US EPA ARCHIVE DOCUMENT

210767
Record No.

122804
Shaug. No.

EEB REVIEW

DATE: IN 1/07/88 OUT 3/17/88

FILE NUMBER 618-OI

DATE OF SUBMISSION 12-3-87

DATE RECEIVED BY HED 12-23-87

RD REQUESTED COMPLETION DATE 2-29-88

EEB ESTIMATED COMPLETION DATE 2-29-88

RD ACTION CODE 180

TYPE PRODUCT Insecticide/miticide

PRODUCT MANAGER G. LaRocca(15)

PRODUCT NAME Agrimec 0.15 EC (Avermectin)

COMPANY NAME Merck Sharp & Dohme

SUBMISSION PURPOSE Proposed registration of use on Citrus

SHAUGHNESSEY NO.	CHEMICAL	%AI
122804	Abamectin	

ECOLOGICAL EFFECTS BRANCH REVIEW

Avermectin

100 Submission Purpose and Label Information

100.1 Submission Purpose and Pesticide Use

The registrant, Merck Sharp and Dohme, proposes to register Abamectin for use on Citrus.

100.2 Formulation Information

Agrimec 0.15 EC is 2 % Avermectin B1, 1 gallon contains 0.15 lb. ai.

100.3 Application Methods, Direction, Rates

Apply using conventional dilute or concentrate ground sprayers. Amount applied depends on size of trees.

Crop	Pests	For dilute[1] Sprays fl oz/100 gal	For concentrate[2] Sprays fl oz/acre
Citrus	Citrus rust mite and Broad mite	1-2	5-20
	Twospotted spider mite	2	10-20

- Do not apply within 7 days of harvest
- Do not apply more than 60 fl oz per acre in any 12 month period.

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[1] Apply in 500-2000 gallons full cover dilute spray depending on tree height and planting density. Do not exceed 20 fl. oz. Agrimec per acre per application.

TREE HEIGHT	<10'	10'to 12'	14' to 16'	18' +
fl oz Agrimec/A	5 - 10	7.5 - 15	10 - 20	15 - 20
lb. ai / A	.006-.012	.009 -.018	.012 -.023	.018-.023

[2] For concentrate sprays - adjust the dosage to apply an amount per acre equal to that used in full cover dilute spray. Use 5 fl oz/acre rate only on trees less than 10 feet in height.

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Maximum application rate is 0.023 lb ai per acre, with a maximum of 3 treatments per season or 0.069 lb ai per acre.

100.4 Target Organism

Citrus Rust Mite, Broad Mite and Twospotted Spider Mite.

100.5 Precautionary Labeling

The following statement would be on the label:

"This product is toxic to fish and wildlife. Keep out of lakes, ponds or streams. Do not contaminate water by cleaning of equipment or disposal of wastes.

Do not apply when weather conditions favor drift from target areas.

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 drift to blooming crops or weeds if bees are visiting the treatment area."

101 Hazard Assessment

101.1 Discussion

Maximum application rate is at 0.023 lb. ai/acre. The maximum number of applications would be 3 per season at an unspecified interval. Citrus are grown in areas closely associated to estuarine and marine habitat. Citrus groves tend to be flat and sandy, making runoff potential negligible.

101.2 Likelihood of Adverse Effects on Nontarget Organisms

The following summarizes the known toxicity information on avermectin.

Acute Tests

Bobwhite quail	LD50>2000 mg/kg
Mallard duck	LD50= 85 mg/kg
Bobwhite quail	LC50=3102 ppm
Mallard duck	LC50= 383 ppm
Mouse	LD50= 13-23 mg/kg
Rat	LD50= 10-11 mg/kg
Nonpolar metabolite / rat	LD50> 48 mg/kg
Polar metabolite / rat	LD50>5000 mg/kg

