State of California

Memorandum

To : Henry J. Voss
Director

Date : September 28, 1989

Place : Sacramento

Phone: 2-2395

From : Department of Food and Agriculture Lyndon S. Hawkins, Chairperson
Subcommittee of the Pesticide Registration and Evaluation Committee

Subject : Aldicarb

Attached are the Findings and Recommendations regarding aldicarb. These are made pursuant to the requirements of the Pesticide Contamination Prevention Act and are submitted on behalf of the Subcommittee of the Pesticide Registration and Evaluation Committee.

The California Department of Food and Agriculture does not concur with the attached finding. The minority finding is attached.

Attachment

SURNAME

SUBCOMMITTEE OF THE
PESTICIDE REGISTRATION AND EVALUATION COMMITTEE

IMPLEMENTATION OF THE PESTICIDE CONTAMINATION PREVENTION ACT
ALDICARB: FINDINGS AND RECOMMENDATIONS

September 28, 1989

Aldicarb has been found in ground water in Del Norte and Humboldt Counties. Results from sampling reported to the subcommittee indicate that aldicarb and breakdown products leach to ground water in the north coast area of California due to legal agricultural use of aldicarb. Under the conditions of a research authorization on a crop for which aldicarb is not registered for use, residues of aldicarb moved to ground water in the San Joaquin Valley.

Pursuant to California Notice 88-20, Notice of Aldicarb Sulfoxide and Aldicarb Sulfone Finds in California Ground Water and Registrants' Opportunity to Request Hearing, and the Notice of Hearing Pertaining to Aldicarb (December 13, 1988), the subcommittee held hearings to review registrant reports, public comment, and other appropriate information regarding the presence of aldicarb and breakdown products in ground water and soil in California. After review of this information, the subcommittee offers the following findings and recommendations to the Director. These findings were agreed upon by the representatives of the Department of Health Services and the State Water Resources Control Board but not the representative of the Department of Food and Agriculture. The minority report which includes findings and recommendations is also attached.

Acknowledgements

The subcommittee thanks those who provided information about aldicarb, including facts about its toxicology, use, and potential relationships to ground water pollution. Additionally, we thank the staffs of the County Agricultural Commissioners and the cooperative U.C. Extension Service who took time to discuss with us the agricultural practices in areas where aldicarb is used and/or has been found in ground water.

PESTICIDE CONTAMINATION PREVENTION ACT
SUBCOMMITTEE
REPORT ON FINDINGS AND CONCLUSIONS ON
ALDICARB

SEPTEMBER 27, 1989

I. Introduction

The subcommittee established pursuant to Section 13150 of the Pesticide Contamination Prevention Act (the Act) has completed its deliberations on the pesticide aldicarb. This report contains the findings of the subcommittee as determined by vote of the subcommittee on September 13, 1989.

In arriving at its findings, the subcommittee has carefully considered whether it could make any of the findings specified in subdivision (c) of Section 13150 of the Act. This question must be clearly addressed, because the Act provides that if none of the findings of subdivision (c) of Section 13150 is made, the economic poison shall be canceled (Section 13151). The subcommittee has determined that none of the findings specified in subdivision (c) of Section 13150 can be made. The findings of the subcommittee follow.

II. Findings

The subcommittee finds that:

a) Aldicarb and its degradation products have polluted, and continue to threaten to pollute, the groundwaters of the State.

b) No modified agricultural uses of aldicarb have been identified which would result in a high probability that aldicarb would not pollute the groundwaters of the State.

c) Cancellation of aldicarb will not cause severe economic hardship on the State's agricultural industry.

d) Aldicarb ~~has failed to meet the conditions of~~ Section 13150(c) of the Pesticide Contamination Prevention Act, as required in Sections 13150 and 13151 for continued registration.

III. Discussion

A. Determination of "Pollution Level"

In making findings pursuant to the Act, the subcommittee must determine a level of "pollution" as defined in the Act. The subcommittee has determined, after consultation with the Department of Health Services, that available data do not support establishment of a specific numerical "pollution level" for aldicarb which would satisfy the definition of the Act.

