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JUN 17 1991

REVIEW NO.

EEB REVIEW

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PRODUCT NAME(S) Zephyr/Agri-Mek 0.15 EC

COMPANY NAME Merck, Sharp & Dohme

SUBMISSION PURPOSE Proposed label restriction to citrus and cotton uses to reduce aquatic organism exposure

SHAUGHNESSEY NO.	CHEMICAL	% A.I.

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

OFFICE OF
PESTICIDES AND TOXIC
SUBSTANCES

June 12, 1991

MEMORANDUM

SUBJECT: Proposed Label Restrictions to Citrus and Cotton to Reduce Exposure to Non-Target Organisms
Record Numbers: 253893 and 253894
Reg. Numbers: 618-97 and 618-98

FROM: James Akerman, Chief
Ecological Effects Branch
Environmental Fate and Effects Division H7507C

6/14/91

TO: George LaRocca PM 15
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Registration Division H7505C

Executive Summary

The EEB has reviewed the request for a waiver from field testing for avermectin used on citrus and cotton. This included consideration of all proposed label modification and additional environmental fate information. It is concluded that the mammal field test is not required, but the aquatic field test is required. The primary source of exposure is drift. This specifically applies to the citrus and cotton uses.

Background

The registrant of avermectin, Merck, Sharp and Dohme, has submitted a proposal to modify their label as a risk reduction measure. They have also submitted a drift study. In addition, the EEB has obtained an EEC from EFGWB based on modeling showing potential concentrations in water.

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Label Modifications

The label modifications include proposed buffers, reduced total active ingredient that can be applied per acre per year, minimum between treatment intervals and geographical limitations where avermectin can be used.

AGRI-MEK: CITRUS

1. A buffer zone in which avermectin would not be allowed to be applied is proposed which would be 25 yards from freshwater systems, and 50 yards from estuarine systems. The rationale is that shrimp are more sensitive than *Daphnia magna*, and it is necessary to stay farther away from habitat potentially containing shrimp or other estuarine invertebrates.

2. A minimum "between treatment" interval of 30 days is proposed to reduce the potential for chronic exposure due to more frequent reapplication.

3. The total amount of ai/acre/year is being reduced from 60 fluid ounces/acre/year to 40 fluid ounces/acre/year. Note that in the submission, this wording appears on page 4, Laboratory Project Id: 618-936-RA-3. On page 6, however, the label states that the maximum that can be applied is 50 fl. oz.

ZEPHYR: COTTON

1. A 25-yard buffer zone in which avermectin would not be used was proposed, since the only areas where it would be used is adjacent to freshwater.

2. A minimum "between treatment" interval of 21 days is proposed to reduce the potential for repeated exposure due to more frequent reapplication.

3. The total amount of ai/acre/year is being reduced from 48 fluid ounces/acre/year to 32 fluid ounces/acre/year.

4. It is proposed that if necessary for risk reduction requirements, the label will prohibit use in the geographic area east of the Mississippi River.

Discussion

These proposed label restrictions bring up several issues. These include the basis of EEB's concern (i.e. toxicity information), exposure potential assuming the label restrictions are accepted, and buffers as a feasible risk reduction tool.

Toxicity

The following presents the concern levels for aquatic and terrestrial organisms that EEB considers to be at risk.

The laboratory data indicate that avermectin is very highly toxic to aquatic organisms.

Bluegill		LC50=9.6 ppb
Rainbow trout		LC50=3.2 ppb
Daphnia magna	acute	LC50 0.22-0.34 ppb (EEB will use 0.22 ppb)
Mysid shrimp	acute	LC50= 0.02 - 0.033 ppb
Daphnia magna	life-cycle	MATC >0.03<0.09 ppb (all dead by day 5 at 0.09 ppb)
Mysid Shrimp	Life-cycle	MATC >0.0035<0.0093 ppb
Rainbow trout	early life stage	MATC >0.52<0.96 ppb

It is important to note that while the *D. magna* life cycle does last 21 days, the adverse effects that occurred at the 90 pptr level occurred within 5 days. Therefore, EEB does not consider exposure for the full 21 days to be necessary for the effect to occur. Furthermore, the concern level for chronic exposure is the NOEL of 30 pptr, not a calculated MATC. The data show the MATC is between 30 and 90 pptr, but the safety level is 30 pptr. The NOEL is especially important in this case, since the effect at the next test concentration (90 pptr) was 100% mortality by day 5.

The fish ELS NOEL is 0.52 ppb. The chronic concern level is 1/10 this level or 0.052 ppb.

The shrimp NOEL of 3.5 pptr and its LC50 of about 22 pptr indicate that shrimp are 10 times more sensitive to avermectin than *Daphnia magna*.

The following data will be used to assess hazard to mammals and birds. Other terrestrial animals for which testing was not conducted will be treated as if they were as sensitive as mammals.

