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(7)

EEE BRANCH REVIEW

DATE: IN 8/25/77 OUT 5/18/78 IN ____ OUT ____ IN ____ OUT ____

FISH & WILDLIFE ENVIRONMENTAL CHEMISTRY EFFICACY

FILE OR REG. NO. 1016-69 1016-78

PETITION OR EXP. PERMIT NO. 6F1849, 6F1824, 7F 1995, 7E 1996

DATE DIV. RECEIVED 8/9/77

DATE OF SUBMISSION 8/9/77

DATE SUBMISSION ACCEPTED ____

TYPE PRODUCTS(S): (I,) D, H, F, N, R, S ____

DATA ACCESSION NO(S). ____

PRODUCT MGR. NO. F. Sanders #12

PRODUCT NAME(S) TEMIK 10G and 15G

COMPANY NAME Union Carbide Corp.

SUBMISSION PURPOSE new registration - dry beans, soybeans, tobacco, pecans, oranges--amended registration - sweet potatoes

CHEMICAL & FORMULATION Aldicarb 2-methyl-2-(methylthio)propionaldehyde-O-(methylcarbamoyl) oxime

100.0 Pesticidal Use

For control of certain insects, mites, and nematodes in (1) dry beans and soybeans, (2) tobacco, (3) oranges, (4) pecans, and (5) sweet potatoes (amended use; use on sweet potatoes currently registered for Louisiana only).

100.1 Application methods, rates, directions

Refer to environmental safety reviews by R. W. Felthousen for oranges (7/6/77), dry beans and soybeans (4/9/77), and tobacco (2/15/77).

For producing pecan trees, apply 50-100 pounds of TEMIK 10G or 33-67 pounds of TEMIK 15G per acre as a 4-6 foot band along dripline on both sides of tree row by spreading granules uniformly and immediately working into the soil or by shanking 2-3 inches into the soil on 12 inches centers. For newly transplanted trees, 1-5 years old, apply 8-32 ounces of TEMIK 10G or 5-20 ounces of TEMIK 15G per tree as a side-dress to individual trees by spreading the granules uniformly around the tree and immediately working into the soil to a depth of 2-3 inches. For aphids and mites, TEMIK should be applied during the period from bud break to nut set, or about April 15 to May 15. For pecan leaf phylloxera (bud moth) apply just prior to bud break or about March 15 to April 15. Do not make more than one application per year. Do not allow livestock to graze in treated areas. Do not harvest forage or hay from treated areas.

For control of nematodes on sweet potatoes, apply at planting time 20-30 pounds of TEMIK 10G (30-44 ounces/1000 feet of row) or 14-20 pounds of TEMIK 15G (21-30 ounces/1000 feet of row) per acre based on 48 inch row spacing. Apply granules in a 12-inch band in opened row; cover immediately with soil by hilling up 8 to 10 inches. Plant in center of treated zone. Do not plant any unregistered crop within 100 days after last application. Do not make more than one application per year. Do not harvest within 120 days of application.

For all uses, deep disc any spills at row ends immediately to prevent birds from feeding on exposed granules. In irrigated areas, follow application with irrigation within one week.

100.2 Environmental Hazards Statement

Proposed label will read (This represents a wording change, not classification change for this submission):

TOXIC TO FISH, BIRDS, AND WILDLIFE

This product is toxic to fish, birds, and other wildlife. Birds feeding on treated areas may be killed. Keep out of lakes, streams, and ponds. Do not contaminate water by cleaning of equipment or disposal of wastes. Apply this product only as specified on this label.

101.0 Chemical and Physical Properties

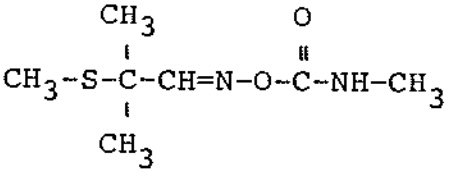
101.1 Chemical Name

2-methyl-2-(methylthio) propionaldehyde-O-(methylcarbamoyl) oxime

101.2 Common Name

Aldicarb

101.3 Structural formula



101.4 Molecular weight 190.3

101.5 Physical State

White crystalline solid with slightly sulfurous odor.

101.6 Solubility

Solvent	Percent Solubility at 10°	30°	50°
Acetone	28	43	67
Benzene	9	24	49
Carbon tetrachloride	2	5	25
Chloroform	38	44	53
Methyl isobutyl keytone	13	24	42
Toluene	10	12	33
Water	0.4	0.9	1.4

102.0 Behavior in the Environment

References: Environmental chemistry reviews (1) R. E. Ney/R. F. Carsel, 9/23/77 (dry beans and soybeans); (2) R.E. Ney/R.F. Carsel, 9/30/77 (oranges). Note: The following comments are based largely on data that environmental chemistry found inadequate to support registration. Additional data has been submitted by registrant, but environmental chemistry has not yet reviewed this data.

102.1 Soil

Aldicarb will metabolize in clay, fine sand, clay loom, and muck soils. The half-life varied from less than one week to greater than 56 days depending upon pH, moisture, organic content, and soil particle size. Aldicarb exhibits volarility and soil binding. Organic matter plays a significant role in the soil fate of aldicarb.

Leaching depends on the soil type, particularly organic matter. E.C. is satisfied that the parent and toxic sulfoxide leached, but data was inadequate to say more than that.

In field dissipation studies, aldicarb had an extrapolated t 1/2 of approximately one week, while the aldicarb sulfoxide and sulfone had extrapolated t 1/2's of about two weeks.

Aldicarb does volatilize, with the rate depending upon soil moisture, temperature, and soil type. It did not show lethal effects on microorganisms tested, although results were based only on questionable "eye ball" methods.

