79	10.2	5.4	3	0.02	0.01	0.01

* exceeds LOC for endangered species (0.1)

[1] RQ = $\frac{\text{EEC (ppm)}}{\text{LD50 (mg/kg)/ \% Body Weight Consumed}}$

Predicted Maximum Kenega Values for Mammalian Granivore:

Mammalian (Granivore) Acute Risk Quotients for Multiple Applications of Lambda-cyhalothrin on Rice Based on a Male Rat LD50 of 79 mg/kg

Site/ App. Method/ Rate in lbs ai/A (No. of Apps.)	Body Weight (g)	% Body Weight Consumed	Rat LD50 (mg/kg)	EEC (ppm) Seeds	Acute RQ[1] Seeds
Rice aerial or ground					
0.04 (3)	15	21	79	3	0.01
0.04 (3)	35	15	79	3	0.01
0.04 (3)	1000	3	79	3	0.00

[1] RQ = $\frac{\text{EEC (ppm)}}{\text{LD50 (mg/kg)/ \% Body Weight Consumed}}$

The results for single and multiple broadcast applications of lambda-cyhalothrin show the following:

o where mean Kenaga values were used to predict exposure, the endangered species LOC was exceeded for small mammals (15 g) for the short grass Kenaga value/multiple application scenario.

o where maximum Kenaga values were used to predict exposure, the restricted use and endangered species LOCs were exceeded for small mammal and medium sized mammals (15 g and 35 g) for the short grass and forage/small insects Kenaga values/multiple application scenarios.

The chronic risk quotients for broadcast applications of lambda-cyhalothrin are tabulated below.

Mammalian Chronic Risk Quotients for Multiple Applications of Lambda-cyhalothrin on Rice Based on a Rat NOEC of 50 ppm

Site/Application ethod	Application Rate in lbs ai/A (No. Apps.)	Food Items	Maximum EEC[1] (ppm)	NOEC (ppm)	Chronic RQ (EEC/NOEC)
Rice aerial or ground	0.04 (3)	Short grass	30	50	0.60
		Tall grass	12	50	0.24
		Broadleaf plants/Insects	15	50	0.30
		Seeds	3	50	0.06

[1] EECs are based on multiples of 0-day Kenega values and assumes no degradation.

The results indicate that for multiple broadcast applications of lambda-cyhalothrin, the mammalian chronic level of concern is not exceeded at the maximum proposed application rate.

It appears that mammals are more sensitive to lambda-cyhalothrin than avian species, because some of the mammalian acute LOCs (endangered species and restricted use) were exceeded. Minimal adverse acute adverse effects to mammalian species, including endangered species, are anticipated for the following reasons: (1) the RQs derived from multiple applications were based on multiples of 0-day Kenaga values where no degradation was assumed; (2) the multiple application scenarios assumed worst-case, i.e. maximum seasonal use rate of 0.12 lb ai/A; (3) mammalian species found in rice fields would normally be associated with border habitat because fields are generally flooded, where residues would be expected to be significantly less; and (4) there are no endangered/threatened small mammals of size 15 gram or less occurring in rice fields (see Section 101.3, Endangered Species).

Insects

Currently, EFED does not assess risk to nontarget insects. Results of acceptable studies are used for recommending appropriate label precautions.

Exposure and Risk to Nontarget Aquatic Animals

The EFED does note normally receive toxicity information on amphibians; such information is unavailable for karate. However, it is assumed that amphibians, including frogs and salamanders associated with aquatic habitat are at least as sensitive as fish to karate. Risk to these organisms is expected to be equivalent to risk to fish.

In its review of the Section 18 for Karate on rice, EEB identified three potential scenarios for entry of lambda-cyhalothrin residues into non-target aquatic areas: spray drift, runoff (e.g. breach of levee caused by heavy rains) and planned drainage (e.g. prior to harvest or for weed control). Other potential scenarios for entry of lambda-cyhalothrin residues into non-target aquatic are seepage and leaching. However, based on lambda-cyhalothrin's environmental chemistry attributes (e.g. high Koc value), seepage and/or leaching are not considered potential routes of exposure.

Nontarget aquatic areas include:

- o estuarine areas in close proximity to rice fields
- o crayfish farms in close proximity to rice farms
- o catfish farms in close proximity to rice fields
- o recreational areas (whether they be man-made canals or natural waterways) in close proximity to rice fields
- o refuge/sanctuaries in close proximity to rice fields

The routes of exposure of lambda-cyhalothrin residues into non-target aquatic areas include:

- o spray drift
- o overflow (e.g. breach of levee caused by heavy rain)
- o planned drainage (e.g. prior to harvest for weed control).

For the aquatic risk assessments we made the following assumptions:

- o typical application rate = 0.04 lb ai/A
- o both 1 application and 3 applications 5 day intervals were modelled

(the rationale for these assumptions was provided in the Section Exposure and Risk to Nontarget and Terrestrial Animals.)

Calculation of Estimated Environmental Concentrations (EECs)

Several EECs were calculated. These are described below.

1. EECs in Adjacent Nontarget Bodies of Water (e.g. unintentional spraying) From Aerial Application

Following EEB's nomograph (Urban and Cook, 1985) using the 6" depth scenario, the expected environmental concentration of lambda-cyhalothrin from direct application is calculated as follows:

single application:

0.04 lb ai/A X 734 ppb X 0.02 = 0.587 ppb

multiple application:

0.04 lb ai/A X 734 ppb X 0.02 X 2.48 = 1.245 ppb

2. EECs in Adjacent Nontarget Bodies of Water Based on Spray Drift (Aerial and Ground)

Following EEB's nomograph (Urban and Cook, 1985) using the 6" depth scenario, the expected environmental concentration of lambda-cyhalothrin in an adjacent body of water (based on a 5% drift loading aerial/ 1% drift loading ground application) is as follows:

Single Application:

(Aerial) 0.04 lb ai/A X 0.05 (spray drift) X 734 ppb X 0.02 = 0.029 ppb

(Ground) 0.04 lb ai/A X 0.01 (spray drift) X 734 ppb X 0.02 = 0.006 ppb

Multiple Applications:

(Aerial) 0.04 lb ai/A X 0.05 (spray drift) X 734 ppb X 0.02 X 2.48= 0.072 ppb

(Ground) 0.04 lb ai/A X 0.01 (spray drift) X 734 ppb X 0.02 X 2.48= 0.015 ppb

(how the 2.48 factor was derived: 3 applications 5 days apart; the amount in the field immediately after the third application, considering degradation at 48-day half-life of loading from first and second applications)

3. EECs in Nontarget Bodies of Freshwater Based on Rice GENEEC Model

A preliminary GENEEC program was developed by the EFGWB to model the aquatic rice scenario. Attachment I contains a listing of the environmental parameters used in the model. It was assumed that only 1.67% lambda-cyhalothrin was available in the water column. The aqueous metabolism half-life used was 48 days. This half-life was based on a crude estimate derived from available terrestrial fate information. The derived EECs are based on ground application. EECs for aerial application would be slightly less than this, about 10%. The rice paddy is assumed to be filled with 4" of water. A 2X dilution factor was assumed (equal volume of lambda-cyhalothrin treated rice water going into equal volume of water).

