UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

AUG 25 1995

OFFICE OF
PREVENTION, PESTICIDES AND
TOXIC SUBSTANCES

MEMORANDUM D209889/D209896

Subject: The Ecological Effects Branch's (EEB) environmental risk assessment for the use of the imidazolinone type herbicide CADRE on peanuts--- (Chemical Code 128943): DP Barcode D209889 and D209896.

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EEB has completed a risk assessment review for the use of the herbicide Cadre on peanuts. Attached is a copy of said review done in RED format.

Also, we have attached an environmental fate data summary faxed by Mr. Jack Arthur of American Cyanamid where he clarifies the proposed label application rate to be 0.063 lb ai/A and the application frequency as once a year.

For further information on this issue, please contact Alvaro Yamhure or Norm Cook of the EEB staff.

C. ENVIRONMENTAL ASSESSMENT

1. Submission Purpose and Pesticide Use

a. Purpose

The registrant, American Cyanamid Company, proposes registering Cadre Herbicide for use on peanuts. Cadre, also known as the ammonium salt of AC-263222, is a new active ingredient that is a member of the imidazolinone herbicide chemical family. It is the fifth active ingredient in this family submitted for registration; the other four chemicals are: imazapyr (Arsenal), imazamethabenz (Assert), imazaquin (Scepter), and imazethapyr (Pursuit).

b. Application Methods, Directions, Rates

Cadre, which contains 2.0 pounds (lbs.) active ingredient (ai) per gallon, is to be applied early postemergence in peanuts. Applications are by **ground only** in ten or more gallons of water per acre and with a spray pressure of 20 to 40 psi; **helicopter, airplane, or other aerial applications are prohibited**. Application rates are from **3 to 4 ounces of product per acre or 0.047 to 0.063 lb. ai per acre, respectively**. Also, Cadre can be tank-mixed with other herbicides.

c. Present Precautionary Labeling

The following environmental precautionary labeling is found on the label:

ENVIRONMENTAL HAZARDS

For terrestrial use only. DO NOT apply directly to water, or to areas where surface water is present, or to intertidal areas below the mean high water mark.

DO NOT contaminate water when disposing of equipment washwaters.

Under the "Directions for Use" section the following restrictions are also found:

DO NOT apply this product through any type of irrigation system.

DO NOT graze or feed treated peanut foliage, vines, hay or straw to livestock.

The label (attached) should be consulted for further restrictions.

2. Ecological Toxicity Data

EFED has adequate data needed to assess the acute hazard of Cadre to nontarget terrestrial organisms for the peanuts use.

a. Toxicity to Terrestrial Animals

(1) Birds, Acute and Subacute

In order to establish the toxicity of Cadre to birds, the following tests are required using the technical grade material: one avian single-dose oral (LD_{50}) study on one species (preferably mallard or bobwhite quail); two subacute dietary studies (LC_{50}) on one species of waterfowl (preferably the mallard duck) and one species of upland game bird (preferably bobwhite quail).

Avian Acute Oral Toxicity Findings

Species	% A.I.	LD_{50} mg/kg	MRID No. Author/Year	Toxicity Category	Fulfills Guideline Requirement
Northern Bobwhite	93.7	>2150 mg/kg	427114-31	practically non-toxic	Yes
Mallard	93.7	>2150 mg/kg	427114-30	practically non-toxic	Yes

Avian dietary studies are required to support registration of an end-use product intended for outdoor application and in a case-by-case basis may be required for products intended solely for indoor application or for manufacturing-use products to be used in the production of end-use products. These studies are used to determine the median lethal concentration (LC_{50}) of a chemical to the surrogate avian species (bobwhite quail and mallard duck).

Avian Subacute Dietary Toxicity Findings					
Species	% A.I.	LC_{50} ppm	MRID No. Author/Year	Toxicity Category	Fulfills Guideline Requirement
Northern Bobwhite	93.7	>5000 ppm	427114-32 433203-04[1]	practically non-toxic	Yes
Mallard	93.7	>5000 ppm	427114-33 433204-04[1]	practically non-toxic	Yes

[1] Avian diet residue analysis data which allowed upgrade of study to core from supplemental.

These results indicate that Cadre is practically non-toxic (Brooks et al, 1973) to avian species on an acute oral and subacute dietary basis. The guideline requirements are fulfilled (MRID #s 427114-30/31/32 and /33 and 433204-04).

(2) Birds, Chronic

Avian reproductive studies are not available now. In order to address the potential for adverse effects from chronic or reproductive effects to birds and reptiles this, type of study is required for an adequate estimation of risk.

Avian reproduction studies are required when birds may be exposed repeatedly or continuously through persistence, bioaccumulation, or multiple applications, or if mammalian reproduction tests indicate reproductive hazard. For Cadre, persistance is a key concern; therefore, avian reproduction studies using bobwhite quail and mallard duck are required [guidelines 71-4(a) and 71-4(b)].

(3) Mammals

Wild mammal testing is required on a case-by-case basis, depending on the results of the lower tier studies such as acute and subacute testing, intended use pattern, and pertinent environmental fate characteristics. In most cases, however, an acute oral LD_{50} from the Agency's Health Effects Division (HED) is used to determine toxicity to mammals (HED Tox Oneliners). This LD_{50} is reported below.

Mammalian Acute Oral Toxicity Findings			
Species	**LD_{50} mg/kg**	**MRID #**	**Toxicity Category**
Rat (small mammal surrogate)	> 5000 mg/kg males and females	427114-07	Practically non-toxic

The available mammalian data indicate that Cadre is practically non-toxic to small mammals on an acute oral basis. (MRID # 427114-07)

(4) Insects

A honey bee acute contact LD_{50} study is required if the proposed use will result in honey bee exposure.

Nontarget Insect Acute Contact Toxicity Findings					
Species	**% AI**	**LD_{50} µg a.i./bee**	**MRID No.**	**Toxicity Category**	**Fulfills Guideline Requirement**
Honey Bee	93.7	> 100 ug ai/bee	427114-38	Practically non-toxic	Guideline or core

There is sufficient information to characterize Cadre as practically non-toxic to bees. The guideline requirement is fulfilled. (MRID No. 427114-38).

b. Toxicity to Aquatic Animals

(1) Freshwater Fish

In order to establish the toxicity of a pesticide to freshwater fish, the minimum data required on the technical grade of the active ingredient are two freshwater fish toxicity studies. One study should use a coldwater species (preferably the rainbow trout), and the other should use a warmwater species (preferably the bluegill sunfish).

Freshwater Fish Acute Toxicity Findings					
Species	**% A.I.**	**LC_{50} ppm a.i.**	**MRID No.**	**Toxicity Category**	**Fulfills Guideline Requirement**
Rainbow trout	93.7	>100 mg/l	427114-35	practically non-toxic	Yes
Bluegill sunfish	93.7	>100 mg/l	427114-34	practically non-toxic	Yes

The results of the 96-hour acute toxicity studies indicate that Cadre is practically non-toxic to fish. The guideline requirements are fulfilled. (MRID 427114-34/35).

Data from fish early life-stage and aquatic invertebrate life-cycle studies (whichever species is most sensitive to the pesticide as determined from the results of the acute toxicity tests) are required if the product is applied directly to water or expected to be transported to water from the intended use site, the pesticide is intended for use such that its presence in water is likely to be continuous or recurrent regardless of toxicity; or if any acute LC_{50} or EC_{50} is less than 1 mg/L; or if the EEC in water is equal to or greater than 0.01 of any acute EC_{50} or LC_{50} value; or if the actual or estimated environmental concentration in water resulting from use is less than 0.01 of any acute EC_{50} or LC_{50} value and any of the following conditions exist: studies of other organisms indicate the reproductive physiology of fish and/or invertebrates may be affected; or physicochemical properties indicate cumulative effects; or the pesticide is persistent in water (e.g. half-life greater than 4 days).

