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RD ACTION CODE/ TYPE OF REVIEW: 300

TYPE PRODUCT(S): Insecticide/Nematicide

ACCESSION NUMBER(S):

PRODUCT MANAGER: D. Edwards (12)

PRODUCT NAME(S): TEMIK 15G (aldicarb)

COMPANY NAME: Rhone-Poulenc Ag Company

PURPOSE OF SUBMISSION: Submission of results from terrestrial field study - Level 1 (Screening) Study 28 plots in 5 states; 7 different application techniques; 3 crops - citrus, potatoes, cotton.

SHAUGHNESSEY NO.	CHEMICAL AND FORMULATION	%A.I.
098301	Aldicarb	15

ECOLOGICAL EFFECTS BRANCH REVIEW

Chemical Name: Aldicarb (Temik 15G)

100.0 Submission Purpose

Rhone-Poulenc Ag Company has submitted a terrestrial field study and a granule incorporation study to support continued registration of aldicarb (Temik). The granule incorporation study is reviewed under a separate cover.

101.0 Background

Aldicarb is a systemic carbamate granular insecticide/nematicide in a 15% active ingredient formulation currently used on a variety of field and vegetable crops including citrus, cotton, and potatoes. The Aldicarb Registration Standard (March 30, 1984) required field testing data which "quantify the impact on avian and small mammal populations" for continued registration. Monitoring protocols were received from Union Carbide Agricultural Products Company and evaluated by the Ecological Effects Branch (EEB) from February 1986 to April 1987. The final field study, identified as a Level 1 (screening) study, was completed in 1987 and received by EEB May 1988.

102.0 Study Design and Methods (excerpted in part from the submission)

102.1 Study Title

"Application of Temik Brand 15G Aldicarb to Three Major Crops: A Terrestrial Vertebrate Field Study"

102.2 Study Author

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102.3 Objectives

To determine the acute effects of Temik brand 15G aldicarb pesticide application on wildlife, with emphasis on avian species.

102.4 Methods

Site Selection - Study sites were designated for citrus in Florida and Texas, cotton in Texas and Arizona, and potatoes in Delaware, Idaho, and Michigan. A preliminary evaluation was

conducted in 1986 to identify 10 or more potential study plots at each site. Data from avian census surveys, maps, and ground and aerial photographs were used to select the 4 best plots at each site. Assessment of plots was based on the following criteria: 1) avian habitat and populations; 2) carcass search practicability; 3) field access; 4) plot separation; and 5) safety to workers.

Agronomic Practices - Aldicarb application method and rate at each study site is summarized below.

Site	Application Dates (1987)	Temik 15G Application Method and Rates
Citrus - Florida	Jan. 19-21	Shanked, before press wheel. 33 lb/ac.
Citrus - Texas	Mar. 31, April 1	Banded in furrows (2-3" depth) with drag chain incorporation. 66 lb/ac.
Cotton - Texas	Mar. 10, 15	In-furrow (depth approx. 2") at plant. 10 lb/ac.
Cotton - Arizona	May 26, 27	Side-dress (2-6" depth). 20 lb/ac.
Potatoes - Delaware	April 14, 15, 20	Banded (4-6"), incorporated (1-2" depth) at emergence. 15 lb/ac.
Potatoes - Idaho	April 18, 20-24	In-furrow (depth approx. 11") pre-plant. 20lb/ac.
Potatoes - Michigan	April 29-May 2, 4-6, 8, 9	In-furrow (depth approx. 4") at plant. 20 lb/ac.

Calibration of application equipment was adjusted by BLAL personnel prior to application at each site. Procedures followed those described in The New Pesticide User's Guide (Reston Publishing Company, Inc. 1983).