Bobwhite quail	LD50>2000 mg/kg
Mallard duck	LD50= 85 mg/kg
Bobwhite quail	LC50=3102 ppm
Mallard duck	LC50= 383 ppm
Avian reproduction test	NOEL=12 ppm LEL=64 ppm (reduced egg prod.)
Mouse	LD50= 13-23 mg/kg

Rat	LD50= 10-11 mg/kg (100 ppm)[1]
Nonpolar metabolite / rat	LD50> 48 mg/kg
Polar metabolite / rat	LD50>5000 mg/kg
Weanling rat	LD50=1.5 mg/kg This value will not be used for determining acute effects to mammals, it will be used for determining potential for chronic impact.
Rat 1-generation reproduction 77-712-0	NOEL=0.1 mg/kg/day (1 ppm[1]) LEL=0.2 mg/kg/day (2 ppm[1])
Rat 1-generation reproduction 77-706-0	NOEL<0.5 mg/kg/day (5 ppm[1]) (decreased pup survival, delay in eye-opening)
Mouse Teratogenic effects test 76-723-3	LEL=0.2-0.4 mg/kg/day (2-4 ppm[1])
Mouse Terat. with photodegradate 84-722-1	NOEL=0.05 mg/kg/day (0.5 ppm[1]) LEL=0.1 mg/kg/day (1 ppm[1])
10-day oral pregnant mouse test 77-717-1	NOEL=0.05 mg/kg/day (0.5 ppm[1]) LEL=0.075 mg/kg/day (0.75 ppm[1]) (1 of 20 female mice died at both 0.1 [3 days] and 0.075 [4 days] mg/kg)

The EEB recognizes that the weanling LD50 (1.5 mg/kg) is intended to show the sensitivity of mammals still nursing and not eating treated feed items. The EEB will use the adult LD50 of 10 mg/kg for the acute concern level.

The other issue is the 10-day oral pregnant mouse test, which resulted in mice being killed at 0.075 and 0.1 mg/kg (1 of 20 at each level and no observed affects at 0.05 mg/kg/day. This effect occurred in 3-4 days. Therefore, as with the aquatic invertebrates, avermectin exerts its toxicity on susceptible organisms relatively quickly. For the sake of risk assessment, the NOEL of 0.05 mg/kg will be used as a chronic effect concern level. This was the NOEL for both the 10-day oral pregnant mouse test and the mouse teratogenic NOEL. This NOEL translates to 0.5 ppm[1] in the diet. This NOEL does not just apply to pregnant females, but to all small mammals.

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[1] Assuming a mammal consumes 10% of its body weight per day, the formula PPM = (dose mg/kg) / % of body wt. consumed per day.

Aquatic:

Runoff: To ensure that the best possible information was used to estimate exposure to aquatic organisms, the EFGWB was asked to provide an EEC. This was done using models designed to both estimate transport via runoff and the fate of avermectin once it reaches the aquatic ecosystems. An application rate of 0.02 lb ai/acre was used. In the wettest year calculation, which would be expected approximately once in 10 years, it was estimated that 0.519 grams of active ingredient (avermectin) would transport from a treated field and contaminate a pond. Using available environmental fate information on avermectin along with hydrographic parameters, the following table was generated showing the concentrations of avermectin in water and sediment over time. This reflects concentrations after one application.

	WETTEST YEAR		AVERAGE YEAR	
Time (days) after loading	Water column pptr	Benthic pptr	Water column pptr	Benthic pptr
0	295	-	6.9	-
1	231	544	5.5	12.9
4	167	1784	3.4	42.3
21	37	3555	0.9	84.2
30	23	3340	0.5	79.1
120	5	932	0.1	22.1
360	0	28	0	0.6

Typical or average year estimates are substantially lower than wettest year estimates. The loading for the wettest year was 0.519 g. The loading for the average year was 0.0123 g which is 2.37% of the wettest year loading. Therefore, all the values for the wettest year were reduced to 2.37% to produce the average year values.

The **wettest year** values exceed many aquatic organism concern levels including (values in parenthesis indicate the approximate length of time the concern level would be exceeded):

1. *Daphnia magna* lowest LC50 value: 220 pptr (about 1 day);
2. 1/2 the *D. magna* LC50: 110 pptr (12 days);
3. Shrimp LC50: 20 pptr (30-35 days);
4. *D. magna* died in 5 days: 90 pptr (about 12 days);
5. 1/10 rainbow trout ELS NOEL: 52 pptr (19 days);
6. *D. magna* chronic NOEL: 30 pptr (23 days); and
7. Shrimp chronic NOEL: 3.5 pptr (>120 days)

These effects would occur rarely and are not considered unacceptable.