Bluegill	LC50=9.6 ppb
Rainbow trout	LC50=3.2 ppb
<u>Daphnia magna</u>	LC50 0.22-0.34 ppb
Avermectin B1a	0.42 ppb)
Polar metabolite	4.2 ppb)
Moderately polar metabolite	6.3 ppb)
	> degradates of abamectin
Nonpolar metabolite	25.4 ppb)
Thin-film polar metabolite	76.7 ppb)
8 a-hydroxy avermectin B1a	25.5 ppb)
Mysid shrimp	LC50= 0.2 ppb
Sheepshead minnow	LC50= 15 ppb
Oyster embryo-larvae	LC50= 430 ppb
Earthworm (<u>Eisenia foetida</u>)	LC50= 18 ppm 28-day 33 ppm 14-day 62 ppm 7-day
<u>Chronic Tests</u>	
Rat 1-generation reproduction 77-712-0	NOEL=0.1 mg/kg/day (0.5 ppm[3]) LEL=0.2 mg/kg/day (1 ppm[3])
Rat 1-generation reproduction 77-706-0	NOEL<0.5 mg/kg/day (2.5 ppm[3]) (decreased pup survival, delay in eye-opening)
Mouse Teratogenic effects test 76-723-3	LEL=0.2-0.4 mg/kg/day (1-2 ppm[3])
10-day oral pregnant mouse test 77-717-1	NOEL=0.05 mg/kg/day (0.25 ppm[3]) LEL=0.075 mg/kg/day (0.375 ppm[3])
Mouse Terat. with photodegradate 84-722-1	NOEL=0.05 mg/kg/day (0.25 ppm[3]) LEL=0.1 mg/kg/day (0.5 ppm[3])
Avian reproduction test	NOEL=12 ppm LEL=64 ppm (reduced egg prod.)
<u>Daphnia magna</u> life-cycle	MATC >0.03<0.09 ppb (all dead by day 5 at 0.09 ppb)
Rainbow trout early life stage	MATC >0.52<0.96 ppb

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[3] Assuming a small mammal consumes 20% of its body weight per day. Many mammals such as voles, mice, rats and shrews commonly ingest at least 20% of their weight per day. Exposure may also occur through other routes such as grooming and licking fur or feet.

Summary of Environmental Fate Information

(From Draft Pesticide Fact Sheet No. 84 for Avermectin B1)

Solubility:	7.8 ppb
Octanol/Water Partition Coefficient:	9.9×10^3
Photolyses:	$t^1/_2 < 1$ day
Hydrolysis:	minimal
Soil metabolism:	Aerobic $t^1/_2$ approx. 2 months Anaerobic is slower
Leaching tendency:	minimal
Accumulation:	Bluegill 69X whole fish 30X fillet 110X viscera

An aquatic degradation and fate study[4] indicated that once it reaches aquatic habitat, abamectin will bind to sediment and dissipate from the water column generally within two weeks. However, once in sediment, it may persist with an approximate maximum half-life of 52 days.

Terrestrial Exposure

If abamectin is applied at 0.023 lb. ai/acre, the following residues may occur on terrestrial food items.

	Short Grass	Long Grass	Leafy Crops	Insects Forage	Seed Pods	Fruit
Maximum	5.5	2.5	2.9	1.3	0.3	0.2
Typical	2.9	2.1	0.8	0.8	0.07	0.03

The registrant has provided residue data on cotton, celery and citrus fruits. The treatment rates were varied, however, the following table provides extrapolated residue values (ppm) as if the application rates were all 0.023 lb. ai/acre. The levels on citrus were all less than 0.003 ppm.

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[4] Wislocki, Peter. Degradation of Abamectin in a Field Study Simulating Both Drift and Runoff. Report date September 23, 1986; Accession Number 400696-10

1984 cotton	after day	1985 cotton	after day	celery	after day
1.33	0	2.68	0	0.07	0
0.10	2	0.13	3	0.02	1
0.06	4	0.13	6	0.01	3
0.03	9	0.03	17	0.007	5
0.02	16	0.007	34	0.003	7
0.007	32			0.001	14

The values on celery (presumably stalks) and citrus are low, as would be expected on large fleshy plant material. The celery levels are between the typical and maximum residues in the fruit column from Kenega's nomograph. The residues on cotton foliage approach the maximum estimated residues on leafy crops. Therefore, the estimated residues on grasses are assumed to be accurate. Since multiple applications are permitted on the label chronic exposure is possible. However, rapid degradation in light ($t^1/_2$ < 1 day) should preclude accumulation on food items between treatments.

Birds

These residues do not exceed the lowest avian dietary LC50 of 383 ppm nor the avian reproductive NOEL of 12 ppm. Therefore, no acute or chronic hazard to birds is expected.

Mammals

Using an acute oral LD50 of 10 mg/kg for adult rats the following 1-day adult LC50 values (ppm) were calculated[5] for selected mammals. The weanling 1 day LC50 values were based on a 1.5 mg/kg LD50 for weanling rats. The third column in the table is the extrapolated reproductive LEL's (ppm) based on the rat 1-generation reproductive test[6]. The weight and food consumption data are from Davis and Golly (1963).

Grazing Herbivores	1 day LC50 (ppm) adult	weanling	Rep. LEL (ppm)
Meadow vole	16	2.5	0.8
Swamp rabbit	24	3.6	1.6
Deer	412	61.4	25.0

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[5] LC50 (ppm) = LD50 X wt (g) / consumption in one day (g).