Avian Censuses - A training seminar in bird identification skills, proper use of field guides, and census data collection was conducted prior to the investigation. Attempts were made to take avian census and activity surveys for 4 days pre-treatment, on the day of treatment, and for 5 days post-treatment. Censusing was conducted to confirm that known populations of ground feeding birds were present in the plots; censusing was not performed for statistical analyses purposes. Surveys were conducted using the transect method. For each plot, the transect line was the

perimeter of the crop area. The transect observation area was approximately 50 yards wide or 25 yards on each side of the transect line. Census surveys were conducted when weather conditions were clement and wind velocity did not exceed 10 mph. Surveys were conducted between dawn and 10 a.m. Observers walked the plot perimeters at approximately 1 mph. Observations were made for visual bird sightings, birds identified by song only; and abnormal behavioral patterns. Activity of birds and other wildlife behavior was recorded and monitored during each survey. Observations were recorded on a study plot map. Entries were then totaled by species on the census report forms. Average numbers of ground feeding birds such as robins, grackles, and doves were determined daily by dividing the total number censused during preceding study periods by the total number of acres surveyed during preceding study periods (cumulative average). On days when censuses were not performed (or were invalid), the preceding day's density was repeated as that day's density.

Carcass Searches - The efficiency of each carcass searcher was established by conducting a minimum of 3 search tests in the open field and 3 search tests in the hedgerow or perimeter areas of a single plot at each site. Tests were announced and performed prior to the actual project carcass searches. A number (10-20) of mallard duckling, and/or bobwhite quail, and/or immature bobwhite quail, and/or adult chicken, and/or adult mallard carcasses were randomly placed around (or in) the plot to be searched. Records were kept of each carcass found and calculations were made of search efficiency in the open field areas and in the hedgerow or perimeter areas. A "weighted average efficiency" was calculated based on the relative in-field area to perimeter area ratio for each site. Unannounced efficiency tests were performed during actual carcass searches at 4 sites. Results from these tests were not utilized in determining carcass search areas.

Predator nonremoval rates of carcasses were determined by placing 5 bobwhite quail and 5 mallard duckling carcasses around the perimeter and/or adjacent areas of each of the application plots. Following placement between 7 and 9 a.m., a count was made of the remaining carcasses before dark, at 24 hours, and at 48 hours post-placement. Attempts were made to place fresh carcasses on 2 separate occasions prior to application and on days 1 and 3 after application. Data were recorded and avian carcass nonremoval rates were calculated.

The size of the area to be searched for each post-application carcass search was determined daily by using the DREAP formula presented in the Guidance Document for Conducting Terrestrial Field Studies (Ecological Effects Branch, Hazard Evaluation Division, Office of Pesticide Programs, U.S. EPA, Washington, D.C.) where A (area to be searched) = 2/DREP, where D = avian density (determined as described above using preceding day's value), E = carcass search efficiency (determined as

described above), R = carcass nonremoval rate (determined as described above), and P = probability (P = 0.20 because an effect on 20% or more of any species is the criterion for concern). Carcass and feather spot searches were conducted as close to the following schedule as possible: 1) pre-treatment data collection and clean-up at 2 days and 1 day prior to application, and 2) post-treatment carcass searches and data collection at 1 to 4 hours and on test days 1, 2, 3, 4, and 5 following application. The hedgerow or perimeter of the study plots was always searched each day. Searchers in the study area followed paths around the perimeter of the plot and between rows in the plot. Each search path was approximately 12 feet wide (6 feet to either side of search path), depending on vegetative cover. Any carcass found on the plots underwent an immediate examination of gross external features and viscera. The liver and crop/gizzard (birds) or stomach (mammals) were removed and respective contents identified. Carcasses and removed viscera were refrigerated for freezing later in the day. Quick-frozen carcasses were shipped on dry ice to Hazleton Laboratories America, Inc. (Madison, WI) for analyses.

Aldicarb Residue Determinations - The method for analysis was developed by Rhone-Poulenc Ag Company and Hazleton Laboratories. Only viscera samples sent by BLAL were analyzed; carcasses and feather spots were not. The procedure consisted of taking a 2g animal tissue sample and extracting aldicarb residues by homogenizing the sample with a mixed solvent 3:1 acetone:water. Aldicarb residues were then oxidized to aldicarb sulfone by addition of peracetic acid. After appropriate clean up of the extract on a florisil column, the pesticide residue levels were determined as aldicarb sulfone by High Performance Liquid Chromatography. Residue was quantified by reference of the peak height or area to a previously prepared calibration curve derived from injection of aldicarb sulfone standard solutions. The procedure has a detection limit of 0.1 ppm. Where measured residues were greater than 0.1 ppm, the mortality was attributable to aldicarb.

Weather Data - Weather parameters were measured at each site daily. Data included temperature (high and low), rainfall, wind, and cloud cover.