The EECs for overflow/drainage reflect both the proposed label recommendation of a minimum 4-day holding period and a 30-day holding period. The EECs for overflow/drainage also reflect both single and multiple applications (3 at 5 day intervals).

The values for rainfall/overflow represent concentrations in surrounding bayous caused by overflows due to the occurrence of a one-in-ten year maximum 24-hour rainfall event thirty days after the final application.

4. EECs in Estuaries

The GENEEC rice model is inappropriate for estimating exposure in estuarine bodies of water. Furthermore, models currently used do not provide useful chronic EECs. For purposes of estuarine acute risk assessment, a "rough" aquatic EEC (acute) was derived by comparing modeled and monitored values from a rice herbicide, thiobencarb, and comparing the values to lambda-cyhalothrin using the following formula:

$$\frac{\text{GENEEC thiobencarb value}}{\text{GENEEC lambda-cyhalothrin value}} = \frac{\text{actual monitored thiobencarb EEC}}{\text{X lambda-cyhalothrin EEC}}$$

$$\frac{695 \text{ ppb}}{0.184 \text{ ppb}} = \frac{25 \text{ ppb (from a Matagorda study/Thiobencarb RED)}}{6.6 \text{ ppt}}$$

Lambda-cyhalothrin on Rice: Description of habitats associated with the various exposure scenarios

Exposure Scenario	Description of Habitat for which EECs Apply
Direct aerial	The rice field itself, and relatively small, shallow ditches and canals between rice fields that may inadvertently receive direct application during aerial spraying. This would rarely be estuarine habitat.
Spray Drift aerial and ground	Ponds, marshes, ditches, canals, streams, bayous and estuaries adjacent to rice fields and close enough to be exposed to spray drift.
Planned Drainage and Overflow	Ditches, canals, streams, bayous and estuaries that receive water discharge from to rice fields. It is considered unlikely that ponds or marshes would receive water discharge from rice fields.

Acute and chronic risk quotients for freshwater fish based on one application are tabulated below.

Lambda-cyhalothrin on Rice: Risk Quotients for Freshwater Fish Based On a Bluegill LC50 of 210 ppt and a Fathead Minnow MATC of 43.8 ppt

Exposure Scenario	LC50 (ppb)	MATC (ppb)	EEC (ppb)	EEC 56-Day Ave. (ppb)	Acute RQ (EEC/LC50)	Chronic RQ (EEC/MATC)
Direct aerial	0.21	0.0438	0.587	0.404	2.80*	9.22***
Spray Drift aerial	0.21	0.0438	0.029	0.020	0.14**	0.46
Spray drift ground	0.21	0.0438	0.006	0.004	0.03	0.09
Planned Drainage (4 day degradation)	0.21	0.0438	0.354	0.244	1.69*	5.57***
Planned Drainage (30 day degradation)	0.21	0.0438	0.243	0.168	1.16*	3.84***
Overflow rainfall/AR	0.21	0.0438	0.104	0.072	0.50*	1.64***
Overflow rainfall/TX,LA,MS	0.21	0.0438	0.123	0.084	0.59*	1.92***
Overflow rainfall/CA	0.21	0.0438	0.049	0.034	0.23**	0.78

* exceeds acute high (0.5), restricted use (0.1) and endangered species (0.05) LOCs
** exceeds restricted use (0.1) and endangered species (0.05) LOCs
*** exceeds chronic (1) LOC

Acute and chronic risk quotients for freshwater fish based on three applications at 5 day intervals are tabulated below.

Lambda-cyhalothrin on Rice: Risk Quotients for Freshwater Fish Based On a Bluegill LC50 of 210 ppt and a Fathead Minnow MATC of 43.8 ppt

Exposure Scenario	LC50 (ppb)	MATC (ppb)	EEC (ppb)	EEC 56-Day Ave. (ppb)	Acute RQ (EEC/LC50)	Chronic RQ (EEC/MATC)
Direct aerial	0.21	0.0438	1.456	1.004	6.93*	22.92***
Spray Drift aerial	0.21	0.0438	0.072	0.05	0.34**	1.14***
Spray Drift ground	0.21	0.0438	0.015	0.01	0.07**	0.23
Planned Drainage (4 day degradation)	0.21	0.0438	0.903	0.623	4.30*	14.22***
Planned Drainage (30 day degradation)	0.21	0.0438	0.602	0.415	2.87*	9.47***
Overflow rainfall/AR	0.21	0.0438	0.258	0.178	1.23*	4.06***
Overflow rainfall/TX,LA,MS	0.21	0.0438	0.301	0.208	1.43*	4.75***
Overflow rainfall/CA	0.21	0.0438	0.122	0.083	0.58*	1.90***

* exceeds acute high (0.5), restricted use (0.1) and endangered species (0.05) LOC
* exceeds restricted use (0.1) and/or endangered species (0.05) LOCs
* exceeds chronic (1) LOC

The acute and chronic risk quotients for freshwater invertebrates (using the most sensitive species, an amphipod, for acute and using the daphnid for chronic) based on a single application are tabulated below.

Lambda-cyhalothrin on Rice: Risk Quotients for Freshwater Invertebrates Based On an Amphipod LC50 of 6.7 ppt and a Daphnid MATC of 2.32 ppt

Exposure Scenario	LC50 (ppb)	MATC (ppb)	EEC (ppb)	EEC 21-Day Average	Acute RQ (EEC/LC50)	Chronic RQ (EEC/MATC)
Direct aerial	0.007	0.002	0.587	0.510	83.86*	255.00**
Spray Drift aerial	0.007	0.002	0.029	0.025	4.14*	12.50**
Spray Drift ground	0.007	0.002	0.006	0.005	0.86*	2.50**
Planned Drainage (4 day degradation)	0.007	0.002	0.354	0.308	50.57*	154.00**
Planned Drainage (30 day degradation)	0.007	0.002	0.243	0.213	34.71*	106.50**
Overflow rainfall/AR	0.007	0.002	0.104	0.092	14.86*	46.00**
Overflow rainfall/TX,LA,MS	0.007	0.002	0.123	0.106	17.57*	53.00**
Overflow rainfall/CA	0.007	0.002	0.049	0.043	7.00*	21.50**

* exceeds acute high (0.5), restricted use (0.1) and endangered species (0.05) LOCs

** exceeds the chronic LOC (1)

The acute and chronic risk quotients for freshwater invertebrates (using the most sensitive species, an amphipod, for acute and using the daphnid for chronic) based on three applications at five day intervals are tabulated below.

