County of Santa Cruz

0279

BOARD OF SUPERVISORS

701 OCEAN STREET, SUITE 500, SANTA CRUZ, CA 95060-4069

(831) 454-2200 FAX: (831) 454-3262 TDD: (831) 454-2123

JANET K. BEAUTZ	ELLEN PIRIE	MARDI WORMHOUDT	TONY CAMPOS	JEFF ALMQUIST
FIRST DISTRICT	SECOND DISTRICT	THIRD DISTRICT	FOURTH DISTRICT	FIFTH DISTRICT

AGENDA: 4/9/02

March 20, 2002

BOARD OF SUPERVISORS
County of Santa Cruz
701 Ocean Street
Santa Cruz, CA 95060

RE: CALTRANS SPRAYING OF PESTICIDES ALONG COUNTY HIGHWAYS

Dear Members of the Board:

The Board of Supervisors has been concerned about reducing pesticide use in the County for quite some time. We have adopted a policy to reduce and, over time, seek to eliminate pesticide use at County facilities and along County roads. In addition, we have urged Caltrans to eliminate pesticide and herbicide use along the County's highways.

Several months ago I received a letter urging me to ask that the Board take stronger action in this area by demanding that Caltrans eliminate spraying in our County. In response, I requested that the County's Integrated Pest Management Departmental Advisory Group (IPM-DAG) consider this proposal. Attached is the letter from the DAG as well as the other relevant correspondence on this matter.

The IPM-DAG, after considering the matter, made three recommendations:

1. Continue to pressure Caltrans to eliminate pesticides while acknowledging the efforts that Caltrans has made to date to eliminate pesticides;

2. Request Caltrans to make it their goal to reach the 80% reduction level by an earlier date than proposed; and

3. Request Caltrans to phase out the use of Category II pesticides, as Santa Cruz County has done.

From the materials provided, it is clear that Caltrans recognizes that pesticide use is not desirable and is attempting to severely reduce it within the constraints under which they operate. It is also the case that a significant number of Santa Cruz County residents are adversely affected by the continued pesticide use and believe that the pace of pesticide reduction proposed by Caltrans is not sufficient.

I have recently learned that Caltrans has agreed to set up a pesticide hotline in the City of Santa Cruz to inform residents on **a** daily basis of the areas where pesticide spraying will take place. It seems to me that to implement a similar hotline for the unincorporated area would be a reasonable and responsible action for Caltrans to take during the interim period during which pesticide use is being reduced. This way, residents particularly sensitive to the use of pesticides can find out what areas of the County they should avoid.

While **I** would prefer to have Caltrans totally eliminate the spraying of pesticides along County highways, Caltrans asserts that at this point there are financial and physical constraints preventing this from happening. I do think, however, that Caltrans could increase their efforts, strengthen their goals, and, at a minimum, institute a hotline to inform the public of where they will be spraying.

Therefore, **I** recommend that the Board **of** Supervisors take the following actions:

1. Direct the Chairperson to send a letter to Caltrans that does the following:

   A. Acknowledges the efforts Caltrans has made to reduce pesticide spraying in the County but urges them to totally eliminate the use of such pesticides and, at a minimum, significantly accelerate their schedule to meet the 80% reduction goal;

   B. Urges Caltrans to immediately phase out the use of Category II pesticides; and

   C. Strongly urges Caltrans to immediately establish a pesticide hotline that informs residents on **a** daily basis of where pesticide spraying will take place in the County.

2. Direct the CAO to follow up on this letter, attempt to have its recommendations implemented, and report to the Board on the Caltrans response on or before August ***6, 2002.***

3. Direct the Chairperson to thank the County's IPM-DAG for their work on this issue and urge them to continue to apply pressure to Caltrans to carry out the Board's recommendations.