The fish embryo-larvae study is required because of Cadre's persistance in the environment. This type of study is needed by EEB for chornic risk assessment purposes.

(2) Freshwater Invertebrates

The minimum testing required to assess the hazard of a pesticide to freshwater invertebrates is a freshwater aquatic invertebrate toxicity test, preferably using first instar *Daphnia magna* or early instar amphipods, stoneflies, mayflies, or midges.

Aquatic Invertebrate Acute Toxicity Findings				
Species	**% A.I.**	**LC_{50}**	**MRID No. Author/Year**	**Fulfills Guideline Requirement**
Daphnia magna	93.7	>100 mg/l	427114-37	Yes

The results of the acute daphnid test indicate that Cadre is practically non-toxic to the surrogate aquatic invertebrate tested. The guideline requirement is fulfilled. (MRID No. 427114-37). However, in order to assess chronic risks, a daphnid life-cycle study [72-4(b)] is required. Again, the environmental persistence of Cadre dictates the need for this type of testing.

(3) Estuarine and Marine Animals

Acute toxicity testing with estuarine and marine organisms is required when an end-use product is intended for direct application to the marine/estuarine environment or is expected to reach this environment in significant concentrations.
The requirements under this category include a 96-hour LC_{50} for an estuarine fish, a 96-hour LC_{50} for shrimp, and either a 48-hour embryo-larvae study or a 96-hour shell deposition study with oysters. Given the acute freshwater animal data and the EEC values obtained for the use, rate and application methods proposed on the peanut label, these data are not required at this time.

c. Toxicity to Plants

(1) Terrestrial

Currently, terrestrial plant testing (seedling emergence and vegetative vigor) is required for herbicides which have terrestrial non-residential outdoor use patterns and appear to move off site of application through mechanisms such as runoff, volatilization (vapor pressure $\geq 1.0 \times 10^{-5}$mm Hg at 25°C) or drift (aerial or irrigation); and/or which may affect endangered or threatened plant species associated with the site of application (peanuts). The above conditions apply to Cadre in that Cadre is very water

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soluble and leaches easily from soil as demontrated by its low Kd/Koc value [refer to Section (4) of this review for EEB's present statement on endangered species statement].

Tier II toxicity data on the technical/TEP (96.9%) material for the most sensitive species is listed below:

Nontarget Terrestrial Plant Toxicity Findings for Cadre Technical
Tier II Seedling Emergence (MRID 433203-08 Test fulfills requirements)
Most Sensitive Endpoints.

Surrogate Species	% A.I.	EC_{25} lb a.i./A (Dry Weight)[1]
Dicot- Soybean	96.9%	0.041 (NOEC=0.032)
Dicot-Lettuce	96.9%	0.0033 (NOEC=0.0020)
Monocot-Onion	96.9%	0.0018 (NOEC=0.0010)
Monocot-Corn	96.9%	0.0076 (NOEC=0.0040)
Monocot-Oats	96.9%	**Plant height** 0.0041 (NOEC=0.0040)
Dicot-Tomato	96.9%	>0.0010 - <0.0020 (NOEC 0.0010)
Dicot-Cabbage	96.9%	0.00043 (NOEC=0.000050)
Dicot-Cucumber	96.9%	0.0014 (NOEC 0.00050)
Monocot-Ryegrass	96.9%	0.0014 (NOEC=0.0010)

[1]Except where noted.

For seedling emergence, the EC_{25} and EC_{50} for all seeds were > 0.064 lb ai/A. The lowest NOEC was 0.032 lb ai/A for onion. For all other species, the NOEC was 0.064 lb ai/A.

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Vegetative Vigor (MRID 433203-09 Tier II Test fulfills requirements) -
Lowest EC_{25} Value for Each Parameter

Parameter	EC_{25} (lb ai/A)	Crop
Percent survival	0.0073	-Onion
Plant height	0.0011	-Oats
Plant dry weight	0.0017	-Cabbage

Vegetative Vigor (MRID 433203-09 Tier II Test fulfills requirements) -
Lowest NOEC Levels for Each Parameter Tested

Parameter	NOEC (lb ai/A)	Crop
Phytotoxicity rating	0.0010	Cabbage, cucumber, tomato
Percent survival	0.0080	Radish, onion
Plant height	0.0020	Radish, tomato, cucumber, cabbage, onion
Plant dry weight	0.00050	Radish

The above tables, for the vegetative vigor test, list the most sensitive species and the corresponding NOECs and EC_{25}s. In terms of the EC_{25} the most sensitive plants were cabbage for dry weight, oats for plant height and onion for survival.

The results indicate that Cadre at the proposed label application rates is highly toxic test surrogate monocot and dicot species. The guideline requirements are fulfilled. (MRID #s 433203-08 and 433203-09)

(2) Aquatic

Currently, aquatic plant testing is required for any herbicide which has outdoor non-residential terrestrial uses that may move off-site of application by runoff (solubility >10 ppm in water), by drift (aerial or irrigation), or is applied directly to aquatic use sites (except residential). Cadre is very soluble in water and stable in the environment, both in soil and in water and likely to move offsite. The registrant has conducted the necessary aquatic plant studies as listed below: *Kircheria subcapitata*, formerly *Selenastrum capricornutum*, *Lemna gibba*, *Skeletonema costatum*, *Anabaena flos-aquae*, and a freshwater diatom (*Navicula pellicullosa*).

Tier I and II toxicity data on the technical material is listed below:

Nontarget Aquatic Plant Toxicity Findings					
Species	**Tier**	**MRID No.**	**% A.I.**	**EC25**	**EC_{50}**
Navicula pelliculosa (Freshwater diatom)	I	433203-10	96.9		> 46.4 ppb
Lemna gibba	II	433203-10	96.9	4.23 ppb	6.10 ppb
Selenastrum capricornutum	I	433203-10	96.9		>52.3 ppb
Skeletonema costatum	I	433203-10	96.9		>45.0 ppb
Anabaena flos-aquae	I	433203-10	96.9		>67.4 ppb

The guideline requirements are fulfilled with the above studies (MRID # 433203-10).

3. Environmental Fate

The environmental fate data used in this review is based on information provided by the registrant. A finalized EFGWB review was not available as EEB finalized its ecological risk characterization for the Cadre peanut use. However, once a final EFGWB review is available, EEB will reexamine its review and forward an amended one if EFGWB's conclusions differ significantly from the registrant's.

4. Exposure and Risk Characterization

a. Ecological Exposure and Risk Characterization

Explanation of the Risk Quotient (RQ) and the Level of Concern (LOC): The Levels of Concern are criteria used to indicate potential risk to nontarget organisms. The criteria indicate that a chemical, when used as directed, has the potential to cause undesirable effects on nontarget organisms. There are two general categories of LOC (acute and chronic) for each of the four nontarget faunal groups and one category (acute) for each of two nontarget floral groups. In order to determine if an LOC has been exceeded, a risk quotient must be derived and compared to the LOC's. A risk quotient is calculated by dividing an

appropriate exposure estimate, e.g. the estimated environmental concentration, (EEC) by an appropriate toxicity test effect level, e.g. the LC_{50}. The **acute** effect levels typically are:

-EC_{25} (terrestrial plants),
-EC_{50} (aquatic plants and invertebrates),
-LC_{50} (fish and birds), and
-LD_{50} (birds and mammals)

The **chronic** test results are the:

-NOEL (sometimes referred to as the NOEC) for avian and mammal reproduction studies, and either the NOEL for chronic aquatic studies, or the Maximum Allowable Toxicant Concentration (MATC), the geometric mean of the NOEL and the LOEL (sometimes referred to as the LOEC), for chronic aquatic studies.