102.2 Water

Aldicarb will hydrolyze at 80°C and 100°C. No hydrolysis study was submitted that tested field conditions and excluded the possibility of photolysis. No photolysis study was submitted.

102.3 Ancillary studies indicated that aldicarb is metabolized in plants primarily to the sulfoxide and an unknown. Activity was uniformly spread throughout the plant.

102.4 Animals

Ancillary studies showed laying hens to have nitrile sulfoxide, oxime sulfone, oxime nitrile, and 13 unknowns in their feces when fed aldicarb and aldicarb sulfone.

103.0 Toxicological Properties

103.1 Acute Toxicity

103.1.1 Mammal

See review by J. Edmundson 8/7/74 - Not in file

103.1.2 Bird

See validation sheet, test ES-C1

103.1.3 Fish

See review by R. W. Felthousen, 4/9/77

Test	Material	Species	Category	Results
1) 96 hr LC_{50}	10%G	Rainbow Trout	invalid	LC_{50}=0.88ppm aa.i.
2) 96 hr LC_{50}	10%G	Bluegill Sunfish	invalid	LC_{50}=0.145ppm a.i.
3) 48 hr LC_{50}	98%	Goldfish	invalid	LC_{50}=8.3ppm
4) LC_{50}	unknown	Bluegill Sunfish	invalid	LC_{50} was not reported

Note: Studies 1) and 2) were resubmitted with the current data, with no changes. They are still invalid because the granules settled to the bottom. This reviewer notes also that tests were run on 10G product rather than technical grade.

103.1.4 Aquatic invertebrates

See validation sheets, tests ES-H1, H2, H3

103.1.5 Phytotoxicity

1. Spurr H. W., Jr. and A. A. Seusa, 1974. Potential interactions of Aldicarb and its metabolites on non-target organisms in the environment J. Environ. Qual. 3:130-133

   At 50 lb ai/acre, a dosage rate of 5 to 20 times permitted, no phytotoxic responses were noted for the following plants:

   Phasealus vulgaris L. (bean)
   Zea Mays L. (corn)
   Lycopersicon esculentum mill (tomato)
   Gossyplum hirsutun L. (cotton)
   Solium perenne L. (perennial ryegrass)
   Setaria itálica L. (pearl millet)
   Amaranthus retroflexus (red root pigweed)
   Brassica pincea var. foliosa (mustard)

2. Woodham, E.W., R. G. Reeves, and R.R. Edwards. 1973. Total toxic aldicarb residues in weeds. grasses. and wildlife from the Texas high plains following a soil treatment with the insecticide. J. Agr. Food Chem. 21:604-607.

   Aldicarb was found to leach from treated fields to untreated areas (dryland fields)approximately 12-13 feet. However, adjacent fields contained no aldicarb as determined by measuring plant residues. No phytotoxic responses were mentioned to occur in these tests.

3. Union Carbide Corp. 1975. TEMIK Aldicarb Pesticide. Technical Info. Bull 64 pp.

   Union Carbide and independent researchers have tested the effect of aldicarb on over 240 plant genera and have stated that where aldicarb was used according to labelled directions, the plants were tolerant to aldicarb. The 240 genera include crops, (annual and perennial including trees) and various ornamentals some of which are extremely sensitive phytotoxic indicator plants. Where injury does occur, it has been caused by concentrating granules near the seeds or roots or by overdosing. Phytotoxicity is characterized by marginal necrosis, chlorosis and resultant plant stunting. Soil condition may enhance the phytotoxic response such as with cotton at rates above 1 kg ai/ha in cold, wet soils.

103.1.6 Beneficial Insects

1. Effects on Beneficial Insects (Reference: initial Scientific and Minieconomic review of Aldicarb. US EPA (OPP-CE) 540/1-75-013. Mar., 1975)

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Bees - Bailey and Swift (1968)[1/] classify aldicarb as "highly toxic" to honey bees, based on laboratory and field tests conducted in California on alfalfa, cotton, citrus, ladino clover, and sweet corn.

The comparative toxicity of aldicarb to honeybees (Apis mellifera) was evaluated in a laboratory test at 48 hr. with 80° F temperature and a relative humidity of 65% (Atkins et al, 1973)[2/]. The LD_{50} was found to be 0.285 ug/bee with a slope value of 5.64 probits.

Morefield (1974)[3/] reported that aldicarb was highly toxic to worker honeybees by topical application of technical active ingredient. However, when granular aldicarb is applied to the soil, direct exposure to bees is eliminated. In field studies with seed alfalfa in California, no mortality occurred to bees or their colonies from foraging on blooming alfalfa for 2 weeks after the crop had been side-dressed with aldicarb at the rate of 2.7 lb AI per acre.

1/ Bailey, J.B., and J.E. Swift, "Honeybees and other Pollinating Insect Losses," Pesticide Information and Safety Manual, University of California, Division of Agriculture Sciences, pp. 7-10 (1968).

2/ Atkins, E.L., E.A. Greywood, and R.L. MacDonald, "Toxicity of Pesticide and Other Agricultural Chemicals to Honeybees," University of California Extension Laboratory Studies (1973).

3/ Moorefield, H.H. (Union Carbide Corporation), Data on Temik Aldicarb Pesticide Environmental Impact, personal communication (1974).

Mizuta and Johansen (1972)[1/] investigated the hazard of aldicarb and several other plant-systemic insecticides to nectar-collecting bees. In the greenhouse, alfalfa leaf cutting bees (Megachile rotundata) were exposed to white sweet clover (Melilotus) treated with aldicarb at the (unspecified) standard field dosage rate. In field tests, honeybees (Apis mellifera) were exposed to birdsfoot trefoil (Lotus sp.) treated with aldicarb at the recommended rate. There are no hazards to the bees from nectar of treated plants.

Morefield (1974) reported that populations of other pollinators such as bumblebees, leafcutter bees, and alkali bees do not appear to be adversely affected by the use of aldicarb as recommended on labels.