[6] Reproductive NOEL (ppm) = rat NOEL X wt (g) / consumption in one day (g). LEL=0.5 mg/kg/day; decreased pup survival (76% compared to 98% in controls).

Granivores			
Red squirrel	142	21.3	7.1
Omnivores			
Deer mouse	51	7.7	2.5
Marsh rice rat	218	32.6	12.5
Raccoon	470	70.8	25.0
Insectivores			
Least shrew	9	1.4	0.45
Carnivore			
Least weasel	40	6	0.4

The extrapolated adult LC50's are not exceeded by the estimated residues on terrestrial food items. The estimated residues on short and long grass and leafy crops equal or exceed the LC50 for weanling meadow voles. Therefore acute effects may occur to certain young mammals. Based on the extrapolated reproductive NOEL's, it is likely that when ingesting food items containing typical residues, grazing herbivores, omnivores, and insectivores of small size would receive greater than their reproductive NOEL. Granivores and carnivores would not likely ingest food with residues greater than their reproductive NOEL. Based on this, it is likely that the use of Abamectin at 0.023 lb. ai/A would cause acute effects to young grazers and chronic effects may occur to certain grazing herbivores, omnivores and insectivores. Even though avermectin is relatively short-lived in light, it is likely that small mammals will experience adverse effects because of multiple applications and high toxicity. Further, the photodegradate causes mammalian teratogenic effects at lower levels than the parent. Field testing is required to determine if reduced reproduction effects observed in the laboratory will occur in the field.

Aquatic

Because of its low solubility (7.8 ppb), high octanol water partition coefficient (9.9 X 10_3), and the flat sandy soil in which citrus is grown, minimal transport of abamectin by runoff is expected. Exposure to aquatic and estuarine organisms is possible through drift. The application rate is 0.023 lb. ai per acre. It is assumed that 5% of the sprayed pesticide would drift.

0.023 lb. ai/A X 0.05 (%) = 0.001171875 lb. ai/A drifts

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water depth	concentration (ppb)
6'	0.071
3'	0.143
1'	0.431
6"	0.86

These levels are greater than the aquatic invertebrate chronic NOEL of 0.03 ppb. The concentrations in shallow water (up to 1 foot) would exceed the Daphnia magna and shrimp LC50's (0.22-0.34 and 0.2 ppb, respectively). They also approach or exceed the rainbow trout chronic NOEL. These concentrations do not exceed the fish or oyster acute effect levels.

Rainbow trout LC50=3.2 ppb
Rainbow trout early life stage NOEL=0.52 ppb

Summary

Based on the above assessment, aquatic or estuarine invertebrates will experience acute and chronic effects. Risk to nonendangered fish will be minimal. This assessment does not take into account the new and unvalidated test results suggesting that abamectin is substantially more toxic to shrimp than previously thought[7]. Before EEB can complete risk assessments for aquatic organisms, further information on these tests will be required. Aquatic field testing will be required also.

Nonendangered birds will experience minimal acute and chronic effects. Neither acute nor chronic risk to large mammals or granivores and carnivores is expected. However, weanling rodents (meadow voles) may experience acute and chronic effects, and grazing herbivores, omnivores and insectivores of small size would receive greater than their reproductive NOEL. This use of abamectin represents a hazard to these mammals and possibly certain exposed reptiles and terrestrial amphibians. Terrestrial field testing would be required before EEB could conclude safety from such exposure.

101.3 Endangered Species Considerations

The endangered species triggers are:

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[7] See review dated 12-30-87, 96-hour flow-through LC50's of 51 and 11 ppt were reported. No information on the test was provided.

Group	Trigger Rep. NOEL	Acute
Birds	12 ppm	38.3 ppm (LC50 / 10)
Mammals, Reptiles & Terr. Amph.	0.09 ppm	0.14 ppm (LC50 / 10)
Fish	0.52 ppb	0.32 ppb (LC50 / 20)
Aquatic inv.	0.03 ppb	0.022 ppb (LC50 / 20)
Mussel	not avail.	21.5 ppb (LC50 / 20)

Terrestrial

Estimated residues on terrestrial food items are:

	Short Grass	Long Grass	Leafy Crops	Insects Forage	Seed Pods	Fruit
Maximum	5.5	2.5	2.9	1.3	0.3	0.2
Typical	2.9	2.1	0.8	0.8	0.7	0.03

Maximum residues do not exceed the avian endangered species triggers. Direct adverse effects to endangered birds are not expected. Adverse effects to birds feeding on aquatic invertebrates are considered likely because of reduced food supply. This could result in effects to the everglades kite. Adverse effects to fish populations are expected to be minimal, therefore, fish-eating birds (bald eagle and wood stork) are not expected to be impacted.