When the risk quotient exceeds the LOC for a particular category, risk to that particular category is presumed to exist. Risk presumptions are presented along with the corresponding LOC's.

Levels of Concern (LOC) and associated Risk Presumption

Mammals, Birds

IF THE	LOC	PRESUMPTION
acute RQ≥	0.5	High acute risk
acute RQ≥	0.2	Risk that may be mitigated through restricted use
acute RQ≥	0.1	Endangered species may be affected acutely
chronic RQ≥	1	Chronic risk, endangered species may be affected chronically,

Fish, Aquatic invertebrates

IF THE	LOC	PRESUMPTION
acute RQ≥	0.5	High acute risk
acute RQ≥	0.1	Risk that may be mitigated through restricted use
acute RQ≥	0.05	Endangered species may be affected acutely
chronic RQ≥	1	Chronic risk, endangered species may be affected chronically **(over...)**

(...continued)

Levels of Concern (LOC) and associated Risk Presumption

Plants

IF THE	LOC	PRESUMPTION
RQ≥	1	High risk
RQ≥	1	Endangered plants may be affected

Currently, no separate criteria for restricted use or chronic effects for plants exist.

(1) Exposure and Risk to Nontarget Terrestrial Animals

(a) Birds

Residues found on dietary food items following application of 0.063 lb ai/A of Cadre may be compared to LC_{50} values to predict potential hazard. The maximum concentration of residues of Cadre which may be expected to occur on selected avian or mammalian dietary food items following a single application is provided in the table below:

Estimated Environmental Concentrations on Avian and Mammalian Dietary Food Items in PPM at a Single Maximum Application for the Peanuts Growing Season at a rate of 0.063 lb ai/A[1]

Food Items	Expected Cadre Concentration on Bird Food Items	LC_{50} (ppm)	Acute RQ (EEC/Lowest LC_{50})
Range Grasses (short)	15	5,000	0.003
Fruit/Vegetable Leaves (other than legumes)	7.0	5,000	0.0014
Forage Legumes and Insects	8.5	5,000	0.0017
Fruits/Seeds	1	5,000	0.0002

[1]From Fletcher, J.S. et al., 1994.

The low, once-a-season application rate (0.063 lb ai/A) combined with low avian acute toxicity values (LC_{50} > 5,000 ppm) result in extremely low RQs and therefore in practically non-existent acute avian risk. The avian acute LOCs (levels of concern)

have not been exceeded (see LOC table in page 9 of this review).

(b) **Mammals**

Small mammal exposure is addressed using acute oral LD_{50} values converted to estimate a LC_{50} value for dietary exposure. The estimated LC_{50} is derived using the following formula:

$$LC_{50} = \frac{LD_{50} \times \text{body weight (g)}}{\text{food cons. per day (g)}}$$

Small Mammal Food Consumption in PPMs (Based on an LD_{50} > 5000 mg/kg)

Small Mammal	Body Weight (grams)	% of Weight Eaten Per Day (%)	Food Consumed Per Day (grams)	Estimated LC_{50} Per Day (ppm)
Meadow vole	46	61	28.1	> 8,185
Adult field mouse	13	16	2.1	> 30,952
Least shrew	5	110	5.5	> 4545

The above table is based on information contained in Principles of Mammology by D. E. Davis and F. Golly, published by Reinhold Corporation, 1963.

The estimated LC_{50} is then compared to the residues listed above to calculate a risk quotient (EEC/LC_{50}). The table below indicates the risk quotients for each of the following application rates:

Mammalian Dietary Risk Quotients (based on Dietary RQ = EEC/Lowest LC_{50})		
Small Mammal	Application Rate = 0.063 lbs. a.i./A	
	EEC/LC_{50}(ppm)	RQs
Meadow vole consuming range grasses	15/>8,185	<0.002
Adult field mouse consuming seeds	1/>30,952	<0.00003
Least shrew consuming forage and insects	8.5/>4,545	<0.002

The above mammlian RQs indicate that at the proposed one/year label application rate of 0.063 lb ai/A application rate, using ground application only, this herbicide is not likely to have an adverse effect on nontarget small mammals.

(c) Insects

The honey bee test with an LD50 > 100 ug/bee and a NOEL of 36 ug/bee is considered to be practically nontoxic to this surrogate beneficial insect and labeling requirements are not likely to be needed.

(2) Exposure and Risk to Nontarget Aquatic Animals

Expected Aquatic Concentrations: Cadre displays low toxicity to most aquatic animals tested to date. EFED calculated generic EEC levels based on runoff from a 10 hectare field to a 1 hectare x 2 meter deep water body. The EEC used throughout this document has been estimated using the EFGWB's computer program named "Geneec" **(copy of the printout of the corresponding computer calculations is attached)**. This generic EEC (Geneec) takes into account degradation in the field prior to a rain event which in the case of Cadre is unlikely to take place. Cadre is a very stable chemical, both in water and soil; however, its potential adverse effects are somehow lessened because it is not applied [to peanuts] by aircraft and only a single, small (0.063 lb ai/A), ground application per season/year is allowed .

If the more refined EEC estimated using the more sophisticated Pesticide Root Zone Model (PRZM1) and the Exposure Analysis Modeling System (EXAMS II) is received from the EFGWB and if said EEC proves to be significantly different from the one calculated here with the Geneec computer program, the PRZM1/EXAMS II model will be given preference and, accordingly, all necessary data adjustments will be made to reflect the differences.

	ESTIMATED ENVIRONMENTAL CONCENTRATIONS (EECs) FOR THE AQUEOUS SOLUTION OF CADRE USING TWO KOC VALUES						
Crop	KOCs	Application Method	Application Rate in lbs a.i./A	Initial (Peak) EEC (ppb)	4-day EEC (ppb)	21-day EEC (ppb)	56-day EEC (ppb)
Peanuts	260	Ground	0.063	1.83	1.70	1.16	0.63
	8,140	Ground	0.063	0.193	0.153	0.063	0.028

Discussion: No KOC values were available from experimental data. The above KOC values were calculated by dividing the experimental Kd values by an estimated organic carbon percent concentration of 5% (0.05) and multiplying by 100. The organic carbon concentration, as well as the formula used were obtained from EFGWB and the designers of Geneec. As expected, the lower KOC value rendered higher EECs. The 4-day EEC (1.70 ppb) is the value used in this risk assessment for acute exposures.

(a) Freshwater Fish

(a) **Freshwater Fish**

Risk Quotients (RQ) for Freshwater Fish and Invertebrates		
Crop/application rate	Species	Acute RQ (96-hr)
Peanuts/0.063 lb ai/A	Bluegill Rainbow trout	$1.70/>100< 1.7 \times 10^{-5}$ $1.70/>100 < 1.7 \times 10^{-5}$
(same)	*Daphnia magna*	(same)

Discussion: The above RQs indicate minimal acute risk to aquatic vertebrates ond invertebrates. The LOCs for these surrogate organisms have not been exceeded.

(c) **Estuarine and Marine Animals**

Discussion: Based on the above RQs, estuarine/marine acute risks are unlikely. Therefore, these data are not required at this time.

(3) **Exposure and Risk to Nontarget Plants**

(a) **Terrestrial and Semi-aquatic**

Non-target terrestrial plants inhabit non-aquatic areas. Non-target "semi-aquatic" plants are plants that usually inhabit low-lying wet areas that may or may not be dry in certain times of the year. These plants are not obligatory aquatic plants in that they do not live in a continuously aquatic environment. The terrestrial and "semi-aquatic" plants are exposed to pesticides from runoff, drift or volatilization.

Runoff exposure is determined from a back of the envelope formula. This runoff is characterized as a one acre to one acre sheet runoff to an adjacent acreage that impacts terrestrial plants or a channelized runoff from 10 acres to a low lying

Spray drift exposure is determined for ground application by assuming 1% of the pesticide application will drift over to an adjacent acreage or to a much longer distance.