Data Analysis - No statistical procedures were employed. The average avian mortality per acre of treated land for each crop was determined by comparing the mean value for mortality attributed to aldicarb to the mean actual carcass search area. This value was then compared to the mean density of ground feeding birds at each site to derive a relative proportion of the standing population of species most at risk which died due to aldicarb.

103.0 Reported Results

Values for measured parameters for each plot at each crop site are summarized in Tables P.1.a.-P.3.c. (photocopied from submitted report), attached. Individual post-application carcass search results (summarized from Appendix L of report) are as follows:

Citrus - Florida: 2 robins, 2 dove feather spots, 2 egret feather spots, 2 unidentified feather spots, 1 rabbit, 1 field rat, 3 opossum, 1 shrew, 1 frog, 2 glass lizards.

Citrus - Texas: 3 doves, 1 great-tailed grackle, 5 dove feather spots/scavenged carcasses, 1 white-fronted dove scavenged carcass, 1 rock dove wings, 2 grackle feather spots, 1 quail feather spot, 1 black-tailed jackrabbit, 1 rat scavenged carcass.

Cotton - Texas: 1 mourning dove, 1 ground dove, 1 killdeer, 1 great-tailed grackle, 1 dove feather spot, 1 killdeer feather spot, 1 egret feather spot, 5 unidentified feather spots, 3 rabbits, 1 snake.

Cotton - Arizona: 1 mourning dove, 2 dove feather spots, 1 great blue heron feather spot, 1 toad.

Potatoes - Delaware: 3 laughing gulls (detected during avian censuses/carcass removal check), 1 grackle, 1 unidentified feather spot.

Potatoes - Idaho: 2 unidentified feather spots, 9 mice.

Potatoes - Michigan: 1 prairie horned lark, 1 song sparrow, 1 grackle, 1 brown thrasher scavenged carcass, 2 mice.

Based on the results of residue analyses (see photocopy of Table 1 of Hazleton Laboratories report, attached), the following mortalities were attributed to aldicarb: 2 robins, 3 opossum, 1 rabbit, 1 shrew, and 2 glass lizards in Florida citrus; 1 mourning dove and 1 rat in Texas citrus; 1 ground dove and 1 mourning dove in Texas cotton; 1 mourning dove in Arizona cotton; 3 laughing gulls in Delaware potatoes; 1 mouse in Idaho potatoes; and 1 horned lark, 1 song sparrow, and 2 mice in Michigan potatoes.

Abnormal behavior at each site was noted in 2 robins in Florida citrus (1 died within 28 minutes of initial sighting),

1 great-tailed grackle and 1 dove in Texas citrus, 1 laughing gull in Delaware potatoes, 1 mouse in Idaho potatoes (died within 1 hour of initial sighting), and 1 killdeer and 1 fledgling sparrow (asphyxiated after 1 hour of observation) in Michigan potatoes.

104.0 Study Author's Conclusions

The ratios of mean mortality attributed to aldicarb per acre over the mean density of ground feeding birds for each crop was as follows: citrus 0.017/3.6 (0.47%), cotton 0.024/7.8 (0.31%), and potatoes 0.019/2.7 (0.70%). Thus, the relative proportion of mortalities attributable to aldicarb represented less than 1% of the standing population of the species most at risk. Based upon these findings, the author concluded that the environmental impact of Temik 15G use on citrus, cotton, or potatoes is expected to be minimal and of no significance to resident or migrating avian populations or to nonavian species.

105.0 Study Evaluation

Site Selection - The study author has failed to justify the major geographic regions chosen for this study. How well do the areas represent those of major aldicarb usage? How prevalent are target organisms in these areas? What characteristics are inherent to these areas which make them better wildlife habitat than other areas? For example, how well do cotton fields in Arizona represent potential hazard to wildlife in and around cotton fields in California or Mississippi - 2 states where acreage planted to cotton annually is twice that in Arizona and where density and diversity of wildlife is likely to be much greater? How are major potato-producing areas such as North Dakota, Maine, and Minnesota represented by the study sites?