Parasites and Predators - Ridgway et al. (1967)[2/] studied the effects of in-furrow applications of aldicarb (and several other systemic insecticides) to cotton on populations of the bollworm (Heliothis zea), the tobacco budworm (Heliothis virescens) and of arthropod bollworm predators. Aldicarb 10% granular was applied on four different plots varying from 0.3-2.0 acres at the rate of 1 lb AI per acre as an in-furrow application and, in another test, as a sidedress at the rates of 0.9 and 2.2 lb AI per acre. Results indicated that populations of certain beneficials, particularly those belonging to the order Hymenoptera were significantly reduced by aldicarb treatments.

1/ Mizuta, H.M., and C.A. Johansen, "Hazard of Plant-Systemic Insecticides to Nectar-Collecting Bees," Wash. Agr. Exp. Sta. Tech. Bull. (72) (1972).

2/ Ridgway, R.L., P.D. Lingren, C.B. Cowan, Jr., and J.W. Davis, "Populations of Arthropod Predators and Heliothis spp. after Applications of Systemic Insecticides to Cotton," J. Econ. Entomol., 60(4):1012-1016 (1967).

Spiders (order Araneida) and certain groups of hymenopterous insects (families Braconidae and Ichneumonidae) were less affected. In two experiments, the number of eggs and larvae of Heliothis spp, increased as the population of predators decreased. These results demonstrated the importance of natural population of predators in suppressing populations of Heliothis spp. The mechanisms by which the beneficial arthropods are affected are not clear. They may feed on sap, pollen, or exudates from treated plants or on plant pests which feed on treated plants; and/or they may lack food because their hosts are destroyed by systemic insecticides.

Coppedge et al. (1969)[1/] applied aldicarb 10% granular as a side-dressing to 4- to 5-acre plots of cotton for the control of overwintered boll weevils (Anthonomus grandis). Rates of active ingredient application were 1 lb/acre; 2 lb/acre; 1 lb/acre + 2 lb/acre 10 days later; and 2 lb/acre + 2 lb/acre 9 to 10 days later. Treated plots were sampled for beneficial insects, including eight species of insect predators and spiders. Insect predators monitored in treated and untreated plots included the genera Notoxus, Hippodamia, Scymnus, Collops, Nabis, Geocoris, Orius, and Chrysopa. The average number of beneficial insects and spiders found per 400 ft of row in the treated plots was inversely related to the dosage of aldicarb used. An average of 13.4 beneficial insects and 3.4

1/ Coppedge, J. R., D. A. Lindquist, R. L. Ridgway, C. B. Cowan, and L. A. Bariola, "Sidedress Applications of Union Carbide UC-21149 for Control of Overwintered Boll Weevils," J. Econ. Entomol., 62(3):558-565 (1969).

spiders/400 ft of row were counted in the plot that received 2 + 2 lb aldicarb per acre, compared to 34.2 beneficial insects and 6.7 spiders in the untreated plots. More bollworms (Heliothis zea) and tobacco budworms (Heliothis virescens) were found in the treated than in the untreated plots.

Bariola et al. (1971)[1/] conducted large-scale field tests of four different farms varying from 10-40 acres with soil-applied aldicarb for suppression of the boll weevil (Anthonomus grandis) in northern Texas. Aldicarb 10% granular was applied at the active ingredient rate of 1 lb/acre in-furrow at planting time; 2 lb/acre sidedressed when cotton plants began to square; 2 lb/acre sidedressed when plants began to square + 2 lb/acre 10 to 14 days later. The aldicarb applications reduced populations of adult boll weevils 94 to 96% until late August when there is extensive seasonal movement, of boll weevils from untreated cotton. This would effect the results of the aldicarb treatment. Populations of bollworms (Heliothis spp.) increased in most aldicarb-treated plots. The in-furrow aldicarb treatment at planting resulted in an average increase of bollworm larvae of 17%; one sidedressing, 141%; two sidedressings, 126%. These increases in bollworm larvae appeared to be with reductions in the numbers of insect predators. There was also some reduction in the numbers of beneficial spiders.

1/ Bariola, L. A., R. L. Ridgway, and J. R. Coppedge, "Large-Scale Field Tests on Soil Applications of Aldicarb for Suppression of Populations of Boll Weevils," J. Econ. Entomoll, 64(5):1280-1784 (1971.

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Cate et al. (1972)[1/] studied the toxicity of aldicarb (and several other insecticides) applied topically and orally to an ichneumonid parasite (Campoletis perdistinctus). Eighty-eight trials using 10 adult C. perdistinctus per cage were placed in the greenhouse on individual flowering cotton plants treated with the pest insecticides. When aldicarb was applied to the stem of the cotton plants at the rate of 10 mg active ingredient per plant, the plants remained toxic to the parasite for more than 21 days. When adult C. perdistinctus were confined in petri dishes on leaves taken from cotton plants treated with aldicarb by soil application at the rate of 34 mg active ingredient per plant, there was 80% mortality 3 days after treatment, 42% after 7 days, and 9% after 14 days. Leaves taken from plants that had received a stem application of aldicarb at the rate of 10 mg active ingredient per plant resulted in 5% mortality 3 days after treatment; 6% mortality 7 days after the treatment (the latter two values not significantly different from parasite mortality in the untreated controls at the 5% level. Nectar collected from greenhouse grown cotton plants treated with aldicarb via the soil at 34 mg active ingredient per plant produced more than 50% mortality of adult C. perdistinctus for at least 7 days after treatment, while stem application of aldicarb at 10 mg active ingredient per plant produced 26 to 28% mortality 3, 7, and 14 days after treatment. In field tests, one aldicarb sidedress application of 2 lb AI per acre produced 18% mortality of adult C. perdistinctus cages on treated plants 3 days after treatment, and 100% mortality of adults offered nectar of treated plants 3 days after treatment.