Sincerely,

Mardi Wormhoudt

MARDI WORMHOUDT, Supervisor
Third District

MW:pmp
Attachments

cc: IPM-DAG
Marilyn Garrett
Barbara Lawrence

1171H3

SANTA CRUZ COUNTY

ADMINISTRATIVE OFFICE

To: Supervisor Wormhoudt
From: Susan A. Mauriello, County Administrative Officer
Subject: Spraying of Herbicides by CalTrans
Date: February 20,2002

As you will recall, you received a letter from Marilyn Garrett dated December 19, 2001, in which Ms. Garrett asked you to request that Caltrans "cease application of pesticides/herbicides and substitute non-toxic methods used by Caltrans in District 1." You referred the letter to my office and requested that the County's Integrated Pest Management Departmental Advisory Group consider whether stronger action by the Board of Supervisors requesting Caltrans to eliminate the use of herbicides along Highway 1 in Santa Cruz County would have any greater impact than the actions already taken.

The Integrated Pest Management Departmental Advisory Group had its first meeting of the year on February 5, 2002, and considered your request.

Roy Freer, the Caltrans representative, offered information on Caltrans' current practices in Santa Cruz County (District 5) and in District 1 (Del Norte, Lake, Humboldt, and Mendocino counties). According to Mr. Freer, Caltrans is using no spray in most of Humboldt County (although some communities have requested Caltrans to use sprays within their jurisdictions). Caltrans continues to spray in the other District 1 counties. Mr. Freer pointed out that District 5 is following similar practices as those followed in District 1 regarding reduced use of pesticide along unimproved roadsides. However, improved roadsides (landscaped areas) require a greater amount of weed control. These types of improved roadsides are very few in District 1, but include Highways 1 and 17 in Santa Cruz County. Caltrans is actively designing landscapes which will reduce or eliminate the amount of pesticides used to maintain improved roadsides, but these improve'ments will only occur as funding becomes available.

Mr. Freer also pointed out that Caltrans has adopted a self-imposed goal of reducing the use of pesticides 50% by 2000 and 80% by 2012. Caltrans achieved the **50%** reduction by 2000 and anticipates meeting the 80% reduction within the scheduled timeline.

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date made 2/26/02

Following the presentation, Joe Rigney, Landscape Architect, proposed and Kim Eabry of the Toxics Action Coalition, seconded the following motion, which was approved:

> The Integrated Pest Management Departmental Advisory Group recommends the following:
>
> 1. Continue to pressure Caltrans to eliminate pesticides while acknowledging the efforts Caltrans has made to date to eliminate pesticides,
> 2. Request Caltrans to make it their goal to reach the 80% reduction level by an earlier date, and
> 3. Request Caltrans to phase out the use of Category II pesticides, as Santa Cruz County is doing.

We will continue to work with Caltrans on these matters.

Please feel free to contact me or Dinah Phillips should you have any questions about the action taken **by** the Departmental Advisory Group.

cc: Members of IPM-DAG

County of Santa Cruz

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FIRST DISTRICT	SECOND DISTRICT	THIRD DISTRICT	FOURTH DISTRICT	FIFTH DISTRICT

December 28, 2001

Drinks - for action file 2/

Marilyn Garrett
351 Redwood Heights Road
Aptos, CA 95003

Dear Marilyn:

Thank you for your letter of December 19, 2001, regarding the spraying of herbicides along Highway 1 by Caltrans. As I mentioned in my previous letter, it appears that Caltrans is attempting to reduce herbicide use along the highway and is experimenting with alternatives. I am not sure that further action by the Board of Supervisors would produce any greater effort on their part than is already occurring.

However, I will check this out further. I am referring your letter to the County Administrative Officer and requesting that she bring this matter to the County's IPM Task Force to consider whether stronger action by the Board of Supervisors requesting Caltrans to eliminate the use of herbicides along Highway 1 in Santa Cruz County would have any greater impact than the actions already taken. I will keep you informed after I hear back from her regarding the Task Force's response.