Criteria for choosing the final 4 study plots needs to be better defined. To what extent were adjacent habitat types considered when assessing avian habitat? Based on submitted ground-level photographs and limited site descriptions, few treatment fields appear to have good quality avian habitat in adjacent areas. What was agrichemical usage in adjacent/nearby crop fields and how did it affect this study? Define what "adequate numbers of avian species potentially at risk to exposure" (p. 11) are as they relate to site selection. "Carcass search practicability" implies that clean-tilled fields with little adjacent cover were chosen when possible. As a general rule, avian habitat quality and avian abundance are directly proportional to the density and diversity of vegetation present in a given area; also, dense vegetative cover in which it is extremely difficult to detect a carcass is also the most likely place a stressed bird will seek. What is the "sufficient distance" (p. 11) necessary to separate test plots? This was neither described nor documented. Further, despite the fact that

photocopies of aerial photos submitted with the report were barely legible, all Arizona cotton plots appear to be within ½ to 1 mile from each other; Delaware potatoes Plots #4 and #11 appear to be <1 mile apart and Plot #12 appears to be across the road from #13; Idaho potatoes Plots #1, #2, #3 appear to be within 2 miles of each other; and Michigan Plot #2 appears to be separated from Plots #1 and #4 by less than 1 mile. The close proximity of the study plots makes it unlikely that they could be considered independent. The study author should submit a legible scaled county map indicating locations of study plots for each site in addition to clear, detailed maps and/or aerial photos depicting each treated field with adjacent land use types.

Exactly what defines each study plot? The report implies a plot is limited to the treated field (97% of the plot area) and its "perimeter area" (3% of the plot area). It is unlikely that this study could have adequately determined true effects of aldicarb to avian wildlife by considering such a limited area.

Agronomic Practices - Aldicarb application methods used in this study do not represent "worst case" situations as required. Although application in Texas citrus is identified in the report as "banded incorporated", submitted photos indicate an in-furrow tube application followed by drag chain incorporation. Since the label states: "Spread granules uniformly and immediately work into the soil (preferred method)", it would be permissible and reasonable to expect that granules be broadcast on top of the soil and then lightly disced or otherwise incorporated - a method more likely to increase granule exposure to foraging birds compared to an in-furrow application.

The label also permits 2 applications to a cotton crop - one at-planting application (maximum 27 lb product/acre banded in Arizona or California, and maximum 10 lb product/acre banded in other states) and one postemergence application (maximum 20 lb product/acre side-dress in all states). This study did not include the at-planting application at the Arizona site nor did it include the postemergence application at the Texas site. Further, in-furrow application was used in Texas cotton; banded application should have been used as per label instructions and for the reasons discussed above.

Aldicarb granules were applied "to a depth of approximately 11 inches in furrow" (p. 32) in Idaho potatoes. Since the label specifies that granules be applied "with seed pieces in planting furrow", and that the typical planting depth of potato seed pieces is 3-4 inches, the procedure used in the study does not represent a standard agronomic practice which would have increased the likelihood of exposed granules compared to the 11 inch deep application.

Finally, BLAL did not permit contracted landowners to set

their own application equipment as they normally would. EEB does not consider PhD-degreed personnel calibrating application equipment with 3 to 8 trials per site "typical application procedures" (p. 9). Also, BLAL personnel interfered with operator application procedure at the Arizona cotton site when "The tractor operator was asked to turn off the electric motor before reducing tractor speed and lifting the application equipment to turn around. This change in procedure appeared to eliminate the deposition of granules on the soil surface" (p. 31).

Avian Censuses - Census techniques used in this study were probably adequate to screen potential study sites; however, limiting the census transects to the perimeter of each treated field is unlikely to provide avian utilization data required for a screening field study (N.B. this concern was also presented by EEB in protocol review comments for the study). In-field transects should have been included at all citrus sites and in fields where avian utilization was not limited by edge effect (e.g. small acreage fields).

What is the justification for censusing avian species for only 5 days post-application? Further, the following sites received an even fewer number of censuses: Florida citrus (all 4 plots), Texas cotton (Plots #8 and #9), Arizona cotton (Plots #3, #17, and #32), Delaware potatoes (all 4 plots), Idaho potatoes (Plot #3), and Michigan potatoes (Plots #1, #2, and #4). How does this limited effort reflect potential avian exposure and hazard?

