090201
Shaughnessy Number

Completed 5/16/84 [signature]

EEB Chemical Profile

Carboxin

100 Fish and Wildlife Toxicity

100.1 Basic Requirements

100.1.1 Avian Acute Oral LD_{50}

Species	T.M.	Results	Category	EEB File Date Reference
Mallard duck	99%	6094.2 mg/kg	Core	5/10/82
Bobwhite quail	Vitavax SP Captan 38.7% Carboxin 37.5% Captan	10 g/kg	Supp. No raw data	4/25/84
Bobwhite quail	Vitavax SP Thiram 17% Carboxin 17% Thiram	2.41 g/kg	Core for formulation	4/25/84

100.1.2 Avian Dietary LC_{50}

Mallard duck	99%	>4640 ppm	Core	4/25/84
Bobwhite quail	99%	>10,000 ppm	Core	5/10/82
Bobwhite quail	75%	>5620 ppm	Core formulation	4/25/84

100.1.3 Fish Acute LC50

Bluegill	D-735 (tech. carboxin)	>562 ppb	Suppl.	4/25/84
Rainbow trout	D-735	>100 ppb	Suppl.	4/25/84
Rainbow trout	99%	2 ppm	Core	5/10/84
Bluegill	99%	1.2 ppm	Core	5/10/84
Rainbow trout	75%	4.5 ppm	Invalid polyethylene liners	4/25/84
Bluegill	75%	2.9 ppm	"	4/25/84
Rainbow trout	Vitavax SP 75% a.i.	4.5 ppm	Core	4/25/84
	Vitavax SP/Captan*	6.6 ppm	Core (formulation)	
	Vitavax SP/Thiram**	0.38 ppm	Core (formulation)	
Bluegill	Vitavax SP 75% a.i.	2.9 ppm	Core	
	Vitavax SP/Captan*	11.2 ppm	Core (formulation)	
	Vitavax SP/Thiram**	0.56 ppm	Core (formulation)	

* 38.7% Carboxin and 37.5% Captan

** 17% Carboxin and 17% Thiram

100.1.4 Aquatic Invertebrates

No study

100.2 Beneficial Insects LD50

Honey bee	Technical D-735	2.0	Core	4/25/84

100.3 Additional Aquatic Laboratory Tests

Fiddler crab	% unknown	964 ppm	Invalid	4/25/84
Pink shrimp	"	14 ppm	"	"

101 General Toxicology

Rat	75%	>2000 mg/kg	?	1/12/82
Rat	Tech.	>3820 mg/kg	?	"
Rat	Pro-Flo Vitavax	> 5 g/kg	Core	6/3/80
Rat	D-735	3.82 g/kg	?	9/29/77
Rat	"	20,000 ppm		"
Rat	?	90-day NEL 200 ppm		2/5/80
Rat	"	2 yr NEL 200 ppm		"
Rat	"	2 yr NEL 600 ppm		"
Rat	"	3 gen. NEL 200 ppm		"

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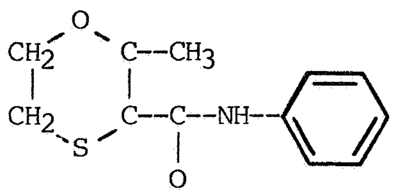
102 Chemical and Physical Properties

102.1 Chemical Name

Carboxin [5,6-dihydro-2-methyl-1,4-oxathiin-3-carboxanilide]

102.2 Structural Formula



102.3 Common Name

Carboxin

102.4 Trade Name

Vitavax D-735

102.5 Molecular weight

235

102.6 Physical State

--off-white crystals
--ordor is faint
--low volatility
--melting point range of the two different crystal stuctures:

a. 91.5 - 92.5°C
b. 98.0 - 100.0°C

--flash point 203°C (COC)
--bulk density 40-45 lbs/ft^3

102.7 Properties

102.7.1 Solubility (Grams of solute/100 grams of solvent at 25°C)

A.	Distilled water	0.017 (170 ppm)
B.	Benzene	15
C.	Dimethyl sulfoxide	150
D.	Acetone	60
E.	Methanol	21
F.	Ethanol	11

102.7.2 Octanol Water Partition Coefficient

Not in file

102.7.3 Soil Adsorption Coefficient Kd

Freudlich adsorption coefficient was K = 0.78
Calculated desorption coefficient was K = 1.10

103 Behavior in the Environment

The following information is directly from the Registration Standard Environmental Fate Profile, see it for references.