Sincerely,

MARDI WORMHOUDT, Supervisor
Third District

MW:ted

cc: Susan Mauriello, County Administrative Officer

1165H3

0285

12/19/01

351 Redwood **Hts.** Rd.
Aptos, Calif. 95003

To Supervisor Mardi Wormhoudt,

AGAIN! CalTrans spraying in Aptos in plants by Hwy. 1 btwn. State Park exit and Park Ave (one of many, many dousings). I witnessed a blast of **hose** spray by a worker in "protective gear" approx. 1:15 p.m. Monday 12/17/01 as I was driving to S.C. Another CalTrans spray vehiclewas observed at this time southbound on Hwy. 1 in the same vicinity. AND AGAIN! today about the same time at the Freedom Bl. entrance to the Fwy, more Dow Chemical (AgroSciences) products on our public roadsides. (see MSDS)(1st page only)

DO YOU KNOW THAT IT IS ESTIMATED TEAT 99% of **sprays** move into the **general** environment and miss the "target." ?? Is this efficiency? Is **this** healthy? I never was paid as a public school teacher to be 9% incompetent - do you know **any** public servant who is? **As** I and other drivers were inevitably exposed, CalTRans is engaging in **TOXIC** TRESPASS which constitutes a violation of our right to "life, liberty, and the persuit of happiness." Clearly **poisoning** violates these rights. . Your inaction allows it.

Are you and the **Board** *of* Supervisors not obligated by **your** oath of office to **halt** such endangerment to the people of Santa Cruz Countg?

I am .writing to you **as** you authored the 8/16/01 letter to CalTrans requesting the Agency "eliminate or reduce the use of pesticides.". .

REDUCE. **Poison** is poison. Do we **ask,** for instance, an abuser of **women** to reduce that abuse, or do we halt **it?** CalTrans Roy Freer at a recent IPM/DAG *committee* meeting explzined what "reduction" **means** to CalTRANS. . reducing the "active" ingredient. For your information (documentation supplied upon request), pesticide (and herbicide) formulations nave inert ingredients. These "inert" ingredients are "trade secret," can be as toxic or **more toxic** than the "active" ingredient and can be used as "active" ingredients in other pesticide formulations. "Reduce" in this context **means** more contamination, more endangement. Deceptive,no?

* I appreciate **your** letter of last week letting **me know** you had contacted CalTrans. HOWEVER, we **over 2,**000 residents of **Santa** Cruz County who signed the **STOP** THE **POISONS** petitions and members of the Toxics Action Coalition Monterey Bay are urging that you **follow** the exemplary **model** of the City of **Santa** Cruz requesting thatCalTrans"CEASE APPLICATION OF PESTICIDES?HERBICIDES ... AND SUBSTITUTE NONTOXIC MEIHODS . . USED BY CALTRANS IN **DISTRICT 1.**" (the attacked documents have been submitted to your Board and are bring resubmitted with this letter).

Please inform me how you will join the wise lead of the City of Santa Cruz and the Humbolt Bd. of Supervisors. Voters are more **likely** to support those they feel act genuinely to represt their most valued interests.

Sincerely,.
Marilyn Garrett
member Toxics **Action** Coalition
Monterey Bay

cc Ellen Pirie

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CITY OF SANTA CRUZ

MAYOR AND CITY COUNCIL

809 Center Street, Room 10, Santa Cruz, CA 95060 • (831) 420-5020 • Fax: (831) 420-5011 • www.ci.santa-cruz.ca.us

July 26,2000

Mr. Jay Walter
CalTrans Director District 5
CalTrans District 5 Office
50 Higuera Street
San Luis Obispo, CA 93401

Dear Mr. Walter:

As Mayor of the City of Santa Cruz, on behalf of the entire City Council, I respectfully request that CalTrans cease application of pesticides/herbicides within the City limits of Santa Cruz and substitute the non-toxic methods used by CalTrans District 1 in Humboldt, Trinity and Mendocino Counties. This policy shift is requested to apply to CalTrans workers, future contracted maintenance and current maintenance contracts within the limits of contract law.

Recent studies link pesticides/herbicides to more illnesses and conditions, while California pesticide/herbicide use has soared. Other toxics are also increasing in our general environment. Growth in human population mandates that we reduce our pollution in order to maintain the status quo, let alone improve the health of our human and biological environment and restore our many endangered and threatened species.