Lambda-cyhalothrin on Rice: Risk Quotients for Freshwater Invertebrates Based On an Amphipod LC50 of 6.7 ppt and a Daphnid MATC of 2.32 ppt

Exposure Scenario	LC50 (ppb)	MATC (ppb)	EEC (ppb)	EEC 21-Day Average	Acute RQ (EEC/LC50)	Chronic RQ (EEC/MATC)
Direct aerial	0.007	0.002	1.456	1.266	208.00*	633.00**
Spray drift aerial	0.007	0.002	0.072	0.063	10.29*	31.50**
Spray drift ground	0.007	0.002	0.015	0.013	2.14*	6.50**
Planned drainage (4 day degradation)	0.007	0.002	0.903	0.602	129.00*	301.00**
Planned drainage (30 day degradation)	0.007	0.002	0.602	0.524	86.00*	262.00**
Overflow rainfall/AR	0.007	0.002	0.258	0.224	36.86*	112.00**
Overflow rainfall/TX,LA,MS	0.007	0.002	0.301	0.263	43.00*	131.50**
Overflow rainfall/CA	0.007	0.002	0.122	0.105	17.43*	52.50**

* exceeds acute high (0.5), restricted use (0.1) and endangered species (0.05) LOCs

** exceeds the chronic LOC (1)

The acute and chronic risk quotients for freshwater invertebrates (using the daphnid) based on a single application are tabulated below.

Lambda-cyhalothrin on Rice: Risk Quotients for Freshwater Invertebrates Based On a Daphnid LC50 of 230 ppt and a Daphnid MATC of 2.32 ppt

Exposure Scenario	LC50 (ppb)	MATC (ppb)	EEC (ppb)	EEC 21-Day Average	Acute RQ (EEC/LC50)	Chronic RQ (EEC/MATC)
Direct aerial	0.23	0.002	0.587	0.510	2.55*	255.00***
Spray drift aerial	0.23	0.002	0.029	0.025	0.13**	12.50***
Spray drift ground	0.23	0.002	0.006	0.005	0.03	2.50***
Planned Drainage (4 day degradation)	0.23	0.002	0.354	0.308	1.54*	154.00***
Planned Drainage (30 day degradation)	0.23	0.002	0.243	0.213	1.06*	106.50***
Overflow rainfall/AR	0.23	0.002	0.104	0.092	0.45**	46.00***
Overflow rainfall/TX,LA,MS	0.23	0.002	0.123	0.106	0.53*	53.00***
Overflow rainfall/CA	0.23	0.002	0.049	0.043	0.21**	21.50***

* exceeds acute high (0.5) LOC
** exceeds restricted use (0.1) and endangered species (0.05) LOCs
*** exceeds the chronic LOC (1)

The acute and chronic risk quotients for freshwater invertebrates (using the daphnid) based on three applications at five day intervals are tabulated below.

Lambda-cyhalothrin on Rice: Risk Quotients for Freshwater Invertebrates Based On a Daphnid LC50 of 230 ppt and a Daphnid MATC of 2.32 ppt .

Exposure Scenario	LC50 (ppb)	MATC (ppb)	EEC (ppb)	EEC 21-Day Average	Acute RQ (EEC/LC50)	Chronic RQ (EEC/MATC)
Direct aerial	0.23	0.002	1.456	1.266	6.33*	633.00***
Spray drift aerial	0.23	0.002	0.072	0.063	0.31**	31.50***
Spray drift ground	0.23	0.002	0.015	0.013	0.07**	6.50***
Planned drainage (4 day degradation)	0.23	0.002	0.903	0.602	3.93*	301.00***
Planned drainage (30 day degradation)	0.23	0.002	0.602	0.524	2.62*	262.00***
Overflow rainfall/AR	0.23	0.002	0.258	0.224	1.12*	112.00***
Overflow rainfall/TX,LA,MS	0.23	0.002	0.301	0.263	1.31*	131.50***
Overflow rainfall/CA	0.23	0.002	0.122	0.105	0.53*	52.50***

* exceeds acute high (0.5), restricted use (0.1) and endangered species (0.05) LOCs
* exceeds restricted use (0.1) and/or endangered species (0.05) LOCs
** exceeds the chronic LOC (1)

The acute risk quotients for estuarine fish based on one application are tabulated below.

Lambda-cyhalothrin on Rice: Risk Quotients for Estuarine/Marine Fish Based on a Sheepshead Minnow LC50 of 807 ppt and MATC of 308 ppt

Exposure Scenario	LC50 (ppb)	MATC (ppb)	EEC (ppb)	EEC 56-Day Average	Acute RQ (EEC/LC50)	Chronic RQ (EEC/MATC)
Direct Aerial	0.807	0.308	0.587	N/A	0.73*	N/A
Spray drift aerial	0.807	0.308	0.029	N/A	0.04	N/A
Spray drift ground	0.807	0.308	0.006	N/A	0.01	N/A

* exceeds the acute high (0.5), restricted use (0.1) and endangered species (0.05) LOCs

While the LOC for acute risk to estuarine fish is exceeded from direct aerial spray, direct spray to estuarine habitat is expected to occur infrequently.

The acute and chronic risk quotients for estuarine fish based on three applications at five day intervals are tabulated below. Some repeated exposure and chronic risk is possible in estuarine habitats because of multiple applications, however, chronic risk quotients were not calculated because available models are not appropriate for estimating long-term exposure in estuarine habitats.

Lambda-cyhalothrin on Rice: Risk Quotients for Estuarine/Marine Fish Based on a Sheepshead Minnow LC50 of 807 ppt and 308 ppt

Exposure Scenario	LC50 (ppb)	MATC (ppb)	EEC (ppb)	EEC 56-Day Average	Acute RQ (EEC/LC50)	Chronic RQ (EEC/ MATC)
Direct aerial	0.807	0.308	1.456	N/A	1.80*	N/A***
Spray drift aerial	0.807	0.308	0.072	N/A	0.09**	N/A***
Spray drift ground	0.807	0.308	0.015	N/A	0.02	N/A***
Theoretical Monitored EEC	0.807	0.308	.0066	N/A	0.01	N/A***

* exceeds the acute high (0.5), restricted use (0.1) and endangered species (0.05) LOCs
** exceeds the restricted use and/ or endangered species LOCs
*** repeated exposure is expected to result in chronic risk in estuarine habitats with low flow rates

While the LOC for acute risk to estuarine fish is exceeded from direct aerial spray, direct spray to estuarine habitat is expected to occur infrequently.

The acute and chronic risk quotients for estuarine/marine aquatic invertebrates based on one application are tabulated below.