103.1 Soil

"Carboxin was degraded in aerobic soil. The half-life of carboxin was less than one day in loamy sand and silt loam soil, and less than three days in sandy soil, with more than 95 percent of the applied carboxin being degraded within seven days. The major degradation product was carboxin sulfoxide, which represented 31-54 percent of the applied radioactivity at seven days after treatment. Carboxin sulfoxide residue levels declined to 28-49 percent and 19 percent of the applied radioactivity at 30 and 154 days after treatment, respectively. Several minor degradation products were also formed (carboxin sulfon, p-hydroxy carboxin sulfoxide, p-hydroxy carboxin, and $^{14}CO_2$. Carboxin was degraded in sterile soil but at a much slower rate than in nonsterile soil (46-72 percent degraded in seven days). This indicated that the soil metabolism of carboxin under aerobic conditions was both a microbial and chemical process. Carboxin sulfoxide and carboxin sulfone were stable under anaerobic conditions (Chin et al., 1972, MRID 00002935; Chin et al., 1969, MRID 00003041; Chin et al., 1970, MRID 05002176; Chin et al.,1970, MRID 05004996; Dzialo and Lacadie, 1978, 1978, MRID 00003225; Dzialo et al., 1978, MRID 00003226; and Spare, 1979, MRID 00005540)."

"Both carboxin and carboxin sulfoxide were mobile in soil, with about half of the applied ^{14}C carboxin leaching through the twelve inch column of clay loam soil (Lacadie et al., 1978, MRID 00003227 and Dannals et al., 1976, MRID 00003114). Lacadie et al. (1978, MRID 00003229) found that radiolabeled carboxin aged in sandy soil was mobile. Approximately 17 percent of the applied radioactivity was recovered in the leachate from a twelve inch soil column. One-third of the radioactivity was in the top three inches and one-fourth was in the three to six inch segment of the soil column. Carboxin, carboxin sulfoxide and carboxin sulfone were identified in the leachate and accounted for 0.3, 3.3 and 0.5 percent respectively of the applied radioactivity.

Smyser (1979, MRID 00005541) found that there is a low potential for carboxin adsorption to a sandy loam soil (Freundlich adsorption coefficient was K=0.78). The calculated desorption coefficient was K=1.10.

A simulated field dissipation study was conducted by Cardona et al. (1976, MRID 00003087). One month after a sandy loam soil was treated with radiolabeled carboxin (1 lb./acre) only 4 percent of the applied carboxin had not degraded.

The major degradation products were carboxin sulfoxide (31-33 percent) and an unidentified compound II (6-18 percent). Two months after treatment the carboxin could not be detected and only 4 percent of the sulfoxide and 2-3 percent of compound II remained. After one year, approximately 75-80 percent of the radioactivity remaining was found in the top six inches. Leaching to at least 11 inches was indicated by the detection of radioactivity at that depth. The detection of the compound, its metabolites, or degradation products at a depth of 11 inches one year after application indicated that carboxin aged residues were persistent and mobile."

103.2 Water

"In aqueous solution (under UV light and in the dark) carboxin was oxidized to carboxin sulfoxide, carboxin sulfone, and two unidentified compounds (A and B). The photolytic half-life was less than four hours. After seven days of irradiation in aqueous solution, 40 and 9 percent of the exposed ^{14}C carboxin was present as the unidentified compounds A and B, respectively. Fourteen days later, 57 percent of the radioactivity was present as compound A and 19 percent as compound B. Formation of compound A was accelerated in a 2 percent acetone-water solution (Smilo, 1977, MRID 00003088)."

103.3 Plant

"Dannals et al. (1976, MRID 00003114) found ^{14}C residues in wheat (seed), beets (top and root) and lettuce planted in a sandy loam soil four month after treated with ^{14}C-carboxin at 1 lb. a.i./acre. The concentration of oxathiin-labeled residues present in those crops were 1.5-60 times higher than the concentration of aniline-labeled residues.

A field study by Uniroyal Chemical (1978, MRID 00003224) showed that carboxin residues were not taken up in turnip roots planted 59 days after treatment with carboxin (Vitavax® 3F). Carboxin residues were less than 0.2 ppm, the sensitivity of the method used, in turnip greens and rye seed planted after treatment. However, the analytical method was not sensitive enough to determine conclusively that residues less than 0.2 ppm were not taken up by rotational crops."

103.4 Animal

"Bluegill sunfish exposed to carboxin at a constant concentration of 0.012 ppm for 30 days accumulated the compound at 0.50 ppm with a bioaccumulation factor of 45. A plateau was not reached during the 30-day exposure period, thus indicating that there is a potential for carboxin residues to accumulate in sunfish. Residue levels were increasing at the end of the exposure period, indicating that continued uptake of ^{14}C residues could occur because carboxin oxidative products (carboxin sulfoxide and carboxin sulfone) are stable and persistent in water and probably would be available for uptake (accumulation) beyond 30 days. After a 14-day depuration period, 23 percent (0.11 ppm) of the maximum ^{14}C residue levels remained in the sunfish (Kuc and Doebbler, 1979, MRID 00005544). Catfish exposed to carboxin and its aged residues at 0.05 ppm accumulated 0.36 ppm with a bioaccumulaton factor of 5 after exposure for 22 days. The ^{14}C residue levels in the whole fish tissue had declined by approximately 15 percent (to 0.31 ppm) at 30 days.