As a Monterey Bay National Marine Sanctuary community, the City of Santa Cruz wishes to make every effort to preserve the life and health of our citizens and environment. Since non-toxic alternatives exist, it behooves us to make use of them and to further their development. Our roadways are public and must be safely accessible to all.

In your response to this request, please disclose to the City of Santa Cruz your current use of pesticides/herbicides with specific information as to chemicals used, amounts, locations and frequency of applications. Thank you for your ongoing service to our community through maintenance of our State highways.

Sincerely,

Keith Sugar
Mayor

cc: Steve Price, CalTrans Division Chief of Maintenance and Operations
Santa Cruz County Board of Supervisors
Santa Cruz County Regional Transportation Commission
City Clerk

I\MAYORKS\LETTER\PESTICIDES.LTR

BOARD OF SUPERVISORS, COUNTY OF HUMBOLDT, STATE OF CALIFORNIA

Certified Copy of Portion of Proceedings, Meeting of Tuesday, March 25, 1997

SUBJECT: **INVITATION BY CALTRANS TO COMMENT ON VEGETATION MANAGEMENT ON STATE HIGHWAYS (PRESENTATION BY CALTRANS REGARDING HERBICIDE SPRAYING ALONG ROADSIDES)**

ACTION: After hearing testimony from community members and a presentation by CalTrans at a regularly-noticed Board of Supervisors' meeting, the Board of Supervisors formally requests that CalTrans, themselves, discontinue all herbicide spraying for any state route or portion thereof within its jurisdiction.

At this time the County has no special program offered to respond to the vegetation control need.

Adopted on motion by Supervisor Dixon, second by Supervisor Woolley, and the following vote:

AYES: Supervisors Dixon, Rodoni, Woolley, Neely, and Kirk
NAYS: None
ABSENT: None
ABSTAIN: None

STATE OF CALIFORNIA)
County of Humboldt)

I, LORA FREDIANI, Clerk of the Board of Supervisors, County of Humboldt, State of California, do hereby certify the foregoing to be a full, true, and correct copy of the original made in the above-entitled matter by said Board of Supervisors at a meeting held in Eureka, California as the same now appears of record in my Office.

pc: Board Assistant
CalTrans
Public Works
Agricultural Commissioner
County Counsel
California Against Toxic Sprays (CATS)

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the Seal of said Board of Supervisors.

LORA FREDIANI

Clerk of the Board of Supervisors of the County of Humboldt, State of California

March 25, 1997

(E-4)

County of Santa Cruz

BOARD OF SUPERVISORS

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JANET K. BEAUTZ FIRST DISTRICT | WALTER J. SYMONS SECOND DISTRICT | MARDI WORMHOUDT THIRD DISTRICT | TONY CAMPOS FOURTH DISTRICT | JEFF ALMQUIST FIFTH DISTRICT

August 16, 2000

Jay Walter, District Director
Caltrans District 5
50 Higuera Street
San Luis Obispo, CA 93401-5415

Dear Mr. Walter:

I am writing on behalf of the Santa Cruz County Board of Supervisors to convey a resolution, adopted by the Board on August 15, 2000, requesting that Caltrans eliminate or reduce the use of pesticides on State-maintained roads in Santa Cruz County. In addition., the Board requests that Caltrans designate a representative to participate on the Santa Cruz County Integrated Pest Management Advisory Group.

It is the Board's intention to work towards the goal of eliminating pesticide use on County property through the development and implementation of an Integrated.Pest Management program. The County will contract with the UC Cooperative Extension Office to provide an Integrated Pest Management Coordinator to develop an implementation program. An Integrated Pest Management Advisory Group will be established to provide citizen input to this'process. Members of the advisory group will include representatives of County departments such as'Parks, Public Works,and Health Services, and public members including a landscape architect or landscape maintenance gardener, a licensed pesticide applicator, Farm Bureau representatives, and representatives of environmental organizations. We do not anticipate that the advisory group would meet more than quarterly. We believe that Caltrans participation will be very beneficial to the.group and to Caltrans.