("Aldicarb" as used in this report means the parent compound aldicarb as well as its oxidation products aldicarb sulfoxide and aldicarb sulfone.) Because of the extremely high toxicity of aldicarb and these oxidation products, it is not possible to assure "with an adequate margin of safety" that any given level of aldicarb in drinking water may be added to the existing residues in the average diet and "not cause adverse health effects." Therefore, the subcommittee has determined that "pollution" shall mean the detectable presence of aldicarb, aldicarb sulfoxide, or aldicarb sulfone in groundwater. This determination is consistent with the Act's definition of "pollution," and with the subcommittee's previous deliberations and findings on other economic poisons. The subcommittee's choice of this intentionally low "level of pollution" relates to uncertainties in the interpretation of toxicological data, as well as to concern for effects of total dietary exposure to aldicarb. In brief, the subcommittee considered the following points, among others.

1. Aldicarb is a very potent cholinesterase (ChE) inhibitor, and one of the most acutely toxic pesticides known. Its dose-response relationship shows that toxicity rises rapidly with increasing dose, i.e. there is little margin between a dose yielding no apparent toxic response and an acutely toxic dose. This indicates that there is little room for error when considering margins of safety.

2. Some states have established drinking water or groundwater standards for aldicarb. Wisconsin has a current groundwater standard of 10 ug/l (micrograms per liter), and a "Preventive Action Limit" of 2 ug/l. A groundwater standard of 1 ug/l has been proposed. New York has established a groundwater standard for aldicarb of 0.35 ug/l.

3. EPA has established a Reference Dose (RfD) of 1 ug/kg/day for aldicarb, and has proposed a Maximum Contaminant Level (MCL) of 10 ug/l, based on the RfD. The subcommittee is concerned about several uncertainties in the establishment of these levels. EPA has accepted as a "No Observed Effect Level" (NOEL) in humans a dose (10 ug/kg/day) which was extrapolated to yield 30 percent whole blood ChE inhibition in the relevant test on human subjects. There is not convincing evidence that depression of ChE activity to this extent whould have no adverse human health impacts, particularly if repeated or prolonged. On the contrary, epidemiological evidence from poisoning incidents suggests that toxic effects may occur at doses as much as ten times lower than reported in the human study.

   EPA's calculation of a proposed MCL of 10 ug/l is based on consumption of drinking water by adults. Consideration of consumption by infants and children could lead to an MCL of approximately one-third this value. If the RfD is also adjusted to account for the greater aldicarb toxicity indicated by epidemiological studies, a further lowering of the MCL by an order of magnitude may be appropriate.

4. Aldicarb residues occur in several foods, particularly potatoes and citrus crops. EPA has calculated that six percent of infants and children in the United States are currently being exposed to aldicarb in excess of the RfD, largely from potatoes and citrus. If drinking water contains the proposed MCL level of 10 ug/l, EPA calculates that 13 percent of infants would receive aldicarb doses in excess of the RfD in their diet, and 63 percent of infants would exceed an intake of half the current RfD.

While "detectable presence" has been determined by the subcommittee to be the appropriate "pollution level" for aldicarb, the subcommittee has also determined that its findings would not be altered by the use of any definition of "pollution" up to and including EPA's proposed MCL of 10 ug/l.

B. The Subcommittee's Finding "a"

Sampling results from Humboldt and Del Norte counties, and from the Central Valley, show clearly that aldicarb has been detected in, and thus has polluted, California's groundwater. Based on evidence from field leaching tests, the subcommittee finds it likely that current use practices have polluted, and continue to pollute, extensive areas of California's groundwaters. Due to the lack of monitoring for aldicarb in areas of heavy use, it is not possible to define the full extent to which pollution by aldicarb has occurred.