Lambda-cyhalothrin on Rice: Risk Quotients for Estuarine/Marine Invertebrates Based on a Mysid Shrimp LC50 of 4.9 ppt and MATC of 0.318 ppt

Exposure Scenario	LC50 (ppb)	MATC (ppb)	EEC (ppb)	EEC 21-Day Average	Acute RQ (EEC/LC50)	Chronic RQ (EEC/MATC)
Direct Aerial	0.005	0.0003	0.587	N/A	117.40*	N/A
Spray drift aerial	0.005	0.0003	0.029	N/A	5.80*	N/A
Spray drift ground	0.005	0.0003	0.006	N/A	1.20*	N/A

* exceeds the acute high (0.5), restricted use (0.1) and endangered species (0.05) LOCs

While the LOC for acute risk to estuarine invertebrates is exceeded from direct aerial spray, direct spray to estuarine habitat is expected to occur infrequently.

The acute and chronic risk quotients for estuarine/marine aquatic invertebrates based on three applications at five day intervals are tabulated below.

Lambda-cyhalothrin on Rice: Risk Quotients for Estuarine/Marine Invertebrates Based on a Mysid Shrimp LC50 of 4.9 ppt and MATC of 0.318 ppt

Exposure Scenario	LC50 (ppb)	MATC (ppb)	EEC (ppb)	EEC 21-Day Average	Acute RQ (EEC/LC50)	Chronic RQ (EEC/MATC)
Direct aerial	0.005	0.0003	1.456	N/A	291.20*	N/A**
Spray drift aerial	0.005	0.0003	0.072	N/A	14.40*	N/A**
Spray drift ground	0.005	0.0003	0.015	N/A	3.00*	N/A**
Theoretical Monitored EEC	0.005	0.0003	0.0066	N/A	1.32*	N/A**

* exceeds the acute high (0.5), restricted use (0.1) and endangered species (0.05) LOCs
** repeated exposure is expected to result in chronic risk in estuarine habitats with low flow rates

While the LOC for acute risk to estuarine fish is exceeded from direct aerial spray, direct spray to estuarine habitat is expected to occur infrequently.

A summarization of the acute RQ exceedences is provided below. Bolded numbers and text denote exceedance of high risk LOC.

1. Acute Risk Quotients/Single Application

ACUTE RISK QUOTIENTS								
Single Application	Direct	Spray Drift		Planned Drainage- After Holding Period (Days)		Rainfall- Overflow Events		
		Air	Gr	4	30	CA	AR	TX,LA, MS
Freshwater Fish	2.8	0.1	*	1.7	1.2	0.2	0.5	0.6
Freshwater Invert (Amphipod)	84	4.1	0.9	51	35	7	15	18
Freshwater Invert (Daphnid)	2.6	0.1	*	1.5	1.1	0.21	0.45	0.53
Estuarine Fish	0.7**	*	*	does not exceed for theoretical monitored EEC				
Estuarine Invertebrates	117**	6	1.2	1.2 for theoretical monitored EEC				

* No LOCs exceeded
** Direct application to estuarine habitats is considered to be an infrequent occurrence.

2. Acute Risk Qoutients/Multiple Applications

ACUTE RISK QUOTIENTS								
Multiple Applications (3 at 5 day intervals)	Direct	Spray Drift		Planned Drainage- After Holding Period (Days)		Rainfall- Overflow Events		
		Air	Gr	4	30	CA	AR	TX,LA, MS
Freshwater Fish	7	0.3	0.07	4.3	2.9	0.6	1.2	1.4
Freshwater Invert (Amphipod)	208	10	2.1	129	86	17	37	43
Freshwater Invert (Daphnid)	6	0.3	0.07	4	2.6	0.5	1.1	1.3
Estuarine Fish	1.8**	0.09	*	does not exceed for theoretical monitored EEC				
Estuarine Invertebrates	291**	14	3	1.3 for theoretical monitored EEC				

* No LOCs exceeded
** Direct application lo estuarine habitats is considered to be an infrequent occurrence.

A summarization of the chronic RQ exceedences is provided below. Bolded numbers and text denote exceedance of high risk LOC.

1. Chronic Risk Quotients/Single Application

CHRONIC RISK QUOTIENTS								
Single Application	Direct	Spray Drift		Planned Drainage- After Holding Period (Days)		Rainfall- Overflow Events		
		Air	Gr	4	30	AR	TX,LA MS	CA
Freshwater Fish	**9**	*	*	**5.6**	**4**	1.6	**1.9**	-
Freshwater Invertebrate	**255**	**12.5**	**2.5**	**154**	**107**	**46**	**53**	**21.5**
Estuarine Fish	no chronic risk quotients were calculated for estuarine species, however, multiple episodes of exposure from drift or runoff after repeated applications may result in sublethal and/or reproductive risk to estuarine species. The EFED concludes that the **chronic LOC is exceeded in estuarine habitats with low flow rates.**							
Estuarine Invertebrate								

* Chronic LOC not exceeded

2. Chronic Risk Quotients/Multiple Applications

CHRONIC RISK QUOTIENTS								
Multiple Applications	Direct	Spray Drift		Planned Drainage- After Holding Period (Days)		Rainfall- Overflow Events		
		Air	Gr	4	30	AR	TX,LA MS	CA
Freshwater Fish	**23**	1.1	*	**14**	**10**	**4**	**5**	1.9
Freshwater Invertebrate	**633**	**32**	**7**	**301**	**262**	**112**	**132**	**53**
Estuarine Fish	no chronic risk quotients were calculated for estuarine species, however, multiple episodes of exposure from drift or runoff after repeated applications may result in sublethal and/or reproductive risk to estuarine species. The EFED concludes that the **chronic LOC is exceeded in estuarine habitats with low flow rates.**							
Estuarine Invertebrate								

* Chronic LOC not exceeded

Results of the acute risk assessment show that karate represents high acute risk under most conditions. The LOCs for acute high risk, restricted use and/or endangered species are not exceeded under the following circumstances:

- o spray drift/aerial application- estuarine fish (1 app.)
- o spray drift/ground application- estuarine fish (1 and 3 apps.); freshwater fish \ (1 app.)
- o estuarine theoretical monitored EEC- estuarine fish (1 and 3 apps.)

Results of the chronic risk assessment show that the only chronic RQs which are not exceeded are:

- o spray drift/aerial application- estuarine fish (1 and 3 apps.); freshwater fish (1 app.);
- o spray drift/ground application- estuarine fish (1 and 3 apps.); freshwater fish (1 and 3 apps.)
- o rainfall/overflow Event (CA): freshwater fish (1 app

Results of the aquatic risk assessment show, in order of highest RQ exceedence to lowest, for a reasonable scenario (a planned drainage occurring 30 days after a single application):

- o chronic/freshwater invertebrate (RQ is approximately 100X the chronic risk LOC)
- o acute/freshwater invertebrates (RQ is approximately 70X the acute high risk LOC based on amphipod data)
- o chronic/freshwater fish (RQ is approximately 4X the chronic risk LOC)
- o acute/freshwater fish (RQ is approximately 2X the acute high risk LOC)

Incident Data

EEB's Incident Data System for the chemical lambda-cyhalothrin lists five incidents. In two of these incidents, lambda-cyhalothrin alone was implicated in the fish kills. Both involved use on cotton. In the other three incidents there was only a possibility that lambda-cyhalothrin was the cause (e.g. other pesticides applied in area, factors unrelated to chemical exposure, e.g. low DO levels in the water).