The following EECs have been determined for non-target terrestrial and semi-aquatic plants that would be exposed from the labeled application of 0.063 lb ai/A of Cadre:

(1) One acre to one acre sheet runoff = 0.032 lb ai/A (0.063 lb ai/A X 5% runoff) (terrestrial plants).

(2) Ten acre to one acre channelized runoff = 0.0032 lb ai/A (0.063 lb ai/A X 5% runoff X 10 A) (semi-aquatic plants).

(3)One acre to one acre spray drift = 0.00063 lb ai/A (0.063 lb ai/A X 1% spray drift) (terrestrial and semi-aquatic plants).

(4) One acre to one acre total loading - sheet runoff plus (+) spray drift = 0.0038 (0.032 lb ai/A + 0.00063 lb ai/A)

(5) Ten acre to one acre total loading - channel runoff plus (+) spray drift = 0.033 lb ai/A (0.032 lb ai/A + 0.00063 lb ai/A).

The EC_{25} value of the most sensitive species in the seedling emergence study is used with runoff exposure to determine the risk quotient. The EC_{25} value of the most sensitive species in the vegetative vigor study is used with the drift exposure.

RQ and EEC Values for Terrestrial and Semi-aquatic Plant Species				
Use Site	Maximum Application Rate	Type of EEC	EEC (lbs a.i./A)	Risk Quotient EEC/EC_{25}

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Peanuts	0.063	(1) sheet runoff	0.0032	7.4
		(2) channel runoff	0.032	74.4
		(3) spray drift	0.00063	0.57
		(4) (1) + (3)	0.0038	8.8
		(5) (2) + (3)	0.033	76.7

- **Seedling emergence lowest EC_{25} = 0.00043 lb ai/A**
- **Vegetative vigor lowest EC_{25} = 0.0011 lb ai/A**

Discussion: All estimated RQs for runoff and total loading are > 1. There is therefore a presumption of risk to terrestrial and semi-aquatic plants that may occur when Cadre is applied under the proposed label conditions. However, the RQ for spray drift only is less than one (<1).

(b) Aquatic Plants

Exposure to non-target aquatic plants may occur through either runoff from terrestrial sites, or drift from aerial application. Of course, aquatic plants are directly exposed from the aquatic weed control use. However, since they are the "target area" for that use, risk from such exposure is not estimated. For the aquatic weed control use, only risk caused by spray drift from aerial treatment of aquatic weeds is assessed for the non-targets.

Runoff and drift exposure for aquatic plants has been estimated in this review using the EFGWB GENEEC computer program (when the more refined PRIZM1/EXAMS II is not available) which yielded a concentration of 1.83 ppb in 2 meters of water resulting from a ten hectare field treated with Cadre.

The risk assessment is usually made for aquatic vascular plants from the surrogate duckweed species *Lemna gibba* (EC_{50} = 6.10 ppb) . However, algae and diatom risk quotients are useful indicators to determine impact to food sources of

The risk assessment is usually made for aquatic vascular plants from the surrogate duckweed species *Lemna gibba* (EC_{50} = 6.10 ppb) . However, algae and diatom risk quotients are useful indicators to determine impact to food sources of aquatic organisms.

RQ and EEC Values for Aquatic Plant Species					
Use Site	Maximum Application Rate	Type of Plant	Type of EEC	EEC (ppb)	Risk Quotient (EEC/EC50)
Peanuts	0.063 lb ai/A	vascular (*Lemna gibba*) EC_{50} = 6.10 ppb	GENEEC	1.83	1.83 ppb/6.10 ppb = **0.3**
		Algae or diatom (S. costatum) EC_{50} > 45 ppb	GENEEC	1.83	1.83 ppb/>45.0 ppb ≤ **0.041**

Discussion: The RQs for aquatic plants have been estimated to be under 1 which is the level of concern for both common and endangered aquatic plants. No adverse risk to this group of plants is anticipated from the proposed label use.

(4) Endangered Species

(a) Endangered Animals

The acute RQs developed earlier for non-endangered terrestrial and aquatic animals do not exceed the LOCs for endangered mammals (0.1), birds (0.1), or aquatic organisms (0.05). Therefore, acute risks to endangered mammals, birds, and aquatic organisms are unlikely. However, EEB is unable to assess chronic risks because pertinent data are lacking.

(b) Endangered Terrestrial and Semi-Aquatic Plants

The EECs developed above for non-endangered terrestrial and semi-aquatic plants are compared to the most sensitive NOEC for these plants. This approach results in the following Rqs:

Scenario[1/]	EEC (lb ai/A)	Risk Quotient (EEC/NOEC)[2/]
(1) Runoff	0.0032	64
(2) Runoff	0.032	640
(3) Drift	0.00063	13
(4) Total	0.0038	76
(5) Total	0.033	660

1/ Scenarios are from previous RQ and EEC table under Nontarget Plant section (3)(a).

2/ Seedling emergence lowest NOEC = 0.00005 lb. ai/A for cabbage. Used for scenarios (1), (2), (4), and (5).
Vegetative vigor lowest NOEC = 0.0005 lb. ai/A for radish. Used for scenario (3).

The RQs developed above (for runoff, total loading, and spray drift) exceed the LOC for endangered terrestrial and semi-aquatic plants LOC (1.0). Therefore, there is a presumption of risk to these organisms when Cadre is applied under the proposed label conditions.

(c) Endangered Aquatic Plants

The EEC developed above for non-endangered aquatic plants is compared to the most sensitive NOEC for these plants. This approach results in the following RQ:

Type of Plant	EEC (ppb)	Risk Quotient (EEC/NOEC)[1/]
Lemna gibba	1.83	0.43

1/ NOEC for this plant species = 4.23 ppb.

The RQ developed above for a representative aquatic plant does not exceed the LOC for endangered plants LOC (1.0). Therefore, no adverse risk to this group of plants is anticipated from the proposed label use.

(d) Endangered Species - Summary Remarks

Considering the above determinations for endangered terrestrial and semi-aquatic plants, formal consultation with the U. S. Fish and Wildlife Service (USFWS) may be

initiated regarding the use of this herbicide and the possible detrimental effects to federally listed endangered or threatened species. The formal consultation with USFWS should be considered before section 3 registration of Cadre is granted unless the label indicates that Cadre is not to be used in counties with endangered species and provides use limitations protecting endangered terrestrial and semi-aquatic plants.

However, EEB is willing to consider any of the registrant's proposals for risk reduction measures that may diminish potential risk to these endangered plants if they are intended to replace county restrictions or preclude formal consultations. Such measures must protect the endangered species. **To assist in this effort we have attached a listing of endangered terrestrial, semi-aquatic, and aquatic plants, by state and county, for the crop peanuts.** However, since the exact location of these species may not be known, entire counties, typically, must be excluded from use of Cadre. One way to reduce the number of counties where Cadre is prohibited is to have the registrant provide information as to the location of these endangered species. This information would be gathered through contacts with the endangered experts who have knowledge of locations of endangered species. This effort does not include field work. **(It is EEB's understanding that this effort is in progress via the newly formed Endangered Species Task Force (ESTF) of the Agricultural Crop Protection Association (ACPA).)**

5. Conclusions:

a. This risk assessment estimates that, given Cadre's toxicological and environmental fate profile as well as the use conditions for peanuts proposed on the label -- application rate (0.063 lb ai/A) and once a year ground application only -- only terrestrial and semi-aquatic plants (including endangered plants) may be adversely affected. The use of Cadre, as proposed on the label, is not likely to have adverse acute effects on animals nor on aquatic plants. Terrestrial and semi-aquatic plants (including endangered plants) could be at risk as demonstrated by the RQ values calculated earlier. For these groups of plants the LOC (1) is clearly exceeded many times.

b. EEB is unable to assess the potential chronic risks from the use of Cadre on peanuts. Because of Cadre's persistence in the environment and the proposed use pattern which will expose breeding birds and nontarget aquatic organisms, the following data are required on technical grade active ingredient (TGAI) to support registration:

71-4(a): Avian reproduction study using bobwhite quail;
71-4(b): Avian reproduction study using mallard duck;
72-4(a): Fish early life-stage test; and
72-4(b): Freshwater aquatic invertebrate life-cycle study.

c. The present precautionary labeling appears adequate for the end-use product.