If you have any questions.,please do not hesitate to contact me or Dinah Phillips, the analyst in the County Administrative Office who has been, working on this issue. You may reach Ms. Phillips at 831-454-3408.

Specimen Label

Dow AgroSciences

Surflan*

A.S.

Specialty Herbicide

*Trademark of Dow AgroSciences LLC

A selective preemergence surface-applied herbicide for control of annual grasses and many broadleaf weeds in:

- **Landscape Ornamentals**
- **Container Grown ornamentals**
- **Field Grown Ornamentals**
- **Drainage Areas Under Shadehouse Benches**
- **Ornamental Bulbs**
- **Ground Covers/Perennials**
- **Christmas Tree Plantations**
- **Non-bearing fruit and nut trees and non-bearing vineyards**
- **Noncropland and Industrial Sites**
- **Established Warm Season Turf (including Bahiagrass, Bermudagrass, Buffalograss, Centipedegrass, St. Augustinegrass and Zoysiagrass)**
- **Tall Fescue (warm season areas)**

Active Ingredient:	
oryzalin: 3,5-dinitro-N^4N^4-dipropylsulfanilamide	40.4%
Inert Ingredients	59.6%
Total	100.0%

Csntains 4.0 pounds of active ingredient per gallon.

EPA Reg. No. 62719-113

12-13-01

Marilyn –
Here are the Product labels and MSDSs you requested.

Roy Suer
District Landscape Specialist

Keep Out of Reach of Children

CAUTION PRECAUCION

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle. (If you do not understand the label. find someone to explain it to you in detail.)

Precautionary Statements

Hazards to Humans and Domestic Animals

Causes Eye Irritation • Prolonged or frequently repeated contact may cause allergic reactions in some individuals

Avoid contact with eyes or clothing.

Personal Protective Equipment (PPE)

Applicators and other handlers must wear:

- Long-sleevedshirt and long pants
- Chemical-resistant gloves
- Shoes plus socks
- Mixers and loaders must wear a chemical-resistant apron in addition to other PPE.

Discard clothing and other absorbent materials that have been drenched or heavily contaminated with this product's concentrate. Do not reuse them. Follow'manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables, use detergent and *hot* water. Keep and wash PPE separately from other laundry.

Engineering Controls Statements

When handlers use closed systems *or* enclosed cabs in a manner that meets the requirements listed in the Worker Protection Standard (WPS) For agricultural pesticides [40CFR 170.240 (d) (4-6)], the handler PPE requirements may be reduced or modified as specified in the WPS.

User Safety Recommendations

Users should:

- Wash hands before eating, drinking, chewing gum. using tobacco or *using the toilet.*
- Remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.
- Remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing.

First Aid

If in eyes: Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing. Call a poison control center or doctor for treatment advice.

Environmental Hazards

This pesticide is toxic to fish. Do not apply directly to water, 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. Cover or incorporate spills.

Notice: Read the entire label. Use only according to label directions. Before buying or using this product, read "Warranty Disclaimer" and "Limitation of Remedies" elsewhere on this label;

Specimen Label

Dow AgroSciences

Gallery* 75 Dry Flowable

Specialty Herbicide

*Trademark of Dow AgroSciences LLC

A selective preemergence herbicide for control of certain broadleaf weeds in:

- **Established turf**
- **Landscape ornamentals**
- **Container grown ornamentals**
- **Field grown ornamentals**
- **Ground covers / Perennials**
- **Non-cropland**
- **Ornamental bulbs**
- **Non-bearing fruit and nut trees and non-bearing vineyards**
- **Christmas tree/Conifer plantations**

Active Ingredient:

isoxaben: N-[3-(1-ethyl-1-methylpropyl)-5-isoxazolyl]-2,6-dimethoxybenzamide and isomers	75%
Inert Ingredients	25%
Total	100%

Contains 0.75 pound active ingredient per pound.