After a 14-day depuration period, 32 percent (0.12 ppm) of the maximum ^{14}C residue levels in catfish remained (Kuc and Doebbler, 1979, MRID 00005545). Since 40-80 percent of the residues in the bluegill sunfish and over 50 percent of the residues in the catfish were unextractable, the identity of the unextractable compounds cannot be established."

103.5 Microorganisms

"Carboxin was oxidized to carboxin sulfoxide and carboxin sulfone by flavin enzymes found in fungal mitochondria. The fungus Ustilago maydis and isolated mitochondria from Trameters versicolor and Aspergillus niger were capable of oxidizing carboxin to carboxin sulfoxide and carboxin sulfone. This reaction was accelerated under illuminated conditions. A Pseudomonas species oxidized carboxin to carboxin sulfoxide in three days and to carboxin sulfone in seven days (Balasubramanya and Patil, 1976, MRID 05006289). Carboxin sulfone was hydrolyzed to form 5,6-dihydro-2-methyl-1,4-oxathiin-3-carboxylic acid-4,4-dioxide and aniline (Lyr et al., 1974, MRID 05003852). Basillus cereus oxidized carboxin to carboxin sulfoxide and carboxin sulfone in Nile River water cocntaining added sludge (El-Dib and Aly, 1976, MRID 05003218; Bachofer et al., 1973, MRID 05005110; and Michail et al., 1975, MRID 05004129).

The effect of carboxin on microorganisms is varied. At two ppm, carboxin had a slight inhibitory effect on fungal populations for 21 days and inhibited starch degradation (33-55 percent) for three days. A severe inibitory effect on nitrification (75-85 percent) occurred from 7 to 14 days after treatment with carboxin at two ppm. This inhibition may have been due to carboxin sulfoxide since more than 95 percent of the carboxin was degraded within seven days (Spare, 1979, MRID 00005540). Carboxin at 50 ppm inhibited dehyrogenase activity in fungi 30 percent (Lyr et al., 1974, MRID 05003852).

In the laboratory, carboxin inhibited two strains of nitrogen-fixing bacteria in nutrient agar. When applied to inoculate seed at 0.1-0.2 ppm (approximate actual application rate), carboxin inhibited nodulation of soybeans inoculated with Rhizobium japonicum by up to 83 percent and completely inhibited nodulation of Vigna anguiculata inoculated with rhizobia strains CB 756 and XS 30 however, treated uninoculated seeds planted in soil containing rhizobia strains CB 756 and XS 30 produced nodules (Curley and Burton, 1975, MRID 05003947). Azotobacter chroococcum, and Rhizobium trifolii in nutrient agar were not inhibited by carboxin at two and ten ppm, respectively. Although carboxin sulfone at 25-150 ppm decreased nitogen fixation by Rhizobia trifolii 20-25 percent, it is doubtful that carboxin sulfone will be present in concentrations greater than 0.05 ppm as a result of the application of carboxin. Of the 23 common soil bacteria and fungi exposed to carboxin, only four experienced growth reductions of 20 percent or more at the lowest concentration of 2.5 ppm (Spare , 1979, MRID 000055540; El-Dib and Aly, 1976, MRID 05003218; Fisher, 1976, MRID 05002757; and Kritzman et al., 1977, MRID 05002989)."

103.6 Summary

"In summary carboxin is rapidly degraded to carboxin sulfoxide and carboxin sulfone (greater than 95 percent within seven days) by microbial and chemical processes in aerobic soil. Based on the mobility data available, carboxin was

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not tightly adsorbed to sandy loam soil and was mobile in soil columns under rapid leaching conditions, indicating a potential to contaminate ground water. Mobility of carboxin aged in soil was mitigated by its degradation to carboxin sulfoxide and carboxin sulfone. However, carboxin sulfoxide and small amounts of carboxin sulfone were mobile in soil columns, indicating their potential to reach ground water.

Carboxin severely yet briefly inhibits starch degradation and when used as a seed treatment on inoculated seeds severely inhibits formation of nodules by some strains of nitrogen-fixing bacteria. Therefore, the use of carboxin on inoculated legumes (currently used on peanuts) may have an effect on symbiotic nitrogen fixation and therefore on the amounts of nitrogen available to peanuts.

Carboxin residue levels of 0.50 and 0.36 ppm accumulated in bluegill sunfish and catfish. Carboxin sulfoxide was the major carboxin metabolite in bluegills, but the carboxin residues in catfish were not identified.