Maximum residues do exceed both the mammalian acute and chronic triggers. Adverse effects are expected to occur to endangered mammal (and reptile) species exposed to abamectin. Such exposure could occur through ingestion of treated material. This would include grazing herbivores, omnivores, insectivores and granivores. It is not likely to include carnivores (reptile or mammalian), since abamectin does not have a high bioaccumulation factor (69X: whole fish, 30X: fillet, 110X: viscera).

In Florida, the susceptible endangered mammals[8] are not known to occur near citrus groves.

Aquatic

The estimated concentration in water adjacent to a treated citrus grove would occur from drift.

0.023 lb. ai/A X 0.05 (5%) = 0.001171875 lb. ai/A drifts

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[8] Key deer, Choctawhatchee beach mouse, Perdido Key beach mouse, Key Largo cotton mouse and Key Largo woodrat.

Chronic exposure is possible, since multiple applications are permitted.

water depth	concentration (ppb)
6'	0.071
3'	0.143
1'	0.431
6"	0.86

The estimated concentrations at all water depths exceed the acute and chronic aquatic invertebrate triggers. The concentrations in shallow water exceed the fish acute trigger (1 foot) and chronic trigger (6 inches). This could effect endangered fish reproduction if exposure occurred.

Based on the Oyster embryo-larvae EC50 of 430 ppb, effects to endangered mussels are unlikely. In addition, no endangered mussels are known to occur near citrus growing areas.

Summary

Adverse effects to endangered birds are not expected. Adverse effects to exposed endangered mammals, invertebrates and fish may occur.

101.4 Adequacy of Data

The available data were inadequate to quantify the risks of this proposed registration to both aquatic and terrestrial organisms.

Since the Cotton review, the Agency has become aware of additional test results suggesting that Avermectin is much more toxic to shrimp than originally thought. These data were not used to evaluate this proposed registration on Citrus because they have not been validated. The EEB cannot complete a risk assessment for citrus and other major uses until additional data have been provided and the question of toxicity to aquatic organisms in general has been adequately researched. Such testing will involve a fish full life cycle test. This test is required since Avermectin is likely to drift into water at levels exceeding 0.1 the fish early life stage NOEL. Furthermore, it will persist for several months in sediment (t1/2=52 days), and it has teratogenic effects on mammals at low level. The effects to mammals suggest avermectin may affect reproduction of other organisms. Finally, aquatic field testing is required to determine effects to fish and invertebrates and if the sensitivity potentially demonstrated by shrimp is shared by other

estuarine or freshwater species. This should include both mesocosm testing and estuarine studies.

Additional chronic mammalian test results have also recently been reviewed showing that avermectin and its photodegradate affect mouse and rat reproduction at levels likely to be experienced in the field by wild mammals. Field testing is required to quantify the affects of Avermectin on wild mammals.

101.5 Adequacy of Labeling

Minor changes in the labeling are required. It should read:

"This pesticide is toxic to fish and wildlife. Do not apply directly to water or wetlands (swamps, bogs, marshes and potholes). Do not contaminate water when disposing of equipment wash water.

Do not apply when weather conditions favor drift from target areas.

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 drift to blooming crops or weeds if bees are visiting the treatment area."

103 Conclusions

The EEB has reviewed the proposed use of Abamectin on Citrus. Based on available information, EEB concludes that this use is likely to result in acute and chronic adverse effects to mammals and aquatic invertebrates. Adverse effects to endangered species are also anticipated. Formal consultation (Section 7, Endangered Species Act) with the Fish and Wildlife Service is required and will be initiated when acceptable field test results have been submitted and reviewed.

Additional data are required to more adequately define the hazards to mammals and aquatic invertebrates such as:

1. Field testing to determine acute and chronic effects on wild mammals. This would involve studying multiple plots to determine acute and chronic effects to small mammals. It is possible that such a study could be designed to address more than one use site;

2. Shrimp life cycle study as well as additional information on the data submitted previously concerning the acute toxicity of Abamectin to shrimp. The EEB understands that the registrant is in the process of performing the shrimp life cycle test;

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3. Fish full life cycle test is required since the EEC exceeds 0.1 the NOEL for the fish early life stage test and avermectin has been shown to have teratogenic effects on mammals and reproductive effects on birds at low levels; and

4. Aquatic field studies to determine effects of Abamectin in aquatic habitats. This study should focus on acute and chronic effects to aquatic invertebrates and chronic effects to fish. It should include residue analysis of organisms as well as measuring individual and population effects. Multiple site estuarine testing is also required to determine the effect of avermectin on populations of shrimp and other estuarine organisms adjacent to citrus groves and other uses adjacent to estuarine habitats.

It is recommended that the registrant submit protocols for both the terrestrial and aquatic field testing.

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