6. Recommendations for Mitigation:

1). Use only ground applcation and as low an application rate as possible to mantain the intended effect.

2). Never use in counties where endangered terrestrial and semi-aquatic endangered plants are known to exist. A listing of these plants as well as their geographic location by counties is attached.

Other generic mitigation measures that can be considered are:

3). Use of alternate pesticides from treatment to treatment or from season to season;
4). Integrated pest management;
5). Education/training programs;
6). Proper equipment calibration; and
7). Regional/local use restrictions.

Attachments:

1. Endangered Plants Listing for Terrestrial and Semi-aqutic Plants Found in Areas Where Peanuts Are Grown.

2. Table of all core Cadre ecotoxicological data found in EEB files.

3. Table listing EEB data requirements for the use of Cadre on peanuts.

4. Geneec EEC calculations computer printout.

5. EEB's back of the envelope EEC calculations for terrestrial and semi-aquatic plants.

6. Environmental Fate Data Summary faxed by Jack Arthur of American Cyanamid (7/6/950.

7. Proposed label for the use of Cadre herbicide on peanuts.

Cadre Ecotoxilogical Acceptable (core) Data in the Ecological Effects Branch (EEB) Files as of 8/25/95.

(Maximum proposed application label rate of 0.063 lb ai/A)

Guide-line	MRID	Test Type	%ai	LC/LD/EC 50 NOEL/LOEL	EC25	Tox Level	Sta-tus
71-1(a)	427114-30	Mallard duck	93.7	LD_{50}>2150 mg/kg NOEL=1470 mg/kg		PNT	core
71-1(a)	427114-31	Bonwhite Quail	93.7	LD_{50}>2150 mg/kg NOEL 2150 mg/kg		PNT	core
71-2(a)	427114-32 433203-04[1]	Acute Diet. quail	93.7	LC_{50}>5000 ppm NOEC= 5000		PNT	core
71-2(a)	427114-33 433203-04[1]	Acute Diet. mallard duck	93.7	LC_{50}>5000 ppm NOEC= 5000		PNT	core
72-1(a)	427114-34	Acute bluegill	93.7	LC_{50}>100 mg/l		PNT	core
72-1(a)	427114-35	Acute rainbow trout	93.7	LC_{50}>100 mg/l		PNT	core
72-2(a)	427114-37	Acute D. magna	93.7	LC_{50}>100 mg/l		PNT	core
123-1(a)	433203-08	Seed Emerg. Phytotox. Tier II	96.9	NOEC 0.000050 lb ai/A (Dry wt. cabbage)	0.00043 lb ai/A (Cabbage)	VHT	core
122-2	433203-10	Lemna gibba Tier II	96.9	EC_{50}=6.10 ppb EC_{25}=4.23 ppb	4.23 ppb	VHT	core
Ditto	Ditto	S. costatum Tier I	96.9	EC_{50}>45.0 ppb		VHT	core
Ditto	Ditto	A. flos-aquae Tier I	96.9	EC_{50}>67.4 ppb		VHT	core
Ditto	Ditto	N. pelliculosa Tier I	96.9	EC_{50}>46.4 ppb		VHT	core
Ditto	Ditto	S.capricornutum Tier I	96.9	EC_{50}>52.3 ppb		VHT	core
123-1(a)	433203-08	Seed Germ. Phytotox. Tier II	96.9	EC_{50}>0.064 lb ai/A NOEC=0.032 lb ai/A (onion germ.)	>0.064 lb ai/A	VHT	core
123-1(b)	433203-09	Veg. Vig. Tier II	96.9	NOEC=0.00050 lb ai/A (radish, dry wt)	0.0017 lb ai/A (cabbage dry wt.)	VHT	core
141-1	427114-38	Honey bee	93.7	NOEL= 36 ug ai/bee LD_{50}> 100 ug ai/bee		PNT	core
81-1	427114-07	Rat acute oral LD_{50}	96.9	LD_{50}>5000 mg/kg (male and female)		PNT	guideline
82-1(a)	427114-19	Rat 3-month feeding	93.7%	NOEL $\geq$ 20,000 ppm		PNT	guideline
83-3	427114-22	Rat developmental	Tech	Developmental NOEL > 1000 mg/kg		PNT	Minimum

PNT = Practically non-toxic
VHT = Very highly toxic
1Avian diet residue analysis data which allowed upgrade of study to core from supplemental.

Date: 8/26/95
Case No: 014171
Chemical No: 128943

NEW CHEMICAL SCREEN
DATA REQUIREMENTS FOR
THE ECOLOGICAL EFFECTS BRANCH
AC 263,222 (CADRE)

Data Requirements	Composition[1]	Use Pattern[2]	Does EPA Have Data To Satisfy This Requirement? (Yes, No)	Bibliographic Citation (MRID, date study was reviewed)	Must Additional Data Be Submitted under FIFRA3(c)(2)(B)?
6 Basic Studies in Bold					
71-1(a) Acute Avian Oral, Quail	TGAI	A	Yes	427114-31	No
71-1(b) Acute Avian Oral, Duck	TGAI	A	Yes	427114-30	No
71-2(a) Acute Avian Diet, Quail	TGAI	A	Yes[3]	427114-32 433203-04	No
71-2(b) Acute Avian Diet, Duck	TGAI	A	Yes[3]	427114-33 433203-04	No
71-3 Wild Mammal Toxicity	----------	---	No	----------	No[4]
71-4(a) Avian Reproduction, Quail	TGAI	A	No	----------	Yes[5]
71-4(b) Avian Reproduction, Duck	TGAI	A	No	----------	Yes[5]
71-5(a) Simulated Terrestrial Field Study	----------	---	No	----------	No
71-5(b) Actual Terrestrial Field Study	----------	---	No	----------	No
72-1(a) Acute Fish Toxicity Bluegill	TGAI	A	Yes	427114-34	No
72-1(b) Acute Fish Toxicity Bluegill	TEP	---	No	----------	No
72-1(c) Acute Fish Toxicity Rainbow Trout	TGAI	A	Yes (Catfish also done)	427114-35 (427114-36 invalid)	No
72-1(d) Acute Fish Toxicity Rainbow Trout	TEP	---	No	----------	No
72-2(a) Acute Aquatic Invertebrate Toxicity	TGAI	A	Yes	427114-37	No
72-2(b) Acute Aquatic Invertebrate Toxicity	TEP	---	No	----------	No
72-3(a) Acute Estu/Mari Tox Fish	TGAI	---	No	----------	No
72-3(b) Acute Estu/Mari Tox Mollusk	TGAI	---	No	----------	No
72-3(c) Acute Estu.Mari Tox Shrimp	TGAI	---	No	----------	No

Date: 2/22/95
Case No: 014171
Chemical No: 128943

NEW CHEMICAL SCREEN
DATA REQUIREMENTS FOR
THE ECOLOGICAL EFFECTS BRANCH
AC 263,222 (CADRE)