Carboxin sulfoxide was the major degradation product of carboxin in soil and water. Carboxin sulfoxide was present in aerobic soil for at least five months and was stable in anaerobic soil, Carboxin was photodegraded to carboxin sulfocide and two unidentified compounds. Carboxin sulfoxide may inhibit nitrification in soil.

Carboxin sulfone (the fungicide oxycarboxin) is a minor product of carboxin degradation. It will not be present in soil in a sufficient concentration to result in significant exposure."

103.7 Estimated Environmental Concentrations

None

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104 Uses

Taken directly from Registration Standard:

"USE SUMMARY

Carboxin is a systemic fungicide registered for use as a seed treatment for control of smuts and seed rot and seedling blight caused by Rhizoctonia solani. As a single active ingredient, use sites include barley, corn, cottonseed, oats, peanuts, and wheat. Carboxin is also registered for Special Local Needs (FIFRA section 24(c) as a combined foliar and soil application on peanuts to control Southern blight (in Alabama, Georgia, North Carolina, Okahoma, South Carolina, and Texas only).

At present six products with carboxin as the sole active ingredient are registered for use: a dust (25% a.i.); a wettable powder/dust (75% a.i.); two ready-to-use flowable liquids (34% and 17.1% a.i.); and two liquid soluble concentrates (both 29.5% a.i.). For SLN use there are two formulations registered: a 34% flowable concentrate and a 4% granular.

Current seed treatment uses and application rates, by formulation, are summarized in Table 1, and SLN combined foliar and soil application rates are summarized in Table 2, on the following pages."

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Table 1

Seed Treatment Application Rates

	RATE RANGE (oz. product/100 lb seeds)			
Formulation*	WP/D (75%)	RTU (34% & 17.1%)	D (25%)	SC/L (29.52%)
Crop				
Barley	2-3[a/]	2-3[b/]		
Corn		2-4[b/]	4-6	
Cottonseed	4-8	16[c/]		20[d/]
Oats	1-2	2-3[b/]		
Peanuts	2-6			
Wheat	2-3[a/]	2-3[b/]		

*WP/D- Wettable Powder/Dust

RTU- Ready-to-Use

D- Dust

SC/L- Soluble Concentrate/Liquid

[a/] 4 oz./100 lbs. for seed production purposes only

[b/] 34% Ready to Use Formulation

[c/] 17.1% Ready to Use Formulation

[d/] Limited by registrant to seed treatment by professional applicators only

Table 2

Foliar Application Rates on Peanuts

Formulation* State	FC (34%)	G (4%)
Alabama	3 pints/acre[a/]	
		25 lbs./acre[d/]
Georgia	3 pints/acre[a/]	
North Carolina	3 pints/acre[b/]	25 lbs./acre[d/]
Oklahoma	3 pints/acre[a/]	25 lbs./acre[d/]
	2 pints/acre[c/]	
South Carolina	3 pints/acre[a/]	
Texas	3 pints/acre[a/]	25 lbs./acre[d]
	2 pints/acre[c/]	

* FC- Flowable Concentrate

G- Granular

[a/] Mixed with 20 gallons of water and applied by ground spray

[b/] Mixed with 30 gallons of water and applied by ground spray

[c/] Applied by overhead irrigation only

[d/] Applied by air or ground broadcast

TABLE 3
Dosage Rates and Use Limitations

SITE	MAXIMUM DOSAGE	USE LIMITATIONS
Barley (grain crop)	2.25 oz. a.i./100 lb. seed	Seed treatment only
Barley (seed crop)	3.00 oz. a.i./100 lb. seed	Seed treatment only
Cotton	6.00 oz. a.i./100 lb. seed	Seed treatment only
Peanuts	4.50 oz. a.i./100 lb. seed	Seed treatment only
Oats	1.12 oz. a.i./100 lb. seed	Seed treatment only
Wheat (grain crop)	2.25 oz. a.i./100 lb. seed	Seed treatment only
Wheat (seed crop)	3.00 oz. a.i./100 lb. seed	Seed treatment only
Peanuts	1.0 lb. a.i./acre	Granular combined foliar and soil application use only.[a] Preharvest interval - 20 days.[b/]
Peanuts	16 oz. a.i./acre	Ground spray only.[a] Preharvest interval - 60 days.[c/]
Peanuts	10.9 oz.a.i./acre	Overhead irrigation only.[a] Preharvest interval - 60 days.[c/]

a/ Combined foliar and soil application to peanuts can be registered under this Standard provided (1) adequate residue data are developed to show that the present tolerance is adequate to cover the proposed use, or (2) 40 CFR 180.301 is revised to accomodate the residues occuring from the use on peanuts, peanut hulls, and peanut hay.

b/ Currently registered only as a Special Local Need (24(c)) registration in Georgia, North Carolina, Oklahoma, and Texas.

c/ Currently registered only as a SLN registration in Alabama, Georgia, North Carolina, Oklahoma, South Carolina, and Texas.

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