Incidents for Lambda-Cyhalothrin

A search was conducted through the Incident Data System and The Ecological Incident Information System to determine the number of incidents which may have been reported for lambda-cyhalothrin, also referred to as Karate as the trade name. The search is dated to 9/9/96.

September 1995- A fish kill was reported to have occurred in Roseboro, NC on September 1, 1995. Forty to fifty goldfish were found dead in a small pond. Low dissolved oxygen were implicated along with the possibility of exposure to Karate, which had been aerially applied to a cotton field 0.8 miles away from the pond, at the recommended label rate. Samples were taken to measure for organophosphate, but no residues were detected. The report did not indicate if residue analysis included synthetic pyrethroids, such as Karate (NC Department of Agriculture, November 30, 1995, I003826-007).

July 1994- A fish kill was reported to have occurred in two sites, Archibald and Crew Lake, Louisiana. Karate along with other pesticides, Profenofos, Asana and other carbamate and organophosphate were used in adjacent cotton fields. Residue analysis did not include synthetic pyrethroid chemistry. Profenofos was detected (Ciba Geigy, October 31, 1994, I001195-001, 002).

August 1994- Karate was implicated in a fish kill incident reported to have occurred August 6, 1994 in Beaver Dam area of Cumberland County, NC. Karate had been applied to an adjacent field on July 20, 1994 and July 28, 1994, and August 7, 1994. Approximately 225 brim and 100-125 large mouth bass were found. A buffer strip, consisting of 100 feet of woods existed beyond between the cotton field and the pond. Residue analysis was conducted, but no residues were detected (the level of detection was not reported). (NC Department of Agriculture, October 31, 1994, I003826-029).

August 1993 - A fish kill to have occurred from the possible use of Karate (3 ounces per acre) to an adjacent cotton field on July 29, 1993 and the fish kill was observed on August 1, 1993 in Oak City, NC. The report indicated that 3 to 4 pounds of copper sulfate tad also been applied to the end of the pond on July 31, 1993 to control aquatic vegetation. No Karate residues were detected in the water samples. Karate residues were detected on nontarget vegetation which was 18 feet west of the pond at 0.002 ppm. The report also indicated that there were low DO levels(I003654-009, NC Department of Agriculture 8/5/93)).

August 1993 - A fish kill was reported to have occurred adjacent to a cotton field treated with Karate which had been applied 10 and 20 days prior to observed incident. The site of the incident was Autryville, NC. The report also indicated that no residue analysis was conducted on the water samples because the DO was measured to be as low as 0.5 mg/l. The report indicated that approximately 60 large, large mouth bass were found dead at the site. (I003654-008, NC Department of Agriculture 8/3/93)).

August 1991- Karate was implicated in a fish kill in Hahira, GA, after a "considerable rainfall". The investigator reported not observing dead fish as the complainant had found, as was initially reported. There was a small boundary(buffer strip) between the pond and the treated cotton field. Samples were taken to measure for residues of Karate but the investigator indicated on the report that the analytical techniques available to the facility were not capable of measuring for Karate (GA Department of Agriculture, I00921-001).

July 1991- A fish kill was reported on July 30, 1991, to have occurred in Dublin, Georgia, approximately July 18, 1991, which included large bass, breams, and catfish (numbers ranged from 50 to 300 depending on the observer). The Karate(4 oz./3 gallons of water) and Bidrin(8 oz./3 gallons of water) were applied to a cotton field, ranging from 20 to 50 yards from the pond, on June 20, 1991. The pond has a buffer strip consisting of 15-20 feet tall willow and gum trees, and signs of heavy rainfall were evident. Two more applications had been made to the fields, July 23, and July 27, 1991, and no adverse effects were observed. Small fish were observed still living in the pond. The investigator noted that it appeared mostly large fish had been observed dead. Results from residue analysis not reported (GA Department of Agriculture, I00922-001).

101.4 Adequacy of Data

The outstanding data required to support this aquatic use pattern are two environmental fate studies: aquatic field dissipation and aerobic/anaerobic aquatic metabolism.

Sediment adsorption and bioavailability studies are currently under review, as are droplet size spectrum and field drift evaluation studies.

Data referenced by Zeneca in their risk assessment, but not submitted, include testing on lambda-cyhalothrin degradates, and a study on effects of Karate on rice fish culture in the Philippines.

101.5 Adequacy of Labeling

The following label deficiencies are noted:

1. Specific directions for use, e.g. timing of applications, should be provided for all pests listed on the draft label. The draft label provides directions for use only for the rice water weevil.

2. The label should state specifically that ULV is prohibited for rice. Otherwise, it could conceivably be used in that manner and not be considered a misuse or violation of FIFRA.

A 4-day holding period was proposed by Zeneca. In the absence of environmental fate data it is not clear whether this is sufficient time to allow degradation of the parent compound and reduce exposure to nontarget animals that may be present in the receiving waters. EFGWB recommends that the holding period be extended significantly.

The current label for Karate includes the following language which is intended to reduce spray drift into aquatic areas: "Do not apply by ground within 25 feet, or by air within 150 feet of lakes; reservoirs; rivers; permanent streams, marshes, or natural ponds; estuaries and commercial fish ponds. Increase the buffer zone to 450 feet when ultralow volume (ULV) application is made." This language does not include ditches, canals, and other water bodies which are often closely associated with rice fields. Drift into these areas could have adverse effects on aquatic organisms or could affect organisms in larger downstream water bodies into which these unique rice water bodies drain. (A. Jones to G. LaRocca; review dated 3/28/97)

101.6 Endangered Species Consideration

The endangered species LOC is exceeded for aquatic animals and small mammals.

Attached is a list of endangered and threatened species occurring in counties in states where rice is grown.

Minimal adverse effects to threatened/endangered mammalian species are anticipated. Although the endangered species LOC was exceeded for small herbivorous mammals, none of these species are found in rice fields. Threatened/endangered mammalian species found in areas where rice is grown include the grey bat, Fresno kangaroo rat, giant kangaroo rat, San Joaquin Kit fox and Louisiana black bear, and American black bear.

Significant adverse effects to threatened/endangered aquatic animals in habitats near rice fields is anticipated. The severity would depend on the proximity of the species to the treated field.