C. The Subcommittee's Finding "b"

Nationwide monitoring has shown that aldicarb may leach to groundwater under widely varying conditions of soil and weather. The registrant's field tests in the Central Valley of California have demonstrated that aldicarb moves readily through these soils into groundwater, to depths of at least 50 feet. At each of these sites where groundwater was sampled (Livingston, Fresno, and Turlock), it was found that a single small-plot application of aldicarb, with normal irrigation practices, resulted in groundwater pollution persisting for at least two to three years after the aldicarb use.

While conditions of use which have resulted in leaching of aldicarb to groundwater have been amply demonstrated, neither the registrant nor any other witness before the subcommittee has presented any conditions of use where leaching has been shown not to occur. The registrant has in this hearing attempted to interpret positive finds of leaching as evidence that under other conditions this result would not have occurred. This interpretation constitutes the only evidence presented to the subcommittee to indicate that any agricultural use of aldicarb can be made without endangering groundwater. As a result, the subcommittee has concluded that neither it, nor any witness before it, nor any source consulted by the subcommittee, has

knowledge of any current or modified agricultural use of aldicarb which can be employed with a high probability that groundwater would not be polluted.

In this regard, the Department of Food and Agriculture (DFA) presented a proposed finding and recommendations to the subcommittee for its consideration. The subcommittee has declined to adopt DFA's proposal, for reasons which include those outlined below. DFA proposed that the subcommittee make a finding pursuant to paragraph 13150(c)(2) of the Act, i.e. a finding that agricultural use of aldicarb could be modified so that there would be a high probability that aldicarb would not pollute the groundwaters of the State. The recommendations offered by DFA as the proposed "modified use" to prevent groundwater pollution were essentially DFA's recently adopted "Pesticide Management Zone" (PMZ) regulations. Under these regulations, DFA will designate a "section" of land (roughly one square mile) as a PMZ for a given pesticide after pollution of groundwater by that pesticide has been found in that section. DFA may then require special permitting and reporting (in some cases banning) of the pesticide within the PMZ.

The subcommittee concludes that DFA's proposed recommendations, and the PMZ regulations in their current form, are not modified agricultural uses in the sense of the Act. A finding pursuant to paragraph 13150(c)(2) of the Act requires modified agricultural uses which will give "a high probability that the economic poison would not pollute" groundwater. Since a PMZ is designated in an area only after groundwater pollution by a pesticide has already occurred and been detected, the PMZ's will have no value in preventing groundwater pollution by aldicarb from occurring, and are not relevant to the preventive requirement of paragraph 13150(c)(2).

D. The Subcommittee's Finding "c"

Aldicarb may be locally important to some growers, but no testimony has been presented to the subcommittee suggesting that its cancellation would cause a severe economic hardship on the State's agricultural industry. Its cancellation may affect some crop patterns, e.g. sugar beets, but in most cases alternative products are available or the impact on crop yield will be minimal.

E. The Subcommittee's Finding "d"

Section 13151 of the Act requires that any pesticide being considered by the subcommittee "which fails to meet any of the conditions of Section 13150 shall be canceled." Aldicarb has failed to meet the conditions of Section 13150(c), in that the subcommittee has declined to make any of the findings specified in paragraphs (1), (2), and (3) of that section. The subcommittee has in fact made directly contrary findings. It is the subcommittee's understanding and intent that the California registration of aldicarb will now be canceled.

IV. Closing remarks

The subcommittee wishes to thank all who participated in the hearing as witnesses, staff, or sources of technical information. The members representing the Department of Health Services and the State Water Resources Control Board wish to particularly acknowledge the fair and firm chairmanship of Mr. Lyndon Hawkins of the Department of Food and Agriculture, who guided the subcommittee's proceedings through to a timely conclusion. The subcommittee also wishes to express concern over the lack of participation in the hearing process by potentially interested individuals or groups representing diverse viewpoints. Increased effort may be fruitful in future hearings to encourage broad public participation.