Census data was inappropriately reported. The study author has "lumped" the data too much to be of use. The main problems are: 1) it cannot be determined from the report the numbers of each avian species that were utilizing each part of the study area (i.e., treated fields, edge, adjacent habitat, etc.); 2) it is not known exactly which species are considered to be "ground feeding birds"; and 3) there is no basis for calculating cumulative averages of bird density or for substituting a preceding day's census result for those days when no censuses were conducted. When reporting census results, all birds detected should be accounted for individually - by scientific name and numbers of each species utilizing each component of the study area, describing what the utilization was (feeding, dusting, perched, etc.) for each daily census. There is no evidence that the density estimates reported in this study are indicative of actual avian utilization of treated fields; therefore, there is no justification for determining carcass search areas based on these censuses. Finally, EEB questions why a training seminar in bird identification and census techniques was necessary for "trained, qualified, and field experienced personnel" (p. 13).

Carcass Searches - Carcass search efficiency trials were inadequate to use for determining needed carcass search areas or

for establishing an effect level. Efficiency trials should have been conducted on all study plots to independently derive a search efficiency value for each plot. Further, efficiency trials were conducted on Texas and Arizona cotton fields which weren't even used as study plots. Results of unannounced trials were reported only for Michigan potatoes; results were not reported for Texas citrus, Texas cotton, or Idaho potatoes where unannounced trials were described. Also, there is no basis for using a "weighted average efficiency" value which artificially inflates the efficiency rating by emphasizing almost exclusively the clean in-field areas over dense edge or adjacent habitats where dead birds were more likely to be and where efficiencies were lower. Finally, since the species considered to be most at risk were doves, robins, etc., all carcasses used in the efficiency trials should have been of this size.

The discussion of predator nonremoval rates is unclear. Exactly how was the data used? Carcass nonremoval data was collected for 12-, 24-, and 48-hour periods both pre- and post-application. Which interval(s) was (were) used and exactly why did "the nonremoval rates also changed daily and were not consistent across the entire search area for each respective day" (p. 110)? What is the relationship between carcass removal survey data presented in Appendix N and the R (nonremoval rate) value used in calculating search areas (Appendix F)? If the R value for Florida citrus Plot #10, days 1, 2, and 3 was 0.2 as reported in Table F.1.a. (p. 296), then the necessary search area (A) should be 52.4 acres, not 15.0 acres as reported. Further, since Plot #10 is only 19.2 acres in size, how could this plot be searched adequately? Since post-application trials were used, what was the effect on removal of pesticide-related mortalities (i.e. baiting)? Why were carcass removal surveys terminated at 48 hours post-placement? Exactly where in each plot (in-field, edge, adjacent habitat, etc.) were the test carcasses placed?

There are 2 major deficiencies in the actual carcass search procedure used in this study. First, adjacent habitat types were not searched for carcasses (a 6-foot wide path along a treated field border does not constitute adjacent habitat). As previously discussed, dense adjacent cover is preferred by stressed/dying animals. Second, searches were terminated after only 5 days post-application. Half-lives of the parent compound in the soil may exceed 56 days and the half-life of sulfone (toxic metabolite) in soils has been documented to be 28 days (Exposure Assessment Branch, U.S. EPA). Clearly the potential hazard of aldicarb use to birds and other wildlife may exceed 5 days post-application and was not accounted for by this study.

Aldicarb Residue Determinations - The procedure for determining aldicarb residues in animal tissue samples was not adequately justified nor documented as a standardized procedure. What was the purpose of converting (oxidizing) aldicarb and

aldicarb sulfoxide to aldicarb sulfone equivalents prior to quantification? Can it be demonstrated that the process converts all the aldicarb and sulfoxide to the sulfone? How was the validation procedure (p. 450) accomplished? EEB notes that the mean recovery of aldicarb in the upper GI tract using this method was only 74% (±6.8) - therefore, it's likely that a sample containing greater than 0.1 ppm aldicarb was not detected as such. The procedure also requires 2g of sample for analysis, yet "some samples were less than 2.0g" (p. 421). Exactly how many samples were of "sufficient" size? Also, the analytical lab's report includes sample #70903410 (Code: 04-02-87/Tex Cit No. 4/4:410 p.m./Mourning Dove Crop/BC,LH) with measurable levels of aldicarb; the study author did not include this in the results reported in the text.