It is anticipated that the giant garter snake, a resident of rice fields in California, could be adversely affected by use of lambda-cyhalothrin, because it feeds on small fish and frogs in rice fields and adjoining canals and ditches. Both frogs and fish are presumed to be at risk from karate.

The Endangered Species Protection Program is expected to become final in the future. Limitations in the use of his chemical will be required to protect endangered and threatened species, but these limitations have not been defined and may be formulation specific. EPA anticipates that a consultation with the Fish and Wildlife Service will be conducted in accordance with the species-based priority approach described in the Program. After completion of consultation, registrants will be informed if any required label modifications are necessary. Such modifications would most likely consist of the generic label statement referring pesticide users to use limitations contained in county Bulletins.

102.0 Classification

Lambda-cyhalothrin is already classified as a "Restricted Use Pesticide" based on its intrinsic toxicity to fish and aquatic invertebrates.

103.0 Risk Characterization

Agricultural Use

According to the USA Rice Federation, rice production in the United States (AR, CA, LA, MS, MO, and TX) was a little over 3 million acres in the year 1995. Of this total acreage, about 850,000 acres were treated with an insecticide (Zeneca's estimates based on Doane, Maritz and USDA-NAPIAP). The predominate use is in CA and LA, accounting for about 85% (EPA BEAD estimates). Zeneca projects that with registration of Karate on rice, the rice insecticide market in year 2000 will be changed from a 1995 market of carbofuran (350,000 to 0 A), methyl parathion (390,000 to 250,000 A), malathion (50,000 to 20,000 A), carbaryl (60,000 to 30,000 A), and lambda-cyhalothrin (600,000 A).

Use on rice is divided into three general areas: the Gulf Coast (Texas and Louisiana), the Mississippi River Valley (Arkansas, Mississippi, Louisiana, and Missouri) and the Sacramento and San Juaquin River Valleys in California. In California ninety-five percent of rice-farming takes place in the Sacramento Valley (Butte, Colusa, Glenn, Sacramento, Tehama, Yolo and Yuba counties). Rice production in that state began in the early part of the century and has gradually replaced about ninety-five percent of the existing natural wetland areas.

Targeted Pests

Lambda-cyhalothrin is targeted to control the following insect pests: rice water weevil (adult), rice stink bug, true armyworm, fall armyworm, yellow-striped armyworm, chinch bug, grasshopper species, leafhopper species, oat birdcherry aphid, and green bug.

Timing of Applications

According to BEAD, lambda-cyhalothrin is likely to be applied from April through August with about 35% of the total usage occurring in July. Zeneca projects it is very likely to be used as early as March to control some of the early season pests. For rice water weevil, application is indicated by scouting for the presence of adults, usually within the time frame of 0-5 days after the permanent flood establishment. Other early season control pests include armyworms (true armyworm, fall armyworm, yellow-striped armyworm), chinch bugs and aphids. Grasshoppers are middle-to-late season control pests, and the rice stink bug is a late season control pest.

Preharvest Interval

A pre-harvest interval of 21 days is specified on the label for application rate of 0.04 lb ai/a.

The draft label also specifies not to apply more than 0.12 lb ai per acre within 28 days of harvest.

Number of Applications

The draft label specifies a maximum of three applications are permitted, with a 5 to 7 day reapplication interval. According to Zeneca, one application would be necessary to control the adult rice water weevil, with two applications occurring mainly in the water-seeded areas of the warmer rice growing regions, typically LA and TX, following a mild winter. In these 2 states, Zeneca projects that about 120,000 A would be treated for rice water weevil and 30,000 of these acres would receive a second treatment for this pest. Zeneca defines a typical application rate as 0.03 lb ai/a. According to BEAD adequate monitoring and techniques and treatment thresholds have not been established for adult rice water weevil. BEAD estimates that if adequate monitoring methods were available about 27% of the US growers would have to make 2 applications and 6% would need to make 3 applications to control the rice water weevil. Information from the southern rice-growing states indicates more than one application would probably be necessary for rice water weevil control (in LA 9/96 comments on EPA's analysis of rice water weevil management alternatives it is stated that in LA 100% of the growers currently using carbofuran would have to make at least two applications using Karate, probably three, and in some cases, four for RWW control; if treatment for the other pests were to be added to this the number could go as high as 6-8 applications).

Rice Habitat

Much of rice farmland is characterized by hard, claypan soils, making the land unsuitable for other crops, but ideal for holding the water needed to culture rice. Water is an extremely important resource for rice production. Abundant waterways (human-built and natural) ranging in size from small narrow canals to larger navigational waterways serve rice farms. These waterways provide an important habitat for fish and wildlife and may also serve as human recreational areas. Fallow rice fields provide important wetland habitat for migratory ducks and geese. About 60,000 acres in the Sacramento Valley are protected in public and private sanctuaries for wildlife.

Rice fields provide habitat for a diversity of terrestrial animals on both a seasonal and year-round basis. Numerous terrestrial animals are associated with rice fields, levees and areas adjacent to the fields. During fall and winter, the crop or stubble in rice fields are often grazed by migratory waterfowl and resident populations. In California, at least 116 species of birds are known to frequent rice fields during their annual cycle; at least 17 species are known to breed or are dependent to some extent for successful breeding on resources provided by the rice fields or set-asides, and 28 species of mammals utilize rice fields (WESCO 1991, WESCO 1994). Seventy to eighty percent of the ducks which winter in the Sacramento Valley were produced there (conversation G. Olson, National Audubon

Society with A. Jones, 2/17/97). A listing of wildlife supported by rice fields is provided in an attachment to this review.

Rice fields provide habitat for a diversity of aquatic animals on both a seasonal and year-round basis. Rice fields occur in coastal plains, tidal deltas and river basins where fresh water is available to submerge the land. Aquatic animals associated with the rice paddies, and/or the surrounding bodies of water include fish, crayfish, and numerous small invertebrates (e.g. annelid worms, small crustaceans (copepods, amphipods, shrimp, cladocerans, mysids, saltwater isopods and aquatic insects). Aquatic invertebrates may be found (1) in the flooded growing rice field; (2) in the rice field after harvest; or (3) in the surrounding freshwater or estuarine aquatic habitats.

Summary of Risk Assessment

The ecological risks are summarized below.

- o use of lambda-cyhalothrin on rice in the US poses a **very high** risk of acute and chronic effects to aquatic invertebrates and a **medium** risk of acute and chronic effects to freshwater fish in adjacent aquatic habitats. The EFED does note normally receive toxicity information on amphibians; such information is unavailable for karate. However, it is assumed that amphibians, including frogs and salamanders associated with aquatic habitat are at least as sensitive as fish to karate. Risk to these organisms is expected to be equivalent to the risk expected for fish.