Donald C. Mengle
Department of Health Services

H. Paul Lillebo
State Water Resources
Control Board

SUBCOMMITTEE OF THE
PESTICIDE REGISTRATION AND EVALUATION COMMITTEE

IMPLEMENTING OF THE PESTICIDE CONTAMINATION PREVENTION ACT\
ALDICARB: FINDINGS AND RECOMMENDATIONS OF THE
DEPARTMENT OF FOOD AND AGRICULTURE

MINORITY REPORT
September 28, 1989

FINDINGS

Finding One

The representative of CDFA on the subcommittee cannot make Finding One (Food and Agricultural Code [FAC] Section 13150[c][1]) because in the absence of a pollution level it cannot be determined whether or not aldicarb pollutes ground water, and based on its detection in ground water and the uncertainties of the impact of continued unmodified use of aldicarb in sensitive areas, it cannot be determined that aldicarb does not threaten to pollute ground water.

Finding Two

The CDFA representative on the subcommittee finds that the agricultural use of aldicarb can be modified so that there is a high probability that aldicarb would not pollute the ground waters of the state. The justification for this recommendation is attached. Also attached are recommendations for modifying use and for monitoring of soil and ground water are attached. Under these conditions the minority finding is Finding Two specified in FAC Section 13150(c)(2).

Finding Three

The CDFA representative on the subcommittee cannot determine whether modified use of aldicarb would cause severe economic hardship on the agricultural industry of the state because available information is not conclusive. Furthermore, no recommendation is made of a level of aldicarb that does not significantly diminish the margin of safety not to cause adverse health effects because the health data are not complete. Therefore, Finding Three specified in FAC Section 13150(c)(3) cannot be made.

Lyndon S. Hawkins
Chair, Subcommittee of the Pesticide
Registration Evaluation Committee

JUSTIFICATION FOR FINDING TWO

I. The PREC Subcommittee has reviewed the detection of five other pesticides (atrazine, simazine, bromacil, diuron, and prometon) found in ground water due to legal agricultural use and in each case has recommended finding two: that their agricultural use could be modified so that there is a high probability that these pesticides would not pollute the ground waters of the State.

II. The agricultural use of aldicarb can be similarly modified because the characteristics and detection history of aldicarb fall within the range of characteristics and detection history of atrazine, simazine, bromacil, diuron, and prometon as follows:

A. Modeling Studies

Modeling studies show that aldicarb is a potential leacher similar to other pesticides that have been found in California ground water. Models are developed to represent or approximate complex systems and can be classified as research, management/educational, or screening models (Wagenet, 1986). Screening models are mathematical or experimental procedures designed to discriminate between the performance of defined elements (such as pesticides) in an idealized scenario (Jury et al., 1988).

Screening models have been developed to give a comparison of the relative potential of pesticides to leach and can be used to select chemicals for actual ground water monitoring (Rao et al., 1985). These models cannot be used to predict pesticide movement under actual field conditions (Wagenet, 1986).

The screening model developed by Jury et al. (1987) ranked five pesticides found in California ground water in order of increasing leaching potential as follows: atrazine, simazine, diuron, aldicarb, and bromacil. The model by Rao et al. (1985) ranked the same pesticides in order of increasing potential as atrazine, simazine, aldicarb, diuron, and bromacil. In both cases, aldicarb is rated as having a lower leaching potential than pesticides which the subcommittee has previously recommended that use can be modified so that there is a high probability that pollution would not occur.

B. Physical and Chemical Factors

Physical and chemical factors indicate that aldicarb is a potential leacher similar to other pesticides that have been found in California ground water. Physical and chemical factors that have been determined to affect the leaching of chemicals have been used to compare the relative mobility of agricultural chemicals applied to soil (Rao et al., 1985; Jury et al., 1987). These factors include water solubility, soil adsorption coefficient (Koc), hydrolysis, and aerobic metabolism. In AB 2021, these factors are grouped as either mobility factors (water solubility, Koc) or persistence factors (hydrolysis, aerobic metabolism). Pesticides which are determined to be both mobile and persistent based on at least one factor in each group are designated as potential leachers. The following table shows values of these factors for atrazine, simazine, bromacil, diuron, prometon, and aldicarb (Johnson, 1988).