2/ Cate, J. R., Jr., R. L. Ridgway, and P. D. Lingren, "Effects of Systemic Insecticides Applied to Cotton on Adults of an Ichneumonid Parasite, Campoletis perdistinctus," J. Econ. Entomol., 65(2):484-488 (1972).

Kinzer et al. (1974) studied the effects of aldicarb applications to cotton on populations of the bollworm (H. zea), the tobacco budworm (H. virescens) and eight arthropod predators, including largely the same species as monitored by Coppedge et al. (1969). Aldicarb 10% granular was applied in-furrow, or as one or two side-dressings; the total amount of active ingredient applied ranged from 1.7 to 2.2 lb/acre. In three field tests, the arthropod predator populations were reduced following these applications. However, at the time of the Heliothis infestations, the reductions in arthropod predator populations did not seem great enough to cause the Heliothis increases that occurred. Results of a field-cage test indicated that tobacco budworm moths, when given a choice between aldicarb-treated and untreated cotton plants, preferred to oviposit on the treated cotton. The authors concluded that reduced arthropod predator populations following aldicarb treatments do not appear to be the sole factor causing Heliothis increases. The increased Heliothis oviposition on aldicarb-treated cotton coupled with reduced arthropod predator populations coupled with reduced arthropod predator populations could greatly increase Heliothis populations on cotton treated with aldicarb.

Further studies on the effects of aldicarb on beneficial insects have been reported (Morefield (1974).

T. R. Pfrimmer, Stoneville, Mississippi, applied aldicarb granules with the seed at planting time to cotton at rates of 0.1 to 1.0 lb active ingredient per acre without diminishing beneficial insect populations. C. B. Cowan, Waco, Texas, applied aldicarb at 0.6 and 1.0 lb active ingredient per acre at planting, followed by 0.6 lb active ingredient per acre sidedressed at the four-leaf stage of cotton, 8 weeks after planting. The numbers of predators and parasites were not adversely affected. R. L. Hanns, at College

Station, Texas, reported that more predaceous insects and spiders were in plots treated with aldicarb at the rates of 0.25 to 2.0 lb active ingredient per acre than in the checks which may have been due to the faster fruiting on the treated cotton. F. R. Gilliland reported that populations of beneficial insects on cotton in Auburn, Alabama, were depressed during early June in plots treated with aldicarb, but late in June and during July, little differences were observed between the populations of beneficials in treated versus untreated plots.

Predators that also feed on plant juices such as Geocoris, Nabis and Orius are reduced in numbers following aldicarb applications, but that the effect is transient, and that the predators frequently reestablish as the aldicarb residues dissipate to prey on insects against which aldicarb is ineffective, e.g., Heliothis and other lepidopterous genera. Coccinella, Collops, Chrysopa, and Colemegilla genera; certain members of the Reduviidae and Carabidae families; spiders; and predatory mites appear to be less affected by aldicarb. Populations of these species may temporarily decrease in numbers simply from lack of food sources. Occasionally, increases in these species have been noted if a large number of prey abound following an aldicarb application. According to Moorefield (1974), aldicarb treatments have no apparent effect on parasitic insects of the Braconidae, Encyrtidae, Eulophidae, Ichneumonidae, Pteromalidae, Scelionidae, and Trichogrammatidae families.

2. Rummel, D.R., and R. E. Reeves, 1971. Response of bollworm and predaceous arthropod populations to aldicarb treatments in cotton. J. Econ. Entomol. 64(4):907-911.

Temik 10G was applied in seed furrow at planting at 1 lb. AI/acre. Some fields received later sidedress application at 1 lb. AI/acre. Tests were run on 2 types of plantings: irrigated and dryland cotton.

Numbers of predaceous arthropods were estimated with a tractor-mounted insect collecting machine, sampling once per week for one month. Study was focussed on assumed bollworm predators.

Results

Irrigated fields:

Only Nabis sp. appeared to be much more abundant in the untreated fields than in the treated fields. The estimated number of Nabis sp. per acre was 11 fold greater in the untreated fields than in the field which received an infurrow + sidedress aldicarb treatment, and 1.5 fold greater than fields receiving a single infurrow treatment.

The number of Chrysopa sp. was greater in both untreated and infurrow than in the sidedress field.

With the exception of Nabis sp., there was little difference noted in untreated and aldicarb-treated irrigated fields with predaceous insects sampled. However, the estimated number of spiders per acre in the sidedress field was less than 1/2 of that found in either the untreated or infurrow-treated fields.

During the period of greatest bollworm activity (July 27-31), estimates of the number of predaceous arthropods/acre indicated that Nabis sp., Geococis sp., Chrysopa sp., Hippodamia sp., and spiders were more abundant in untreated irrigated cotton.

Dryland fields:

There was little difference in the total number of insect predators in the treated and untreated dryland fields. There were, however, almost twice as many spiders present in untreated dryland fields as in the sidedress and infurrow-treated fields.

3. Kinzer, r.e., C.B Cowan, R. L. Ridgway, J. W. Davis, Jr., I. R. Coppedge, and S. L. Jones, 1977. Populations of arthropod predators and Heliothis spp. after applications of aldicarb and monocrotophos to cotton. Env. Entomol 6(1):13-16.

The effects of aldicarb application to cotton were evaluated for the following groups of arthropod predators: (1) Hippodamia spp., (2) Collops spp., (3) Scymnus spp., (4) Geocoris spp., (5) Nabis spp., (6) Orius spp., (7) Chrysopa spp., and (8) spiders. Populations were sampled with a vacuum sampling machine.