- o use of lambda-cyhalothrin on rice in the vicinity of estuarine areas (i.e. LA and TX Gulf coast areas) poses a **small** risk of acute effects to estuarine fish and invertebrates. Chronic risk would be expected in estuarine habitat with low flow rates, however, where tidal flow causes rapid exchange of water, chronic risk would be reduced. Note that in Louisiana, the southern-most extent of rice production is limited by the availability of freshwater for flooding the rice fields. This limits estuarine exposure in Louisiana.

- o there is minimal risk of acute or chronic risk to terrestrial animals; however, as fish and invertebrates serve an important food source for terrestrial species feeding in the rice field/adjacent aquatic habitats, negative population effects on aquatic animals could have indirect adverse affects on terrestrial animals. It is anticipated that the giant garter snake, a resident of rice fields in California, could be adversely affected by use of lambda- cyhalothrin, because it feeds on small fish and frogs in rice fields and adjoining canals and ditches.

Terrestrial Animals

The routes of exposure to birds and mammals are contamination of habitat and contamination of food source. Because no avian acute or chronic LOC was exceeded for single or multiple applications, the EEB concludes that minimal adverse effects are expected for avian species, including endangered and threatened species. The chronic risk quotient was close to exceeding the Agency's LOC for chronic effects (EEC/NOEC: 30 ppm/>30 ppm- highest dose level tested). Chronic risk is not anticipated, however, because (1) worst-case Kenaga values (short grass) were used; (2) the maximum number of applications, three, were made with no degradation assumed; (3) the NOEC was >30; and (4) the most sensitive species, mallard, was used in the risk assessment (bobwhite quail NOEC = 50 ppm). [Zeneca performed a risk assessment using unsubmitted mustard green data, with estimated half-life of 6 days, resulting in a RQ value of 0.28].

It appears that mammals are more sensitive to lambda-cyhalothrin than avian species, because some of the mammalian acute LOCs (endangered species and restricted use) were exceeded (see Section 101.3). Minimal adverse acute adverse effects to mammalian species, including endangered species, are anticipated for the following reasons: (1) the RQs derived from multiple applications were based on multiples of 0-day Kenaga values where no degradation was assumed; (2) the multiple applications assumed worst-case, i.e. maximum seasonal use rate of 0.12 lb ai/A; (3) mammalian species found in rice fields would normally be associated with border habitat because fields are generally flooded, where residues would be expected to be significantly less; and (4) there are no endangered/threatened small mammals of size 15 gram or less occurring in rice fields (see Section 101.3, Endangered Species).

Aquatic Animals

1. Lambda-cyhalothrin's Aquatic Ecotoxicity/Field and Incident Data

Available aquatic ecotoxicity data are adequate to support registration of lambda-cyhalothrin on rice. Results of aquatic ecotoxicity studies show that lambda-cyhalothrin is extremely toxic to aquatic animals. Toxicity values are expressed in terms of parts per trillion. Values used in the risk assessment include:

amphipod LC50 =6.7 ppt
daphnid MATC =2.32 ppt
bluegill LC50 =210 ppt
fathead minnow MATC =43.8 ppt
sheepshead minnow LC50 =807 ppt
sheepshead minnow MATC =308 ppt
mysid shrimp LC50 =4.9 ppt
mysid shrimp =MATC 0.318 ppt

Results of a 1986 mesocosm study showed negative effects on invertebrate populations (in some cases entire populations decimated), not only at concentration levels equivalent to

5% spray drift from a 0.03 lb ai/A treatment rate, but also at spray drift rates of 0.5% and 0.05% of that rate. Negative effects of fish populations manifested by reductions in biomass were observed at all treatment levels.

EEB's Incident Data System for the chemical lambda-cyhalothrin lists five fish kill incidents, in two of which lambda-cyhalothrin alone was implicated in the fish kills. Both involved use on cotton.

2. Aquatic Sites Associated With Rice Fields

Nontarget aquatic sites that may be found in close proximity to rice fields include:

- estuarine areas
- crayfish farms in LA and TX
- catfish farms
- human recreational areas (whether they be man-made canals or natural waterways)
- bird refuge/sanctuaries

3. Non-target Aquatic Exposure Potential

The routes of exposure of lambda-cyhalothrin into non-target aquatic areas include spray drift, overflow (e.g. breach of levee caused by heavy rain), and planned drainage (e.g. prior to harvest for weed control).

Although water is an expensive resource in rice farming, farmers may drain fields prior to harvest for specific reasons (e.g. straighthead control, or herbicide application). Zeneca says that about 15% of the acreage of rice fields are drained for straighthead control in the southern states only, and would occur 25 to 45 days after application of lambda-cyhalothrin to control rice water weevil.

Unplanned drainage for circumstances of excessive rainfall can also occur. The frequency would be greatest in the coastal regions of LA and TX, and lowest in CA. Information received from the California Department of Regulation (CDR, Marshall Lee conversation with A. Jones 2/18/97) indicate that historically late rains are relatively infrequent, but they have occurred in 1990, 1993, 1995, and 1996. According to DPR records the percentage of total rice acreage for which there was an early, unplanned release of water was: '90 - 6.3%; '91 - 0.7%; '92 - 0.29%; '93 - 2.5% (3 inches of rain fell in one week in May, which is very unusual); '94 - 0.04%; '95 - 0.23%; and '96 - 1.46%. EFED does not have similar data for the southern states.

EEC values for the potential exposure routes, in order from lowest EEC value to highest EEC value, were as follows:

- o spray drift (ground)
- o spray drift (aerial)
- o excessive rainfall event (CA)
- o excessive rainfall event (AR)
- o excessive rainfall event (LA and TX)
- o planned drainage (30 days after last application)
- o planned drainage (4 days after application)
- o inadvertent direct spray to nontarget aquatic site

4. Aquatic Risk

Use of lambda-cyhalothrin on rice is expected to pose a **very high** risk of acute and chronic effects to aquatic invertebrates. With a conservative assumption of only one application held for thirty-days before being released into an equal volume of water, the chronic daphnid RQ exceedence is 100X. It is expected aquatic invertebrates in habitats adjacent to rice fields (e.g. refuge areas, smaller drains and canals) could be adversely effected, and that crayfish farms in the vicinity of rice fields could be adversely effected by lambda-cyhalothrin use. In the South, there are approximately 75,000 to 80,000 acres of rice stubble utilized each year as forage for commercially harvested crawfish (LSU Agri. Center, 1996).

- o use of lambda-cyhalothrin on rice in the US poses a **medium** risk of acute and chronic effects to freshwater fish. It is expected freshwater fish in habitats adjacent to rice fields (e.g. refuge areas, smaller drains and canals) could be adversely effected, and that catfish farms in the vicinity of rice fields could be adversely effected by use of this pesticide in rice fields.The EFED does note normally receive toxicity information on amphibians; such information is unavailable for karate. However, it is assumed that amphibians, including frogs and salamanders associated with aquatic habitat are at least as sensitive as fish to karate. Risk to these organisms is expected to be equivalent to the risk expected for fish.