Data Requirements	Composition[1]	Use Pattern[2]	Does EPA Have Data To Satisfy This Requirement? (Yes, No)	Bibliographic Citation (MRID, date study was reviewed)	Must Additional Data Be Submitted under FIFRA3(c)(2)(B)?
72-3(d) Acute Estu/Mari Tox Fish	(TEP)	---	No	----------	No
72-3(e) Acute Estu/Mari Tox Mollusk	(TEP)	---	No	----------	No
72-3(f) Acute Estu/Mari Tox Shrimp	(TEP)	---	No	----------	No
72-4(a) Early Life-Stage Fish	TGAI	---	No	----------	Yes[5]
72-4(b) Live-Cycle Aquatic Invertebrate	TGAI	---	No	----------	Yes[5]
72-5 Life-Cycle Fish	TGAI	---	No	----------	No
72-6 Aquatic Org. Accumulation		---	No	----------	No
72-7(a) Simulated Aquatic Field Study		---	No	----------	No
72-7(b) Actual Aquatic Field Study		---	No	----------	No
122-1(a) Seed Germ./Seedling Emerg.					
122-1(b) Vegetative Vigor					
122-2 Aquatic Plant Growth	TGAI	A	Yes	433203-10	No
123-1(a) Seed Germ./Seedling Emerg.	TGAI	A	Yes	433203-08	No
123-1(b) Vegetative Vigor	TGAI	A	Yes	433203-09	No
123-2 Aquatic Plant Growth		---	--	----------	--
124-1 Terrestrial Field Study		---	No	----------	No
124-2 Aquatic Field Study		---	No	----------	No
141-1 Honey Bee Acute Contact	TGAI	A	Yes	427114-38	No
141-2 Honey Bee Residue on Foliage	TGAI	A	No	----------	No
141-5 Field Test for Pollinators		---	No	----------	No

* In Bibliographic Citation column indicates study may be upgradeable

1. Composition: TGAI = Technical grade of the active ingredient; PAIRA = Pure active ingredient, radiolabeled; TEP = Typical end-use product

2. Use Patterns: A = Terrestrial Food Crop; B = Terrestrial Feed Crop; C = Terrestrial Non-Food Crop; D = Aquatic Food Crop; E = Aquatic Non-Food Outdoor; F = Aquatic Non-Food Industrial; G = Aquatic Non-Food Residential; H = Greenhouse Food Crop; I = Greenhouse Non-Food Crop; J = Forestry; K = Outdoor Residential; L = Indoor Food; M = Indoor Non-Food; N = Indoor Medical; O = Indoor Residential; Z = Use Group for Site 00000

3.Both dietary bird studies (quail and mallard) have been classified as supplemental and may be used for risk assessment purposes; however, further testing may be required if new uses or increased application rates are sought.

4.EEB reserves the right to request studies that have not been requested up to this point in the review process.

5. Based on use pattern and persistance of pesticide in the environment.

* In Bibliographic Citation column indicates study may be upgradeable

Listing of Endangered Terrestrial, Semi-Aquatic, and Aquatic Plants, by State and County for Peanuts

COUNTY	STATE	INVNAME	Exposure
BRUNSWICK	NC	AMARANTH, SEABEACH	Terrestrial
RANDOLPH	AL	AMPHIANTHUS, LITTLE	Aquatic
ETOWAH	AL	BARBARA'S BUTTONS, MOHR'S	Terrestrial
FRANKLIN	AL	BLADDERPOD, LYRATE	Terrestrial
MARION	FL	BONAMIA, FLORIDA	Terrestrial
MARION	FL	BUCKWHEAT, SCRUB	Terrestrial
GADSDEN	FL	CAMPION, FRINGED	Terrestrial
GADSDEN	FL	CHAFFSEED, AMERICAN	Terrestrial
OKALOOSA	FL	CLADONIA, FLORIDA PERFORATE	No Data
AIKEN	SC	CONEFLOWER, SMOOTH	Terrestrial
BURKE	GA	DROPWORT, CANBY'S	Semi-Aqu
MORGAN	AL	FERN, AMERICAN HART'S-TONGUE	Terrestrial
HARRIS	TX	FLOWER, TEXAS PRAIRIE DAWN	Semi-Aqu
JEFFERSON	FL	GOOSEBERRY, MICCOSUKEE (FLORIDA)	Semi-Aqu
FRANKLIN	AL	GRASS, TENNESSEE YELLOW-EYED	Semi-Aqu
DE KALB	AL	HARPERELLA	Semi-Aqu
LINCOLN	NC	HEARTLEAF, DWARF-FLOWERED	Semi-Aqu
MARTIN	NC	HEATHER, MOUNTAIN GOLDEN	Terrestrial
BEAUFORT	NC	JOINT-VETCH, SENSITIVE	Semi-Aqu
ST. CLAIR	AL	LEATHER-FLOWER, ALABAMA	Semi-Aqu
BEAUFORT	NC	LOOSESTRIFE, ROUGH-LEAVED	Semi-Aqu
WALTON	FL	MEADOWRUE, COOLEY'S	Semi-Aqu
MARION	FL	MINT, LONGSPURRED	Terrestrial
CHOCTAW	OK	ORCHID, EASTERN PRAIRIE FRINGED	Semi-Aqu
NORTHAMPTON	VA	PIGWEED, SEABEACH	Terrestrial
CALHOUN	FL	PINKROOT, GENTIAN	Terrestrial
AUTAUGA	AL	PITCHER-PLANT, ALABAMA CANEBRAKE	Semi-Aqu
DE KALB	AL	PITCHER-PLANT, GREEN	Semi-Aqu
MARION	FL	POLYGALA, LEWTON'S	Terrestrial
JACKSON	AR	PONDBERRY	Semi-Aqu
AUTAUGA	AL	POTATO-BEAN, PRICE'S	Terrestrial
FRANKLIN	AL	PRAIRIE-CLOVER, LEAFY	Semi-Aqu
GADSDEN	FL	RHODODENDRON, CHAPMAN	Semi-Aqu
TYRRELL	NC	SPIRAEA, VIRGINIA	Semi-Aqu
LINCOLN	NC	SUMAC, MICHAUX'S	Terrestrial
ROWAN	NC	SUNFLOWER, SCHWEINITZ'S	Terrestrial
GADSDEN	FL	TORREYA, FLORIDA	Semi-Aqu
HENRY	AL	TRILLIUM, RELICT	Terrestrial
DE KALB	AL	WATER-PLANTAIN, KRAL'S	Aquatic

CADRE

Attachment A

EEC CALCULATION SHEET

(Back of the Envelope)

I. For un-incorporated ground application

A. Runoff $0.063 \times 0.01 \times 10 = 0.0063$

0.063 lb(s) x 0.05* (_% runoff) x 10 (A) (from 10 A. drainage basin) = 0.0315 lb(s) (tot.runoff)

EEC of 1 lb a.i. direct application to 1 A. pond 6-foot deep = 61 ppb

Therefore, EEC = 61 ppb x 0.0315 (lb) = 1.922 ppb (5%)

$61 \times 0.0063 = 0.3843$ ppb (1%)

II. For incorporated ground application

A. Runoff

___lb(s) ÷ _____ (cm) (depth of incorporation) x 0.0_ (_% runoff) x 10 (A) (10 A d.basin) = _____lb(s) (tot.runoff)

Therefore, EEC = 61 ppb x _____(lbs) = _____ppb

III. For aerial application (or mist blower)

A. Runoff

____ lb(s) x 0.6 (appl. efficiency) x 0.0 (_% runoff) x 10 (A) (10 A. d.basin) = _____lb(s) (tot.runoff)

B. Drift

_____ lb(s) x 0.05 (5 % drift) = _____ lb(s) (tot. drift)

Tot. loading = _____ lb(s) (tot. runoff) + _____ lb(s) (tot. drift) = _____lb(s)

Therefore, EEC = 61 ppb x _____(lbs) = _____ppb

* 5% (0.05) used for highly water soluble compounds.