The **average year** water column estimates exceed the shrimp NOEL of 3.5 pptr, and this should dissipate within 4 days to levels

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below this level. Since the between treatment interval is 21 to 30 days, this exposure would only occur every three to four weeks.

The concentrations in sediment exceed the shrimp acute LC50 of 20 pptr, and approach the level (90 pptr) which resulted in 100% mortality to Daphnia magna after just 5 days exposure. This raises a question of possible effects of sediment bound avermectin to benthic organisms. Sediment testing with Daphnia magna does not answer the question of adverse effects to benthic organisms since they do not dwell in the sediment and would not be exposed in the same manner as organisms that do occur in the sediment. Field testing is required to address this concern.

Low year estimates were significantly below the average year estimates.

Based on these estimates, it appears that avermectin under typical use conditions is unlikely to have an unreasonable impact aquatic organisms due to runoff from treated areas. Under wettest year conditions, that may occur every ten years or so, serious adverse effects to aquatic invertebrates may occur. This impact is not considered unacceptable.

Drift: Typical exposure due to drift is estimated at 5% of the application rate. The concentration in 6 feet of water from drift is estimated to be 61 pptr. This concentrations is expected to dissipate relatively quickly, representing only an acute exposure. The level in deep water exceeds the shrimp LC50 (20 pptr), 1/10 the rainbow trout ELS NOEL (52 pptr), the Daphnia chronic NOEL (30 pptr) and the shrimp life cycle NOEL of 3.5 pptr. Concentrations in shallow water (6") could reach 734 pptr. This exceeds the shrimp and dahpnia LC50's. Chronic exposure due to repeat applications is not expected since the minimum between treatment interval is 21 days for cotton and 30 days for citrus. Therefore, impact is limited to acute effects. The proposal by the registrant to limit the cotton use to areas west of the Mississippi River would reduce the potential for impact to estuarine and marine habitat. However, exposure from drift is expected to result in acute effects and field testing is required to negate this concern or to quantify the effects. This quantification is necessary for EEB to fully evaluate the actual impact of Avermectin drift to aquatic organisms.

Combining the exposure due to drift with that from runoff makes practically no difference in the conclusions. Drift still causes the majority of the exposure.

61 pptr (drift) + 6.9 pptr (runoff) = 67.9 pptr

No new concern levels are exceeded over those exceeded by drift alone.

Terrestrial:

The following theoretical values were calculated based on historical measured residue data used to generate a nomograph presented in Hoerger and Kenaga (1972)[2].

	Short Grass	Long Grass	Leafy Crops	Insects Forage	Seed Pods	Fruit
Maximum	4.8	2.2	2.5	1.1	0.2	0.1
Typical	2.5	1.8	0.7	0.6	0.06	0.03

Acute and chronic effects to birds are not expected since estimated residues do not exceed the dietary LC50 of 383 ppm or the avian reproduction NOEL of 12 ppm.

These residues do not exceed acute dietary concern levels for mammals (100 ppm[3]). These levels do exceed the level which caused mortality (1 mouse in 20 at day 4) in a 10-day feeding study (0.75 ppm) and chronic effect levels such as the rat 1-generation NOEL (1 ppm), and the mouse teratogenic LEL's (2-4 ppm). However, since retreatment is not permitted by the label from 21 days (cotton) or 30 days (citrus) and avermectin is relatively short-lived on surfaces, chronic exposure is expected to be minimal from these two uses.

Drift Study

The registrant has provided a drift study[4] in which one field was treated three times, and drift from each treatment (involving from 7 to 25 swaths) was measured at various points downwind up to 100 yards. The study has been forwarded to EFGWB for evaluation. The major drawbacks to the study was that only one field was treated and raw data were not provided, and extrapolations from log graph would be necessary to verify if the registrant used the data correctly in their conclusions. There is no way to estimate "between field" variation of drift potential and the effect of

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[2] Hoerger, F.C. and E.E. Kenaga. 1972. Pesticide Residues on Plants Correlation of Representative Data as a Basis for Estimation of Their Magnitude in the Environment. Environmental Quality. Academic Press, New York, I:9-28.

[3] Based on the LD50 of 10 mg/kg from which a 1-day LC50 can be calculated (ppm=LD50 X WT / CONS) assuming a mammal consumes 10% of its body weight per day.

[4] Riley, C.M., C.J. Wiesner and W.R. Ernst, 1989, Off-target Deposition and Drift of Aerially Applied Agricultural Sprays, Pesticide Science, Vol 26, pp 159-166.

various meteorological conditions. Further, the drift study was not conducted with avermectin.

The registrant used the study results to support their proposed buffer zones. Their rationale is presented beginning on page 3 of their 10-11-89 submission. They indicate:

> "Results from the study show that within 8 (ca. 25 feet) meters of the application area the residues were at a concentration of less than 3% of the theoretical level... At 50 meters (approx. 150 feet), the concentration of deltamethrin impacting the area averaged 0.615%."