Aldicarb application dates:

In-furrow	-	April 26
Sidedress	-	May 23, June 10

Results

Although the total amount of aldicarb applied per acre was approximately the same in all treatments (1.7 - 2.1 lb. AI/A), the method of application and the amount of toxicant per application greatly influenced the arthropod predator populations. During the initial sampling period (May 23 - June 10), the in-furrow treatment applied at 1.7 lb. toxicant/A, and the sidedress applications at 1.6 lb/A plus. 6 lb/A, and at 2.1 lb/A caused substantial reductions in the arthropod predators sampled. However, the sidedress application of .9 lb/A had little effect during this period.

During the second sampling period (June 17-28), all treatments again reduced the coleopterous predators.

The sidedress applications of 2.1 lb/A and 1.6 lb/A plus .6 lb/A had the greatest effect on other arthropod predator populations.

In a supplemental test, aldicarb at 4 lb/A and combined applications of aldicarb and monocrotophos reduced the numbers of insect predators and spiders.

4. Tyler, B. M. I., P.A. Jones, and B. H. Kantack, 1974. Greenbug, parasite, and predator populations on sorghum, as related to six systemic insecticides. Env. Entomol. 3(3):409-411.

Application of aldicarb (band treatment, 1 lb.AI/A) to sorghum indirectly affected greenbug parasite populations by decreasing the populations of greenbugs. No significant decrease in populations of adult and larval coccinellids was observed.

103.2.0 Dermal Toxicity

See R. W. Felthousen review (4/9/77) and J. Edmundson review (8/7/74)

103.3 Subacute Toxicity

103.3.1 Mammal

For subacute inhalation toxicity, see R. W. Felthousen review (4/9/77)

103.3.2 Bird

See validation sheets, tests ES-D1 and E1.
Refer also to R. W. Felthousen review (4/9/77).

Test	Material	Animal	Category	Results
10 day dietary	10%G	Bobwhite	acceptable	LC_{50}=240ppm a.i.

Note: This test was reviewed again for this submission and found to be unacceptable as a core study, because technical grade was not used.

103.5 Field Studies

refer to (1) R.W. Felthousen review 4/9/77
(2) Validation sheets, tests ES-BB1, ES-DD1-3

104.0 Hazard Assessment

The following hazard assessment is based on incomplete data and, therefore, should be considered preliminary. Environmental chemistry data that has been reviewed to date were found to be inadequate to support registration. Further data have been submitted by registrant, but have not yet been reviewed. In addition, only the aquatic invertebrate LC_{50} and waterfowl dietary LC_{50} have been found to be core by the environmental safety staff. Although lack of valid fish studies precludes an assessment to aquatic organisms, there is abundant evidence of its avian toxicity, most of which is based on supplemental studies.

104.1 Discussion

Aldicarb is a systemic carbamate insecticide that is currently registered for use on cotton, peanuts, potatoes, sugar beets, and sugar cane. The proposed amendment is for additional use on oranges, pecans, sweet potatoes, dry beans, soybeans, and tobacco. Like other carbamates, Aldicarb is a potent cholinesterase inhibitor, in which the parent compound and its sulfoxide and sulfone degradates are all toxic.

104.2 Likelihood of exposure of non-target organisms

Aldicarb is very toxic. The oral LD50 to rats is 0.6 mg/kg (memo by Reto Engler, 9/30/76, toxicology review of 6F1829), and based on a study considered supplemental the oral LD50 to six-month old mallards is 4.44 mg/kg (see test ES-C1). Registrant has published (TEMIK Aldicarb pesticide, technical information, 1975. Union Carbide Corporation) other toxicity information on various animals, although these data did not include references and may or may not have been reviewed. Acute toxicity on an active ingredient basis was given as (Table 22, p. 51): male rat - 0.9 mg/kg; mice - 0.4 mg/kg; cat and rabbit - 1.3 mg/kg. Table 25 (p.55) gives LC_{50}s for bluegill -0.05 -0.1 ppm a.i., and rainbow trout - 0.5 ppm a.i., and also an LD_{50} for bobwhite quail of 34 mg/kg for the 10% granular formulation.

Under the proposed use patterns, the following quantities of aldicarb active can be expected to occur in one square foot (see appendix for calculations): Pecans-36.4 mg/ft^2; oranges-28.0 mg/ft^2, sweet potatoes-1.52 mg/ft^2; dry beans (for nematodes)-33.75 mg/ft^2; dry beans (for arthropods) 15.4 mg/ft^2; soybeans (for beetles)-2.9 mg/ft^2; soybeans (for nematodes)-50.5 mg/ft^2; tobacco-45.1 mg/ft^2.

One granule weighs about 2 mg. (R. W. Felthousen memo on classification of granulated formulations, 9/9/77). The only available LD_{50} information for bobwhite

quail is the unreviewed data submitted by registrant (published brochure cited above), which is 34 mg/kg based on 10% or 3.4 mg/kg based on active ingredient. Bobwhite quail weigh approximately 190 grams and therefore, the LD_{50} for bobwhite would be 0.646 mg/bird. One TEMIK 10G granule would contain 0.2 mg active, and one TEMIK 15G granule would contain 0.3 mg. ingested would be a dose in excess of the LD_{50}. If the LD_{50} were comparable for smaller birds, one granule would be the equivalent of the LD_{50} dose for birds weighing 50 g and less, such as sparrows. Somewhat larger seedeating birds, such as doves and blackbirds, would need to ingest two granules to to receive in excess of an LD_{50} dose. For all of the proposed use patterns, except soybeans for mexican bean beetles and sweet potatoes, the availability of aldicarb per square foot substantially exceeds the estimated LD_{50} for avian species.