	Water Solubility	Koc	Hydrolysis	Aerobic Metabolism
Atrazine	33	180	160	190
Simazine	4.9	220	110	110
Bromacil	820	60	110	300
Diuron	42	460	110	NA
Prometon	720	79	NA	280
Aldicarb	6000	79	1330*	46*
Specific Numerical Values	>4	<2400	>9	>730

* CDFA Registrant Data

Water Solubility: Values greater than 4 indicate a potential leaching pesticide. Water solubility for aldicarb is almost an order of magnitude greater than the next highest pesticide, bromacil. Greater water solubility might indicate greater potential for leaching. However, the differences between bromacil and aldicarb may be minimized when the amounts of irrigation or rainfall are considered. For example, at an application rate of 15 lbs active ingredient/acre which is greater than any crop label application rate, either pesticide theoretically would be completely solubilized in an irrigation or rainfall of .10 inches. Since irrigation rates are normally much greater than .10 inches, water solubility probably does not distinguish between the leaching potential of bromacil and aldicarb.

It should also be noted that oxymayl and dicamba, both found in ground water due to agricultural use in other States, have higher water solubility values (280,000 and 6100, respectively) than aldicarb, but have not been found in California ground water.

Koc: Values less than 2400 indicate a potential leaching pesticide. The Koc for bromacil is lower than aldicarb indicating a higher leaching potential for bromacil. The Koc for prometon is the same as aldicarb.

Hydrolysis Values greater than 9 indicate a potential leaching pesticide. Aldicarb is significantly more stable in water at pH 7 than the other five pesticides.

Aerobic Metabolism: Values for aerobic metabolism cannot be used to distinguish leaching pesticides from non-leaching pesticides. However, the aerobic metabolism value (at 25° C) for aldicarb is less by almost an order of magnitude than the other pesticides found in ground water indicating a significantly greater degradation rate for aldicarb.

Thus, regarding mobility (water solubility, Koc), aldicarb is more soluble than the other five leaching pesticides but falls in the range of Koc values for the other five. Under irrigated conditions in California, differences in solubility are minimized because of the high amount of residues solubilized in a single irrigation.

Regarding persistence (hydrolysis, aerobic metabolism), aldicarb is stable in water at pH 7 but has a shorter aerobic metabolism half-life than the other leaching pesticides. This simply reflects the different pathways of degradation of these compounds. Atrazine, simazine, bromacil, diuron, and prometon are degraded hydrolysis whereas aldicarb is degraded mainly by oxidation (Rhone Poulenc, 1989).

C. Sampling

The locations of sampling and numbers of samples analyzed for aldicarb residues are similar to other pesticides found in California ground water. AB 2021 requires that the CDFA maintain a statewide data base of wells sampled for pesticide active ingredients (Food and Agricultural Code [FAC] §13152[c]). In consultation with the California Department of Health Services and the State Water Resources Control Board, the contents of this data base are annually reported to the Legislature (FAC §13152[e]).

Cumulatively, the well inventory data (Well Inventory Data Base, 1979-89 sampling period) show that between 1984 and 1987 aldicarb was extensively sampled for in California wells. A total of 558 wells were sampled in 34 counties, resulting in the detection of aldicarb in 34 wells located in Del Norte and Humboldt Counties. To date, aldicarb has not been found in any of the remaining 32 counties that have been sampled (County Summary of Aldicarb Information: Sampling and Use Data submitted to the subcommittee). Most of the sampling was conducted as part of the statewide well survey mandated by AB 1803 and carried out by the CDHS. AB 1803 requires sampling for many chemicals, including pesticides, from both large and small municipal water systems that may draw from shallow or deep wells.

The following table shows the number of counties sampled, the number of positive counties, and the number of total samples analyzed based on reports submitted between 1986-1988 for atrazine, simazine, bromacil, diuron, prometon, and aldicarb (Brown et al., 1986; Ames et al., 1987; Cardozo et al., 1988).