They further indicate that the study shows that a buffer zone of 75 feet or 25 yards would reduce the immediate level of exposure to aquatic organisms to 26 pptr. A buffer zone of 150 feet or 50 yards would reduce the initial level of exposure to 9.3 ppb.

As far as EEB is concerned, the study shows that drift becomes less at distances further from the treated area; a point not contended. It is not adequate to show with any confidence that at certain specific distances the drift would be reduced to a certain amount and would thus be below concern levels. Additional drift studies at different geographical locations and under different meteorological conditions **with avermectin** would be necessary to provide such information.

Label Restrictions and Comment

The label restrictions precluded the need for mammal field testing with citrus and cotton. However, they do not eliminate the need for aquatic field testing.

Limiting the use of Zephyr on cotton to specific areas west of the Mississippi River and away from estuarine and marine areas would significantly reduce potential of exposure to estuarine organisms. However, it does not eliminate exposure to freshwater organisms.

The minimum "between treatment" intervals (21 and 30 days) will reduce the potential for chronic exposure to both aquatic and terrestrial organisms. Because of this, mammal field testing is not required.

The registrant has proposed to impose buffers (lay-off distances from aquatic habitat) on the label to reduce exposure to aquatic organisms. This, to eliminate the need for field testing. However, the EEB does not concur that buffers on Section 3 labels are a feasible risk reduction measure.

Endangered Species

Triggers:

Avian	Acute	38 ppm (1/10 LC50)
	Chronic	12 ppm (Rep. NOEL)
Mammal (reptiles and amphibians)	Acute	20 ppm (1/10 LC50[5])
	Chronic	1 ppm (NOEL[6])
Fish	Acute	0.16 ppb (1/20 LC50)
	Chronic	0.52 ppb (ELS NOEL)
Mollusks	Acute	21.5 ppb (1/20 EC50)
Terrestrial Invertebrates:	Assumed hazardous to any exposed invertebrates	

Terrestrial Exposure:

The following residues (ppm) are expected on various terrestrial food items following an application of 0.02 lbs ai/acre.

	Short Grass	Long Grass	Leafy Crops	Insects Forage	Seed Pods	Fruit
Maximum	4.8	2.2	2.5	1.1	0.2	0.1
Typical	2.5	1.8	0.7	0.6	0.06	0.03

These residues do not exceed the avian concern levels for endangered species.

These residues do not exceed the mammalian acute concern levels, but do exceed the mammalian chronic effect levels for endangered species. However, since avermectin is short-lived on surfaces and is proposed to be applied with between treatment intervals of 21 days or 30 days, chronic effects to endangered mammals, reptiles or terrestrial amphibians are unlikely.

Aquatic Exposure:

Based on modeling performed by EFGWB, the following estimates of concentration (pptr ai) were developed for a pond adjacent to a treated area.

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[5] The LD50 of 10 mg/kg is used to develop a 1-day dietary LC50 of approximately 200 ppm assuming 5% food consumption.

[6] Dietary NOEL extrapolated from 10-day oral pregnant mouse test assuming a mammal consumes 5% of its body weight per day.

Time (days) after loading	Water column	Benthic
0	6.9	-
1	5.5	12.9
4	3.4	42.3
21	0.9	84.2
30	0.5	79.1
120	0.1	22.1
360	0	0.6

The concentrations in water due to runoff and drift do not exceed the fish or mollusk endangered species concern levels. Formal consultation with the USFWS is not required.

Summary of Impacts to Nonendangered Species and Data Requirements

Effects to birds are expected to be minimal.

Acute and chronic effects to mammals are expected to be minimal.

Drift is the primary route of exposure to aquatic habitat and it expected to result in acute effects to estuarine and freshwater invertebrates. Chronic NOEL's are also exceeded. However, because treatment would only occur every 21 days or 30 days, exposure is expected to be relatively short-lived. The cotton use is limited to areas west of the Mississippi which would reduce significantly the potential for exposure to estuarine habitat. Runoff is expected to result in minimal aquatic exposure compared to drift.

The label restrictions proposed by the registrant preclude the need for mammal testing, but the aquatic field study is still required because of expected acute effects to aquatic invertebrates.

The EEB does not object to registrants voluntarily placing buffers or lay-off distances from aquatic habitat, on their labels in a conscientious effort to reduce risk. However, these will not be used in our risk assessment process to reduce the EEC or preclude field testing.

Note to PM: This review applies only to the citrus and cotton registrations. The other proposed registrations will be evaluated in separate reviews. If you have questions, contact Dan Rieder.

The fish full life cycle test is not required for the citrus and cotton use, since the between harvest interval is 21 days or greater. However, this waiver does not apply to other proposed uses with shorter between harvest intervals