Thus four 10G or three 15G granules

Aldicarb is even more toxic to mammals than to birds, with LD_{50}s generally below 2 mg/kg. While field studies have indicated that rabbits and deer are not likely to be adversely affected (see review of test ES-BB1), neither of these species are seed-eaters. The hazard to seedeating mammals, such as sciurid, heteromyid, and cricetine rodents, would be much greater. Certainly the availability per square foot far exceeds the LD_{50} dose for these small mammals.

The high toxicity of aldicarb is enough to consider it a substantial hazard to seedeating wildlife. But there is additional evidence in field studies showing repeated mortality to avian species in particular. These are briefly summarized below:

1. A small pen field test (ES-DD1, this review) had two experimental quail die. Cause was not attributed to pesticides, but no explanation was given.

2. In another small pen field test (ES DD3, this review), after 48 hours 23 out of 30 valley quail died in a treated, unirrigated area, while 4 of 30 died in an irrigated area. Investigators concluded little hazard if directions for use are followed. The label states that treated areas should be irrigated within one week, yet more than 75% of birds in non-irrigated area died within 48 hours. Indeed, in one plot that had only 2 hours of dryland conditions, 50% of 6 birds died. Even if the label read "irrigate within one day", substantial mortality could be expected.

3. In two small pen field tests (R. W. Felthousen review, 4/9/77), a small amount of mortality occurred in bobwhite quail.

4. In a wildlife survey in England, bird mortality was assessed by 2-3 pre-treatment and 4 post-treatment searches. Fourteen dead birds were found, ten of which had aldicarb residues. Mammal surveys had no significance.

5. In a small pen field test (R. W. Felthousen review, 4/9/77), two valley quail died and one more became sick (out of 11 experimentals) after minimal feeding on treated sugar beet tops. It is possible that adverse effects may have come from ingesting exposed granules at row ends.

6. In a radio telemetry field test (R.W. Felthousen review, 4/9/77), unconfined valley quail and pheasants were released in a treated area. After 3 days 7 of 21 quail had died as had 4 of 10 immature pheasants. Of five dead quail examined 3 had detectable aldicarb residues in the liver. In addition 3 immature and 2 adult pheasants had been taken by predators.

These data give substantial evidence that quail and other birds will suffer moderate to extensive adverse effects from Aldicarb treatment. These same studies suggest little hazard to adult pheasants and probably also to other larger birds. They also suggest that while ingestion of granules can be a very serious problem, ingestion of treated plants is considerably less hazardous. Since the granules are the major problem, it would be expected that birds and mammals that primarily eat seeds would be the species most affected.

Plants. At the labelled rates, there should be no phytotoxic response from non-targets plants within or outside of the target area unless over dosing or granular concentrating occurs. Horizontal leaching in the soil appears to be minimal and therefore the likelihood of aldicarb affecting plants in adjacent fields or plots will not occur.

Beneficial Insects

It has been shown that aldicarb granular insecticide, used at recommended rates, presents no hazard to bees.

In regard to arthropod parasites and predators, nearly all the available research deals with cotton insects. Aldicarb effect on beneficial arthropods varies with species, method of application, and amount of toxicant applied. Some studies have shown little or no effect from aldicarb application to cotton. Others have shown population decreases in predators (Coleoptera, Hemiptera) and parasites (Hymenoptera). Apparently, aldicarb can affect populations of parasites and predators in two ways:

1. direct reduction in population numbers may be due to mortality of beneficial insects feeding on nectar, sap, or exudate of treated plants;

2. indirect reduction may be due simply to reduction in population of the host (prey) insects(s).

Direct reduction in populations of plant-feeding predators and parasites appears to be short-lived, as a rule. This may be due in part to repopulation of treated areas by beneficials from untreated areas, an effect that would diminish with increase in the size of the treated area.

No valid assessment can be made at this time, for the following reason. Except for one published study on sorghum insects, all research has been done in cotton. There has been no research on possible aldicarb-beneficial insect effects in any of the proposed crops (dry beans, soybeans, tobacco, oranges, pecans, sweet potatoes). Information of this type is necessary for a valid assessment, especially in view of the fact that proposed rates for use in some of these crops are higher than those presently used in cotton.

104.3 Endangered Species Considerations

Because of the absence of valid fish toxicity studies and lack of environmental chemistry data, no determination is made regarding aquatic endangered species. Because of the granular nature of the formulation, this reviewer feels that the major hazard would be to smaller bird and mammal species that eat seeds. There are very few endangered seedeaters associated with the proposed corps.

The Delmarva peninsula fox squirrel, Sciurus niger cinereus is found in Kent Co. in Delaware, and Queen Anne's, Talbot, and Dorchester Counties in Maryland. According to Gary Taylor of the Maryland Department of Natural Resources, this squirrel is associated with agricultural areas in Talbot and Dorchester counties. Its major agricultural association is with corn, but it also uses soybean fields for food gathering and could, if the LD_{50} is comparable to known mammals, receive a lethal dose of aldicarb by ingesting as few as 2 granules.

Gusey and Maturgo (1972. Wildlife Utilization of Croplands, Shell Oil Co.) also list low (infrequent or intermittent) use of soybean fields for feeding by squirrels. This reviewer feels that a hazard would exist for the Delmarva peninsula fox squirrel from application of granular aldicarb in Talbot and Dorchester Counties in Maryland.

104.1.3 Adequacy of Toxicity Data

(see validation sheets)

The following required tests have been classified as core:

1. Avian subacute dietary LC_{50} - waterfowl
2. Aquatic invertebrate 48 hour LC_{50}

104.1.4 Additional Data Required

1. Avian acute oral LD_{50}
2. Avian subacute dietary LC_{50} - upland game bird
3. Fish acute 96 hour LC_{50} - warmwater
4. Fish acute 96 hour LC_{50} - coldwater

105.0 Classification

Classification can not be completed until all required studies are submitted and reviewed.