The analytical procedures used have not documented a sensitivity able to detect lethal concentrations of aldicarb in tissue samples; sublethal levels, which may have made an animal more susceptible to predation also were not able to be determined. Therefore, EEB does not accept that a carcass tissue sample measuring less than 0.1 ppm aldicarb was not due to aldicarb. Further, where a carcass or feather spot was not analyzed for residues or where post-mortem findings do not indicate another cause of mortality (which also may have been treatment-related), EEB attributes the death to aldicarb.

Weather Data - The study author should present a discussion and justification as to how adverse/severe weather events affected this study. Also, data for the Texas cotton site is not included- Table G.2.a. is a duplicate of weather data for the Florida citrus site, not Texas cotton.

Data Analysis - EEB concurs with the study author in that: 1) "the study design does not allow for the use of the DREAP formula to calculate a proportion of the avian population which was effected" (p. 109); 2) "an accurate assessment of avian density cannot be made" (p. 109); and 3) "no quantitative assessment of this data can be derived" (p. 110). Therefore, EEB does not understand why the study author attempted to derive a percentage of the avian population which represented mortalities attributable to aldicarb. There is absolutely no basis for analyzing the data in this manner; carcass search efficiency, carcass nonremoval rates, and confidence limits reflecting the power of the test and the level of significance were not even considered when attempting to establish an effect level.

Conclusions - Because of the deficiencies in the methods used in this study, there is no data in the report which supports the study author's conclusions that "the relative proportion of mortalities attributable to aldicarb represents less than 1% of the standing population of the species most at risk" or that "the environmental impact of Temik 15G use on citrus, cotton, or

potatoes is expected to be minimal and of no significance to resident or migrating avian populations". Conversely, EEB concludes that of the carcasses detected during this study, mortalities due to aldicarb use at each study site were as follows:

Site	Species (number)
Citrus	
Florida	American robin (2) Dove (2) Egret (2) Unidentified bird (2) Opossum (3) Rabbit (1) Shrew (1) Glass lizard (2) Frog (1)
Texas	Dove (7) White-fronted dove (1) Mourning dove (2) Rock dove (1) Grackle (2) Great-tailed grackle (1) Quail (1) Rat (1) Black-tailed jackrabbit (1)
Cotton	
Texas	Mourning dove (1) Ground dove (1) Dove (1) Killdeer (2) Great-tailed grackle (1) Egret (1) Unidentified bird (5) Rabbit (3)
Arizona	Mourning dove (1) Dove (2) Great blue heron (1) Toad (1)

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Potatoes		
	Delaware	Laughing gull (3) Grackle (1) Unidentified bird (1)
	Idaho	Unidentified bird (2) Mouse (7)
	Michigan	Prairie horned lark (1) Song sparrow (1) Brown thrasher (1) Grackle (1) Mouse (2)

Because of deficiencies in carcass searching procedure (discussed above), the actual numbers of mortalities due to aldicarb use on the study sites were likely to have greatly exceeded the numbers listed. However, methods of data collection were inadequate to estimate an effect level.

The results of this study, while somewhat equivocal because of the previously identified weaknesses in design and methods, indicate that aldicarb when used under less than "worst case" conditions will cause mortality to birds, wild mammals, reptiles and amphibians. Definitive field studies quantifying acute and subacute effects observed in this study are required to support continued registration. Methods should be sufficient to document the magnitude of effects to the mortality/survival of wildlife in areas treated with aldicarb. The registrant is encouraged to consult the Guidance Document for Conducting Terrestrial Field Studies (Fite, et al. 1988, U.S. EPA) before submitting a protocol for review.

106.0 Summary

EEB has reviewed a terrestrial field screening study on citrus, cotton, and potatoes submitted by Rhone-Poulenc Ag Company to support the continued registration of aldicarb (Temik 15G). Major aspects of the study, including study site selection, agronomic practices, avian census techniques, carcass search methods, residue analysis, and data analysis are all inadequate to document that significant adverse effects to wildlife are not occurring as a result of aldicarb use. All that can be determined from the study is that aldicarb use in the listed crops poses a hazard (both lethal and sublethal) of unknown significance to a variety of nontarget wildlife species. Additional definitive field studies, as discussed above, are required to support continued registration of aldicarb.

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