	Number of Counties Sampled	Number of Positive Counties	Number of Total Samples Taken
Atrazine	37	7	1691
Simazine	39	8	1952
Bromacil	21	2	917
Diuron	29	1	1233
Prometon	12	1	498
Aldicarb	34	2	982

Generally, sampling for aldicarb took place in major agricultural counties where the pesticide has been used. Of the 34 counties sampled for aldicarb, 27 have reported that the pesticide was used during 1987, the most recent data available. Sampling was conducted in 7 counties where no aldicarb use was reported and no sampling was done in 11 counties where some aldicarb use was reported. Sampling for the other five leaching pesticides occurred in the major agricultural counties of the State. Aldicarb was found in only 2 counties compared to atrazine which was found in 7, and simazine which was found in 8. In addition, more samples have been taken for aldicarb than for bromacil and diuron, both of which the subcommittee recommended could be used under modifications to prevent pollution.

D. Levels detected in pumping wells and drinking water health levels.

The levels detected and health level for aldicarb are similar to other pesticides detected in California ground water. The following table shows the range of detections and drinking water health levels for aldicarb and the other five pesticides found in ground water:

	Range of Residue Levels Detected (ppb)	Median of Positive Detections (Range) (ppb)	Health Level (ppb)
Atrazine	.8 - 8.5[a]	.20	3[b]
Simazine	.02 - 1.4	.29	10[b]
Bromacil	.1 - 6.7	(.5 - .99)	90[c]
Diuron	.05 - 2.8	(.05 - .49)	10[c]
Prometon	.1 - 5.9	.25	100[c]
Aldicarb	.2 - 13.2[a]	1.15	10[d]

a. One well exceeded the Department of Health Services (DHS) action level. Range for aldicarb is from Humboldt County sampling.
b. Maximum contaminant level
c. EPA lifetime health advisory
d. DHS Action Level

Except for one well in which it was found at a higher level than the other leaching pesticides, aldicarb has been found at the same range of residue levels as the other leaching pesticides. The median positive level detected for all six chemicals falls close to 1 ppb or below, and the aldicarb drinking water health level is higher (safer) than atrazine and the same as simazine and diuron.

III. The US EPA has not yet adopted a program to prevent aldicarb contamination of ground water. The EPA has issued for public comment a Preliminary Determination of aldicarb (PD 2/3) and a Special Review Technical Support Document (June 1988) that are part of a special review process that will culminate in a final document (PD4).

The PD 2/3 is a draft plan for protecting ground water from contamination by the registered uses of aldicarb through label requirements, monitoring, and state management plans. Following a 90-day comment period, the EPA is in the process of reviewing comments and issuing a final plan to prevent aldicarb contamination of ground water. Although the Department is developing a state management plan, it will receive no guidance for modifying aldicarb use from the EPA until the final PD 4 document is issued.

IV. Since the characteristics of aldicarb and its detection history are similar to one or more of the other five pesticides found in California ground water and regulated under the Department's Ground Water Protection Program, it is appropriate to adopt similar regulations to prevent aldicarb movement to ground water. Under this program, the Department adopts regulations to modify the use of pesticides found in ground water or soil under certain conditions to prevent pollution of California ground water. These regulations (1) identify leaching pesticides, (2) designate such pesticides as restricted materials, (3) establish areas (Pesticide Management Zones-PMZs) sensitive to ground water contamination, (4) specify uses prohibited in PMZs, (5) require growers to submit ground water protection advisories in order to get permits to use leachers inside PMZs when allowed, (6) provide that advisories can only be written by Pest Control Advisers who have completed the Department's Ground Water Protection Training Program, and (7) require use and sales reporting of leaching pesticides.

Pursuant to recommendations by the PREC subcommittee, the Director has adopted such regulations to modify use of atrazine and has proposed regulations to modify use of simazine, bromacil, diuron, and prometon. Because aldicarb is a leaching pesticide similar to these other leaching pesticides, such regulations are also appropriate for modifying the use of aldicarb.