JR

RUN No. 1 FOR Cadre INPUT VALUES

RATE (#/AC) ONE(MULT)	APPLICATIONS NO.-INTERVAL	SOIL KOC	SOLUBILITY (PPM)	% SPRAY DRIFT	INCORP DEPTH(IN)
.063(.063)	1 1	260.0	36000.0	1.0	.0

FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)

METABOLIC (FIELD)	DAYS UNTIL RAIN/RUNOFF	HYDROLYSIS (POND)	PHOTOLYSIS (POND-EFF)	METABOLIC (POND)	COMBINED (POND)
.00	2	30.00	.25- 30.67	.00	15.17

GENERIC EECs (IN PPB)

PEAK GEEC	AVERAGE 4 DAY GEEC	AVERAGE 21 DAY GEEC	AVERAGE 56 DAY GEEC
1.83	1.70	1.16	.63

RUN No. 2 FOR Cadre INPUT VALUES

RATE (#/AC) ONE(MULT)	APPLICATIONS NO.-INTERVAL	SOIL KOC	SOLUBILITY (PPM)	% SPRAY DRIFT	INCORP DEPTH(IN)
.063(.063)	1 1	8140.0	36000.0	1.0	.0

FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)

METABOLIC (FIELD)	DAYS UNTIL RAIN/RUNOFF	HYDROLYSIS (POND)	PHOTOLYSIS (POND-EFF)	METABOLIC (POND)	COMBINED (POND)
.00	2	30.00	.25- 30.67	.00	15.17

GENERIC EECs (IN PPT)

PEAK GEEC	AVERAGE 4 DAY GEEC	AVERAGE 21 DAY GEEC	AVERAGE 56 DAY GEEC
192.86	153.01	62.59	27.78

$KOC = \frac{Kd}{\%OC} \times 100$

$Lowest\ KOC = \frac{0.13}{0.05} \times 100 = 260.0$

$Highest\ KOC = \frac{4.07}{0.05} \times 100 = 8,140$

GENEEC = 1.83 ppb
BACKENV = 1.153 ppb

0.063 lb = 1.008 ounces.

RUN No. 1 FOR Cadre INPUT VALUES

RATE (#/AC) ONE(MULT)	APPLICATIONS NO.-INTERVAL	SOIL KOC	SOLUBILITY (PPM)	% SPRAY DRIFT	INCORP DEPTH(IN)
.063(.063)	1 1	260.0	36000.0	1.0	.0

FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)

METABOLIC (FIELD)	DAYS UNTIL RAIN/RUNOFF	HYDROLYSIS (POND)	PHOTOLYSIS (POND-EFF)	METABOLIC (POND)	COMBINED (POND)
.00	2	30.00	.25- 30.67	.00	15.17

GENERIC EECs (IN PPB)

PEAK GEEC	AVERAGE 4 DAY GEEC	AVERAGE 21 DAY GEEC	AVERAGE 56 DAY GEEC
1.83	1.70	1.16	.63

RUN No. 2 FOR Cadre INPUT VALUES

RATE (#/AC) ONE(MULT)	APPLICATIONS NO.-INTERVAL	SOIL KOC	SOLUBILITY (PPM)	% SPRAY DRIFT	INCORP DEPTH(IN)
.063(.063)	1 1	8140.0	36000.0	1.0	.0

FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)

METABOLIC (FIELD)	DAYS UNTIL RAIN/RUNOFF	HYDROLYSIS (POND)	PHOTOLYSIS (POND-EFF)	METABOLIC (POND)	COMBINED (POND)
.00	2	30.00	.25- 30.67	.00	15.17

GENERIC EECs (IN PPT)

PEAK GEEC	AVERAGE 4 DAY GEEC	AVERAGE 21 DAY GEEC	AVERAGE 56 DAY GEEC
192.86	153.01	62.59	27.78

CYANAMID

AMERICAN CYANAMID COMPANY
Agricultural Research Division
P. O. Box 400
Princeton, NJ 08543-0400 U.S.A.
Phone # (609) 799-0400
FAX # (609) 275-0655

Message #: _____

Date Sent: _____

FACSIMILE TRANSMITTAL SHEET

GLOBAL PLANT SCIENCE DEVELOPMENT DEPARTMENT

TO: Alvaro Yanhvre

LOCATION: EPA - EEB

FROM: Jack Arthur

DATE: 7/6/95

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American Cyanamid Company
Agricultural Research Division
P.O. Box 400
Princeton, NJ 08543-0400
(609) 799-0400

7/6/95

To: Alvaro Yamhure

From; Jack Arthur

Subject: Your phone call of July 5, 1995. CADRE herbicide.

The answer to your questions,
What is the maximum labeled rate for CADRE herbicide on peanuts? The maximum labeled rate for CADRE herbicide in peanuts is **0.063 lb. ae per acre**.

How many applications may be made per season? There is only application per season of CADRE.

Also atached for your information is a copy of our environmental fate general summary which was submitted with our package. Please note that the reported dissipation rates for CADRE are considerably less than that reported in the aerobic soil metabolism study. I believe the half lives from the field studies are more appropriate for predicting the actual concentrations that are likely to occur under actual use conditions. The aerobic soil studies have not proven to be good predictors of the field results for any of the herbicides in this class.

ENVIRONMENTAL FATE DATA REQUIREMENTS

GENERAL SUMMARY

1. Introduction

The proposed CADRE® label in this application is for the application of CADRE to peanuts and weeds as an early postemergence treatment. CADRE can be applied once per season at a maximum rate of 0.063 lb ae/A. When CADRE is applied postemergence, absorption occurs through both the foliage and roots. Susceptible weeds stop growing and either die or are not competitive with the crop.

AC 263,222 inhibits the enzyme acetohydroxyacid synthase (AHAS), which is part of the biosynthetic pathway leading to the formation of leucine, isoleucine, and valine. Reduction in the levels of these three amino acids affects the synthesis of necessary proteins and stops the growth of a susceptible plant as these essential amino acids are used up. This process will eventually lead to the death of the plant. The selectivity of AC 263,222 to peanuts results from the peanut plant's rapid metabolism/degradation of AC 263,222.

Higher animals do not use the same biosynthetic pathway for the production of amino acids. Because of this the AHAS enzyme is not found in animals. Since the mode of action for the toxicity of AC 263,222 is through inhibition of a biosynthetic pathway not present in animal systems, there is very low toxicity in animals.

2. Solubility

AC 263,222 is soluble in aqueous media. The solubility of AC 263,222 at 25°C has been determined to be 2,150, 36,000, 479,000, and 518,000 ppm in deionized water, pH 5, 7, and 9 buffers, respectively (MRID 42711403).

3. Partitioning Behavior

The n-octanol/water partition coefficients (Kow) of AC 263,222 were studied to obtain information on its potential for bioaccumulation (MRID 42711403). Because AC 263,222 is an ionizable compound and would be ionized at the pH values normally encountered in the environment, the partition coefficients were also studied using buffers at various pH values. The apparent Kow values at various pH values are shown in the table below. The apparent value represents the sum of the ionized and non-ionized forms of AC 263,222 that were found in each phase.

®Registered Trademark of American Cyanamid Company

pH	Apparent Kow
4	0.462
5	0.158
6	0.0318
7	0.0101
8	0.0053
9	0.0024

When the apparent Kow values were corrected for dissociation, to determine the true partitioning of the non-ionized form, the Kow of the non-ionized species was determined to be 4.83. The low partition coefficient values for AC 263,222 suggest low bioaccumulation potential for the compound.