U.S. Patent Nos. 5,086,184 and 4,636,243

EPA Reg. **No,** 62719-145

Keep Out of Reach of Children

CAUTION PRECAUCION

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle. (If you do not understand the label, find someone to explain it to you in detail.)

Precautionary Statements

Hazards to Humans and Domestic Animals

Causes Eye Irritation • Harmful **If** Inhaled

Avoid ingestion, breathing dust or spray mist, and contact with skin, eyes, or clothing.

Personal Protective Equipment (PPE)

Applicators and other handlers must wear:

- Long-sleeved shirt and long pants
- Shoes plus socks

Follow manufacturer's instructions for cleaning/maintaining **PPE.** If no such instructions for washables, use detergent and hot water, Keep and wash **PPE** separately from other laundry.

User Safety Recommendations

Users should:

- Wash hands before eating, drinking, chewing gum, using tobacco or using the toilet.

Remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.

First Aid

If in eyes: Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a poison control center or doctor for treatment advice.

If swallowed: Call a poison control center or doctor immediately for treatment advice. Have person sip a glass of water if able to swallow. Do not induce vomiting unless told to do so by the poison control center or doctor. **Do** not give anything by mouth to an unconscious person.

If on skin or clothing: Take *off* contaminated clothing. Rinse skin immediately with plenty of water for 15-20 minutes. Call a poison control center *or* doctor for treatment advice.

If inhaled: Move person to freshair. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably by mouth-to-mouth, if possible. Call a poison control center or doctor for further treatment advice.

Have the product container or label with you when calling a poison control center or doctor, or going for treatment.

Environmental Hazards

Do not contaminate water when disposing of equipment washwaters. Do not apply directly to water, to areas where surface water is present or to intertidal areas below the mean high water mark. Drift may result in reduced germination or emergence of non-target plants adjacent to treated area.

Notice: Read the entire label. Use only according to label directions. Before buying or using this product. read "Warranty Disclaimer" and "Limitation of Remedies" elsewhere on this label.

in case *of* emergency endangering health or the environment involving this product, call 1-800-992-5994. If you wish to obtain additional product information, visit our web site at www.dowagro.com.

Agricultural Chemical: Do not ship or store with food, feeds, drugs or clothing.

MATERIAL SAFETY DATA SHEET

Dow AgroSciences

Emergency Phone: 800-992-5994
Dow AgroSciences LLC
Indianapolis, IN 46268

SURFLAN* A.S. HERBICIDE - ORNAMENTALS

Effective Date: 8/3/99
Product Code: 20122
MSDS: 003738

1. PRODUCT AND COMPANY IDENTIFICATION:

PRODUCT: Surflan* A.S. Herbicide - Ornamentals

COMPANY IDENTIFICATION:
Dow AgroSciences
9330 Zionsville Road
Indianapalis, IN 46268-1189

2. COMPOSITION/INFORMATION ON INGREDIENTS:

Oryzalin: 3,5-Dinitro-N4,N4-dipropyl-sulfanilamide	CAS# 019044-88-3	40.4%
Inert Ingredients, Total, Including:		59.6%
Propylene Glycol	CAS# 000057-55-6	
Glycerin	CAS# 000056-81-5	

This document is prepared pursuant to the OSHA Hazard Communication Standard (29 CFR) 1910.1200). In addition, other substances not 'Hazardous' per this OSHA Standard may be listed. Where proprietary ingredient shows, the identity may be made available as.provided in this standard.

3. HAZARDOUS IDENTIFICATIONS:

EMERGENCY OVERVIEW

Hazardous chemical. Product is an opaque bright orange liquid with a slight aromatic odor. May cause slight transient eye irritation. Prolonged exposure may cause skin irritation. Water based, will not burn. Product is toxic to fish and aquatic organisms.

EIMERGENCY PHONE NUMBER: 800-992-5994

POTENTIAL HEALTH EFFECTS: This section includes possible adverse effects which could occur if this material is not handled in the recommended manner.