V. Detections of aldicarb in ground water in other states, and under the conditions of research authorizations in California, do not represent conditions of legal agricultural use in California.

Aldicarb has been found in ground water in 16 other states. However, detection of pesticides in other states has not been a good predictor of detection under California conditions. For example, Johnson (1988) has identified 26 pesticides that have contaminated ground water in the U.S. due to normal agricultural use, yet only 8 of the 26 have been found in California ground water due to such use. For this reason, actions to regulate pesticide use in California should not be based on detections in other states.

Aldicarb has also been detected in monitoring wells in the Central Valley where aldicarb was applied under a research authorization. Research authorizations are issued by the Department to allow registrants to collect data in support of registrations of new uses of pesticides in California. Such data is used to evaluate new uses and do not represent conditions of current allowed uses. If the data indicate that the experimental use of the pesticide may result in the contamination of ground water, the Department considers this information when deciding whether or not to register the pesticide for the new use. If the Department determines that the data suggest that existing uses may also contaminate the environment, the Department would place the pesticide in reevaluation and require registrants to conduct additional studies on currently registered uses.

VI. There is a high probability that aldicarb will not pollute ground water if deep percolation of water is significantly reduced.

Leaching pesticides are moved downward in soil by water either from rainfall or applied irrigation water. Without water, no leaching would occur. In areas of high rainfall following aldicarb application, it is difficult to control the amount of deep percolation. However, in areas where irrigation is the principal source of water following aldicarb applications, irrigating using a water budget method based on the amount of water actually used by the crop, can reduce deep percolation.

In California, programs have been developed to conserve water and reduce drainage. A prime example is in the Westlands Water District and the Westside Resource Conservation District where water conservation and drainage reduction measures are being implemented on a relatively large scale in the Central Valley where subsurface layers prevent deep percolation, resulting in perched water tables that damage crop roots. The same technology can be adopted by growers who use leaching pesticides in sensitive areas to reduce deep percolation of irrigation water and thus leaching of pesticides.

A study in Wisconsin (Wyman et al., 1985) demonstrated that downward movement of aldicarb downward in soil was reduced when aldicarb was applied at emergence rather than at planting, and when irrigations were applied at crop evapotranspiration (Et) rates rather than at greater than Et rates. This strategy would need to be tailored to California conditions.

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RECOMMENDATIONS

A. To assure current use of aldicarb does not threaten ground water, conduct soil and ground water monitoring in areas of highest aldicarb use with particular emphasis in areas of shallow ground water.

B. Establish aldicarb Pesticide Management Zones (PMZs) as follows:

1. All sections of land in Humboldt County where rainfall in relation to the monthly crop evapotranspiration and to application timing of aldicarb to any crop listed on the label of products containing aldicarb, result in a potential threat to ground water. This recommendation is based on (1) the registrants decision in 1984 to not register aldicarb for use in Del Norte County where such rainfall conditions appear to cause agricultural areas similar to those in Humboldt County to be sensitive to aldicarb contamination of ground water and (2) the Humboldt County Agricultural Commissioner's decision in 1985 to not issue permits for outdoor use of aldicarb in Humboldt County because of similarity of conditions to those in Del Norte County.

2. All sections of land outside Humboldt County where aldicarb is registered for use and has been found in soil as specified in the Pesticide Contamination Prevention Act or ground water due to legal agricultural use.

C. To protect ground water, establish the following use requirements for use of aldicarb inside PMZs:

1. Prohibit use in all PMZs in Humboldt County.

2. Modify use of aldicarb in PMZs outside Humboldt County as specified in Title 3 of the California Code of Regulations Section 6416, and emphasizing the critical role of irrigating using a water budget method to prevent aldicarb leaching.

D. Monitor soil in PMZs outside Humboldt County to evaluate the effectiveness of modification of use of aldicarb.

E. Develop a well head protection program to prevent direct point source contamination of ground water.

F. Continue field studies to identify factors influencing pesticide leaching and incorporate findings into the ground water protection training program.

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