106.0 RPAR Criteria

Aldicarb is a highly toxic insecticide that exceeds one or more RPAR triggers for the proposed uses on oranges, pecans, dry beans, soybeans, and tobacco. For all of these uses, 0-hour residues

exceed the LD_{50}s for both mammals and birds. Thus, the acute toxicity criteria (Sec 162.11 (a)(3)(i)(B)(1) and (2)) have been exceeded for these uses. Residues for these uses are calculated in the appendix and are listed herein for reference.

use	residue
oranges	28.0 mg/ft^2
pecans	36.4 mg/ft^2
dry beans (for nematodes)	33.7 mg/ft^2
dry beans (for arthropods)	15.4 mg/ft^2
soybeans (for nematodes)	50.5 mg/ft^2
tobacco	45.1 mg/ft^2

Note that these residues have been calculated on the basis of soil incorporation, which takes into account a safety factor for such incorporation (see R. Felthousen memo: Classification of granulated formulations 9/9/77). It should be noted that these residues would result in an acute oral hazard, ~~rather~~ more than a subacute dietary hazard to birds. For discussion of acute toxicity, see section 104.2.

In addition to the acute triggers, there have been consistent field studies that have demonstrated non-target mortality (see section 104.2), some of it extensive. Also, for use in soybeans, there is a possiblity of mortality to the endangered Delmarva Peninsula Fox Squirrel (see section 104.3). These two hazards exceed the trigger (sec. 162.11(a)(3)(ii)(C)).

Although not considered in this review, it is likely that some currently registered uses also exceed RPAR criteria. It should also be noted that although valid fish studies are lacking, aldicarb appears to be highly toxic (LC_{50} < 1 ppm) to fish.

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107.0 Conclusions

The Environmental Safety Section identifies the proposed uses for oranges, pecans, soybeans, dry beans, and tobacco as exceeding the acute toxicity criteria (Sec. 162.11 (a)(3)(i)(B)(1) and (2)) and toxicity criteria (Sec 162.11(a)(2)(3)(ii)(C)). However, any referral to OSPR should be withheld pending completion of the environmental chemistry data and a better definition of the environmental fate of aldicarb.

Prior to consideration of the amended registrations the following studies are necessary to make the hazard assessment:

1. An avian acute oral LD_{50}, preferably on mallard duck or bobwhite quail. The referenced study included no raw data and used only 5 birds per concentration, however, it may support registration if the following information is submitted: bird weights and food consumption, raw mortality data, toxicity symptoms, and date of study.
2. An avian subacute dietary LC_{50} for upland game bird, preferably bobwhite quail or ring-necked pheasant. The referenced studies were unacceptable because the technical grade was not used, and in the other no dose level higher than 300ppm was tested.
3. A fish acute 96 hout LC_{50} for both warmwater and coldwater species of fish, preferably bluegill sunfish and rainbow trout. The submitted studies were unacceptable primarily because the technical grade was not used.

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5/18/78

Appendix

Calculations on hazard of TEMIK to wildlife
(reference: R. W. Felthousen memo 9/9/77 on granulated formulations)

1. Pecan trees — 10-12 trees/acre (ref. phone conversation with Mike Hammer, Georgia Dept. of Agric.)

application procedures:

4-6 ft. band along dripline on both sides of tree-spread uniformly and incorporate 2-3" deep.

worst case calculations: (10 pounds a.i./acre)

a. assume 9 trees/acre in 3 rows of 3 trees each

b. each tree is treated both sides, therefore, 3 rows trees equals 6 rows pesticide

c. 6 rows pesticide x 4 ft width = 24 row ft. of each acre $(208.7 \text{ ft})^2$

d. 24 ft. ÷ 208.7 ft = 11.5% of acre is treated with a total of 10 pounds active

e. if 10 pounds active is on 11.5% of an acre, this is equivalent to 88 pounds active/acre on treated area.

availability as adjusted for incorporation:

a. at 1 pound/acre expected concentrations in top 0.1 inch = 22.0 ppm

b. average expected concentration over 2-3 inch range equals (1.1 + 0.73) ÷ 2 = .91 ppm

c. soil adjustment factor = $\frac{22.0}{.91}$ = 24.3

d. availability = application rate ÷ 24.3
= 3.6 pounds/acre
$= 36.4 \text{ mg/ft}^2$

Number 10% granules/ft^2 = $\frac{mg/ft^2}{mg/granule}$ = $\frac{36.4\ mg/ft^2}{0.2\ mg/granule}$ = 182

Number 15% granules/FT^2 = $\frac{mg/ft^2}{mg/granule}$ = $\frac{36.4\ mg/ft^2}{0.3\ mg/granule}$ = 121

2. Orange trees 50-100 trees/acre

application procedures

2-4 ft. band along dripline on both sides of tree-spread uniformly and incorporate 2-3" deep.

worst case calculations: (10 pounds a.i./acre)

a. assume 64 trees/acre in 8 rows of 8 each

b. each tree is treated both sides, therefore 8 rows trees equals 16 rows pesticide

c. 16 rows pesticide x 2 ft. width = 32 row ft. of each acre $(208.7\ ft)^2$

d. 32 ft ÷ 208.7 ft = 15.3% acre is treated with a total 10 pounds active

e. if 10 pounds active is on 15.3% of acre, this is equivalent to 65 pounds active/acre

availability as adjusted for incorporation

a. soil adjustment factor same as for pecans = 24.3

b. availability = application rate ÷ soil adjustment factor
= 65 pounds/acre ÷ 24.3
= 2.7 pounds/acre
= 28.0 mg/ft^2

3. Sweet potatoes 48 inch row spacing

application procedure:

apply granules in a 12" band in opened row. Cover immediately with soil by hilling up 8-10 inches.