4. Fish Bioconcentration Study

In a dynamic 42-day study conducted to evaluate the bioconcentration of CL 263,222 by bluegill sunfish (*Lepomis macrochirus*) a flow-through proportional diluter system was used which maintained a mean measured water concentration of 0.50 ± 0.014 mg/L of ^{14}C-CL 263,222 [labeled at C-6 of the pyridine ring] for a 28-day exposure period. The extremely low BCF factor of 0.11 ± 0.02 demonstrates that CL 263,222 does not bioaccumulate in fish. The compound is absorbed, rapidly excreted, reaches a steady state within three days of exposure and depletes to <MQL following 24 hours of nonexposure.

5. Vapor Pressure

The vapor pressure of AC 263,222 was determined to be less than 10^{-7} torr (mm Hg) at 25°C (MRID 42711403). This indicates that the compound would not be volatile.

6. Hydrolysis

AC 263,222 was studied for 30 days at a concentration of approximately 11 ppm in sterile pH 5, 7, and 9 buffers at 25°C (MRID 42711444). The results show AC 263, 222 is hydrolytically stable in aqueous solution over a 30-day period.

7. Photolysis in Water

AC 263,222 in solution is rapidly degraded by simulated sunlight from a borosilicate filtered Xenon-lamp, with first-order half-lives of 0.30, 0.25, and 0.26 days (7.2, 6.0, and 6.24 hours) of continuous irradiation in pH 5, 7, and 9 buffers, respectively. There were six photoproducts formed which accounted for greater than 10% of the applied dose. One of the products was carbon dioxide, which accounted for 46%, 21%, and 10% of the applied dose from samples in pH 5, 7, and 9 buffers. The other five photoproducts were: 5-methyl-3-pyridinecarboxylic acid (CL 263,407); 2-[(1-carbamoyl-1,2-dimethylpropyl)

carbamoyl]-5-methyl nicotinic acid, (CL 290,610); 5-methyl-2,3-pyridine dicarboxylic acid (CL 290,811); 2-carbamoyl-5-methyl-nicotinic acid; and 2-formyl-5-methyl-nicotinic acid. Several other photoproducts were present at less than 10% of the dose. The identities of these minor degradates are unknown.

8. Photolysis on Soil

Approximately 75% of the applied dose remained as AC 263,222 after 30 days of continuous irradiation. The half-life was calculated to be 106 days of continuous irradiation. The control samples were stable throughout the course of the study.

There was one major product formed which accounted for greater than 10% of the applied dose. This product, which accounted for 11% of the applied dose after 30 days, was identified as the diacid, AC 312,622. There were three unidentified radiolabeled components, each of which represented between 3 to 8% of the applied dose.

9. Soil Metabolism

An aerobic soil metabolism study was conducted to determine the fate of AC 263,222 in a sandy loam soil. Volatile materials collected during the 12-month testing period were less than 1% of the applied dose, indicating that volatilization of the parent compound or metabolites had not occurred. There were no metabolites detected, and non-extractable residues were at or below 8% of the applied dose. There was little degradation of AC 263,222 over one year in the aerobic soil metabolism study; the calculated half-life was 67 months.

10. Anaerobic Aquatic Metabolism

An anaerobic aquatic metabolism study was conducted to determine the fate of AC 263,222 in a mixture of water and sandy loam soil. Under anaerobic conditions, the compound is stable, with only 9% degradation over one year. There were no metabolites detected which accounted for greater than 10% of the applied dose, or were present at levels greater than 0.01 ppm. Volatile materials collected during the 12-month testing period were less than 1% of the applied dose, indicating that volatilization of the parent compound or metabolites had not occurred.

11. Mobility <5 mobile {lowest Kd - highest T½ is worst case

An adsorption/desorption study was conducted on six soils using the batch equilibrium technique. The soil/water partition coefficients, Kd, were determined to be 0.13 on a loamy sand, 0.19 on a silty clay loam, 0.58 on a loam, 0.82 on a sandy loam, 2.81 on a silt loam, and 4.07 on a clay loam. Because the compound is ionized at pH values normally encountered in the soil, there was no strong correlation of adsorption with organic matter in the soil. Rather, adsorption of ionizable compounds is a complex function of the soil pH and organic matter. For most of the soils studies, the adsorbed

$KOC = \frac{4.07}{0.05} = 81.4$ $KOC = \frac{0.13}{0.05} = 260$ $KOC = \frac{Kd}{C^{12}\text{ content of soil}}$ (0.05/0.5/1.0%)

compound was more tightly bound during the desorption phase than the adsorption phase, as evidenced by the larger soil/water partition coefficients found during the desorption phase. This helps explain CADRE's limited mobility in the soil.

Increased binding of AC 263,222 to soils with time was also observed in the anaerobic aquatic metabolism study, where the amount of AC 263,222 which was present in the water decreased from 69% of the dose on day-7 to 29% by 12 months, while the amount of AC 263,222 which was present in the soil increased from 31% on day-7 to 60% by 12 months.

12. Field Dissipation

Six rate-of-dissipation (ROD) studies were conducted with AC 263,222 in areas which represented the peanut growing region of the United States. Residues remained in the top 6" of the soil in three studies (RES 93-115; RES 93-123; RES 93-130), and in the top 18" of the soil in three studies (RES 94-005; RES 94-006; RES 94-007).

Study	Location	Soil Type	Half-life (days)	DT50 (days)	Rainfall at DT50 (inches)	Rainfall at Half-life (inches)
RES 93-115	NC	Sandy loam	31	14	2.61	10.1
RES 93-123	AR	Loam	233	30	2.74	35.6
RES 93-130	GA	Sandy loam	184	30	4.28	24.3
RES 94-005	TX	Silt loam	93	90-150	5.6-11.0	5.6
RES 94-006	GA	Loamy sand (4)	104	30-60	9.0-11.5	19-28.1
RES 94-007	FL	Loamy sand	99	30	9.9	25.2

$\Sigma = 744/6 = \bar{X} = 124$

Graphs of dissipation in the six soils are shown in Appendix 1. In most of the studies the dissipation of AC 263,222 was more rapid during the first one to two months of the study than over the remainder of the study. This is shown by the rapid DT50 values, which measure the time needed for the residues to dissipate to 50% in the initial measured value, relative to the first-order calculated half-lives. The rapid initial degradation is not due to significant movement through the soil profile since the DT50 generally occurs during a time period where there was little rainfall (2-10 inches). When several times this amount of rainfall occurred at later times in the study, dissipation slowed. Thus it is unlikely that large amounts of AC 263,222 are dissipated in the first month due to leaching.

13. Confined Accumulation on Rotational Crops

The field phase of a confined rotational crop study was conducted in Madera, CA. Bare ground was treated with carbon-14 labeled CL 263,222 in an aqueous soluble formulation (2 ASU) at an application rate of 0.064 lb ae/A. Barley was planted at 90-, 120-, and 270-DAT (days after treatment); cotton and corn at 270- and 300-DAT; lettuce and carrots at 300-DAT.

Total carbon-14 residues in barley grain were 0.014, 0.030, and 0.045 ppm at 90-, 120-, and 270-DAT. Residues in straw were 0.013, 0.056, and 0.070 ppm, respectively.

Total carbon-14 residues in corn grain at 270- and 300-DAT were <0.01 ppm. Residues in forage were 0.010 and 0.016 ppm, respectively, and in fodder 0.019 and 0.028 ppm.

Total carbon-14 residues in cotton seed were 0.017 and <0.01 ppm at 270- and 300-DAT, respectively. Residues in the linters were 0.015 and <0.01 ppm.

Total carbon-14 residues in lettuce and carrots at 300-DAT were <0.01 ppm.

CL 263,222 was found only in trace amounts (<0.01 ppm) in barley, cotton, and corn. The two principal components of the residue in barley (grain and straw) and corn (fodder) are the same as the metabolites observed in peanuts, CL 263,284 (hydroxymethyl derivative of CL 263,222) and CL 189,215 (glucose conjugate of CL 263,284). Some evidence indicates that they may also be present in cotton (seed).