- o use of lambda-cyhalothrin on rice near estuarine areas (i.e. LA and TX Gulf coast areas) poses a **small** risk of acute effects to estuarine fish and invertebrates. The occurrence of acute effects would depend on how close the estuarine habitat was to the rice field, the effects of tidal flushing, and the size of the estuary (dilution factor). Chronic effects would not expected due to dilution and tidal flushing. Although acute RQ values for spray drift were high for estuarine invertebrates, the scenario used to calculate the EEC is probably not appropriate to use for estuarine habitats. The occurrence of acute effects to estuarine invertebrates would depend on how close the estuarine habitat was to the rice field, the effects of tidal flushing, and size of the estuary (dilution factor).

- o As fish and invertebrates serve as an important food source for terrestrial animals feeding in the rice field and adjacent habitats, negative population effects on aquatic animals could indirectly negatively effect terrestrial animals. These effects would be extremely difficult to measure.

Uncertainties in Our Assessment

1. Bioavailability

Zeneca states that pyrethroids are only bioavailable when "free" in water and therefore, the period of exposure to aquatic organisms is very short as the compound rapidly becomes adsorbed and is biologically inactive. EFED does not know (1) what lambda-cyhalothrin's bioavailability to benthic dwelling animals is; (2) what the exposure is; and (3) how to estimate the exposure. EFED has little experience in evaluating sediment toxicity data and has never performed an ecological risk assessment for bottom-dwelling aquatic organisms. EPA-Duluth will be asked to review EFED's work on the sediment toxicity data that is currently in-house, and a Science Advisory Panel will then be necessary to get feedback on the risk assessment approach that is developed [current projected due date for the first review of these studies is early 1997; a risk assessment review by Duluth, review by the Science Advisory Panel, and application to other pyrethroids is projected to be completed by 10/97].

2. Environmental Fate

Lambda-cyhalothrin's environmental fate data base supports terrestrial uses. Rice is considered an aquatic use site. Environmental fate data to support this aquatic use are outstanding. EFED's risk assessment is based on an aquatic half-life of 48 days (an extrapolated value from terrestrial data). Zeneca says the aquatic half-life is less than 1 day. This needs to be resolved. Pending submission and review of the aquatic environmental fate data, a revised risk assessment will be necessitated (EEC could be much higher or much lower).

3. Effects on Food Chain/Population Rebounds

Fish and invertebrates serve as an important food source for waterfowl and other avian species, feeding in the rice field and in adjacent aquatic habitats. Negative population effects on aquatic animals could negatively effect animals higher in the food chain. While Zeneca says that the low number of applications more readily allows recovery of aquatic animals in the event of a treatment related effect, we will have no way to measure these broader ecosystem effects.

4. Exposure in Estuarine Habitats

In southern rice growing regions, rice fields can be in close proximity to estuaries.

However, the EFED does not have great confidence in current models to estimate exposure in these habitats. Furthermore, different estuaries differ greatly in flow characteristics. It is likely that lambda-cyhalothrin will get into estuaries, and it is toxic to estuarine organisms at extremely low levels. Therefore, the EFED presumes there is both acute and chronic risk to these organisms. However, these risks are not easily quantified.

Risk Mitigation

Zeneca has four risk mitigation proposals:

1. Four- Day Holding Period

Zeneca says its recommendation for a 4-day holding period is supported by sound scientific evidence. EFGWB recommends that the holding period be extended significantly (A. Jones to G. LaRocca; Draft review).

Per April 23 mtg with Zeneca we agreed to a 7 day holding period until data is submitted.

2. Spray Drift

There is a concern about the practicality of implementing spray drift mitigation in rice growing areas. The buffers of 150 ft (aerial application) and 25 ft (ground application) my be incompatible with certain pest control practices. Information from rice researchers in California indicates the most severe rice weevil damage generally occurs in the first 15 to 20 feet from the field margins and levees, and this is where it is advised treatment should be targeted. Fall armyworm infestations usually occur along the field border and rice leaf miner infestations usually occur on the upper side of the levees where water is deeper (Louisiana State University Agricultural Center publication, 1987).

Per April 23 mtg we agreed that the current spray drift mitigation was acceptable on an interim basis until results from SDTF are concluded. Also we would like to include the label ... currently labelled for cotton and other crops.

3. ULV Prohibition/Increase in Spray Volume from 2 gal/A to 5 gal/A

The label should state specifically that ULV is prohibited for rice. EFGWB recommends that ULV be prohibited for all other uses of lambda-cyhalothrin (currently label says to increase the buffer zone to 450 ft when ULV application is made). Although a larger spray volume (5 gal/A) may result in the use of larger droplets (and hence reduce drift potential), increases in spray volume are not always directly correlated with larger droplet size.

we will require ULV prohibition for rice use

<u>Bibliography</u>

EPA. Memorandum George Tompkins to Rebecca Cool Dated 8/7/93. Section 18 (State of Texas) Request for Use of Karate (Lambda-cyhalothrin) on Rice for Control of Fall Armyworm.

EPA. Memorandum A. Maciorowski to G. LaRocca. Dated 12/14/94. Transmittal of all outstanding deliverables relating to Cyhalothrin Action D188684

EPA. Memorandum A. Maciorowski to D. Deegen. 6/28/96. EEB's Response to Louisiana's Section 18 Request for the Use of Karate to Control Rice Water Weevil in Rice (D225814)

EPA. Ecological Levels of Concern. Comparative Analysis. OPP USEPA, Washington, DC March, 1995

EPA. Executive Summary of the Comparative Risk Analysis for Unregistered Alternatives to Granular Carbofuran on Rice. A. Maciorowski to M. Rice 10/26/93

Louisiana State University Agriculture Center. 1987. Rice Production Handbook Pub. 2321 (5M) 3.87.

Louisiana State University Agriculture Center. 1996. Rice Federation-EPA Meeting Washington, DC September 1996. Louisiana Comments Regarding EPA Analysis of Rice Water Weevil Management Alternatives, Compiled by Dr. Joe A. Musick and Dr. Mark Muegge

Reisner, Marc. 1992 Coming together on ricelands, wetlands and fisheries. Forum. Bay on Trial. Summer/Fall 192

Rice Field Day. Rice Experiment Station. Biggs, CA. August 28, 1996

Rice Production Handbook LA State University Agricultural Center 3/87

Western Ecological Services (WESCO). 1991. Environmental Attributes of rice cultivation in California. Report to California Rice Promotion Board. CRPB 9001.

Western Ecological Services (WESCO). 1994. Special Status Wildlife Species Use of Rice Cultivation Lands in California's Central Valley. Report to California Rice Industry Association.

Urban, D. and N. Cook, Ecological Risk Assessment, EPA-540/9-85-001.