worst case calculations: 3 pounds a.i./acre or 44 ounces/ 1000 feet of row

a. 44 ounces/1000 feet of row, 12" inch wide bands → 44 ounces/1000 ft^2 = (44 oz x 28.35 g/oz)/100 ft^2 = 1.24 g/ft^2 = 1240 mg/ft^2

b. soil adjustment factor = (22 ppm ÷ 0.27) x 10 = 815

c. 1240 mg/ft^2 ÷ 815 = 1.52 mg/ft^2

4. Dry beans 36 inch row spacing

application procedure:

a. Arthropod pests - drill granules 2-3 inches below seed line or at side of seed line.

b. nematodes - apply in 8-12 inch band and work into soil or cover to depth of 2-4 inches.

worst case calculations: 2 pounds active/acre or 22 ounces/ 1000 feet of row

(1) nematodes

a. 22 ounces/1000 ft of row, 8" band → 22 ounces/667 ft^2 → (22 oz x 28.35 g/oz) ÷ 667 = .935ft^2 = 935 mg/ft^2

b. soil adjustment figure

1. soil incorporation 22ppm ÷ [(1.1 + .73 +.55 ÷ 3] = 27.7
2. covering (1) above x 10 = 277

c. label rate/soil adjustment figure

1. 935 mg/ft^2 ÷ 27.7 = 33.75 ft^2
2. 935 mg/ft^2 ÷ 277 = 3.375 ft^2

(2) arthropods (assume 2" wide band)

a. 22 ounces/100 ft of row 2" band ⟶ 22 ounces/667 ft^2
(22 oz x 28.35 g/oz) ÷ 167ft^2 = 3.73 = 3730 mg/ft^2

b. soil adjustment figure (treat as "covered")
(22 ppm ÷ [(1.1 + .73) + 2]) x 10 = 242

c. label rate/soil adjustment figure
3730 mg/ft^2 ÷ 242 = 15.4 mg/ft^2

5. Soybeans 36 inch row spacing

application procedures:

a. Mexican bean beetle - drill granules 2-3 inches below seed line or 2-3 inches to the side of the seed line

b. Nematodes - apply granules in an 8-12" band and work into soil or cover with soil to depth of 2-4 inches.

worst case calculations

(1) Mexican bean beetle 1.5 pounds active/acre; 16.5 ounces 1000 feet of row

a. 16.5 ounces/1000 ft of row, 8" band ⟶ 16.5 oz/667 ft^2
(16.5 oz x 28.35 g/oz) ÷ 667 ft^2 = .701 g/ft^2 = 701 mg/ft^2

b. soil adjustment figure - same as for arthropods in dry beans = 242

c. label rate/soil adjustment factor 701 mg/ft^2 ÷ 242 = 2.9 mg/ft^2

(2) nematodes 3 pounds active/acre; 3302/1000 feet of row

a. 33 oz/1000 ft of row, 8" band ⟶ 33 oz/667 ft^2
(33 oz x 28.35 g/oz) ÷ 667 = 1.4 g/ft^2 = 1400 mg/ft^2

b. soil adjustment figure - same as for nematodes in dry beans soil incorporation: 27.7
covering: 277

c. label rate/soil adjustment factor
incorporation 1400 mg/ft^2 ÷ 27.7 = 50.5 mg/ft^2
covering 1400 mg/ft^2 ÷ 277 = 5.05 mg/ft^2

6. Tobacco 48 inch row spacing

application procedure

apply in a 12-24 inch band and incorporate thoroughly; transplant into treated area OR apply granules as overall broadcast, incorporate 2-4 inches into the soil followed by pulling soil from the middle to form beds; transplant into treated area.

worst case calculations: 3 pounds active/acre or 44 ounces/ 1000 feet of row

(1) bands

a. 44 oz/1000 ft of row, 12" band ⟶ 44 oz/100 ft^2
(44 x 28.35) ÷ 1000 = 1.25 g/ft^2 = 1250 mg/ft^2

b. soil adjustment factor
22 ppm ÷ [(1.1 + .73 + .55) ÷ 3] = 27.7

c. label rate/soil adjustment figure
1250 mg/ft^2 ÷ 27.7 = 45.1 mg/ft^2

(2) broadcast

cannot calculate from label information - does not say how deeply granules are to be incorporated. Exposure is likely to be less than for band application.

7. Calculations for turn areas. Assume 4-6" deep incorporation. In all cases, availability = actual (not adjusted) label rate divided by the soil distribution factor which remains constant at 500 for 4-6" incorporation.

a. Oranges and pecans 10 pounds active/acre
availability = 10 pounds/acre ÷ 500 = 4536 g/acre ÷ 500
$= \frac{1361000 \text{ mg}}{43560 \text{ ft}^2} \div 500 = 31.2 \text{ mg ft}^2 \div 500$
= ~~.06~~ .31 mg/ft^2

b. Sweet potatoes, tobacco and soybeans (for nematodes)
3 pounds active/acre

availability = 3 pounds/acre ÷ 500 = 1361 g/acre ÷ 500

$= \frac{1361000 \text{ mg.}}{43560 \text{ ft}^2} \div 500 = 31.2 \text{ mg ft}^2 \div 500$

$= .06 \text{ mg/ft}^2$

c. Dry beans 2 pounds active/acre

availability = 2 pounds/acre ÷ 500 = 907 g/acre ÷

$= \frac{907000 \text{ mg}}{43,560 \text{ ft}^2} \div 500 = 20.1 \text{ mg/ft}^2 \div 500$

$= .04 \text{ mg/ft}^2$

d. Soybeans (for arthropods) 1.5 pounds active/acre

availability = 1.5 pounds/acre ÷ 500 = 680 g/acre ÷ 500

$= \frac{680000 \text{ mg}}{43560 \text{ ft}^2} \div 500 = 15.6 \text{ mg/ft}^2 \div 500$

$= .03 \text{ mg/ft}^2$