EYE: May cause slight transient (temporary) eye irritation. Corneal injury is unlikely.

SKIN: Prolonged exposure may cause skin irritation. Prolonged or frequently repeated skin contact may cause an allergic skin reaction in some individuals. A single prolonged exposure is not likely to result in the material being absorbed through skin in harmful amounts. The LD_{50} for skin absorption in rabbits is >5000 mg/kg.

INGESTION: Single dose oral toxicity is low. The oral LD_{50} for rats is 5000 mg/kg. Small amounts swallowed incidental to normal handling operations are not likely to cause injury; swallowing amounts larger than that may cause injury.

INHALATION: At room temperature, exposure to vapors are minimal due to physical properties; higher temperatures may generate vapor levels sufficient to cause irritation and other effects. The LC_{50} for rats was >6.30 mg/L in 4 hours.

SYSTEMIC (OTHER TARGET ORGAN) EFFECTS: Propylene glycol, in animals, has been shown to cause liver, kidney, bladder, spleen or blood effects. Human signs and symptoms may include central nervous system depression (headache, dizziness, drowsiness and incoordination).

CANCER INFORMATION: Thyroid follicular cell tumors observed in rats were considered a secondary response caused by mechanisms not relevant to humans. Benign skin and adnexal tumors observed in rats may also have been secondary to thyroid effects.

TERATOLOGY (BIRTH DEFECTS): Oryzalin did not cause birth defects, other fetal effects occurred only at doses toxic to the mother.

REPRODUCTIVE EFFECTS: Most components of this product did not interfere with reproduction. Reproductive effects seen in female animals are believed to be due to altered nutritional states resulting from extremely high doses of glycerin given in the diet. Similar effects have been seen in animals fed synthetic diets.

4. FIRST AID:

EYES: Flush eyes with plenty of water.

SKIN: Wash aff in Rowing water or shower.

INGESTION: If swallowed, seek medical attention. Do not induce vomiting unless directed to do so by medical personnel.

INHALATION: Remove to fresh air if effects occur. Consult a physician.

MATERIAL SAFETY DATA SHEET

Dow AgroSciences

Emergency Phone: 800-992-5994
Dow AgroSciences LLC
Indianapolis, IN 46268

GALLERY* 75 DRY FLOWABLE HERBICIDE

Effective Date: 8/25/00
Product Code: 20116
MSDS: 003994

1. PRODUCT AND COMPANY IDENTIFICATION:

PRODUCT: Gallery* 75 Dry Flowable Herbicide

COMPANY IDENTIFICATION:
Dow AgroSciences
9330 Zionsville Road
Indianapolis, IN 46268-1189

2. COMPOSITION/INFORMATION ON INGREDIENTS:

Isoxaben: N-(3-(1-ethyl-1-methylpropyl)-5-isoxazolyl)-2,6-dimethoxybenzamide and isomers (Isoxaben)	CAS# 082558-50-7	75%
Inert ingredients, total, including:		25%
Kaolin	CAS# 001332-58-7	
Crystalline silica (in Kaolin)	CAS# 014808-60-7	

This document is prepared pursuant to the OSHA Hazard Communication Standard (29 CFR 1910.1200). In addition, other substances not 'Hazardous' per this OSHA Standard may be listed. Where proprietary ingredient shows, the identity may be made available as provided in this standard.

3. HAZARDOUS IDENTIFICATIONS:

EMERGENCY OVERVIEW

Hazardous Chemical. Light tan water dispersible granule, mild aromatic odor. May cause moderate eye irritation with slight transient corneal injury. Prolonged or repeated exposure may cause slight skin irritation. LD_{50} for skin absorption in rabbits is >5000 mg/kg. The oral LD_{50} for rats is >5000 mg/kg.
EMERGENCY PHONE NUMBER: 800-992-5994

POTENTIAL HEALTH EFFECTS: This section includes possible adverse effects, which could occur if this material is not handled in the recommended manner.

EYE: May cause moderate eye irritation, which may be slow to heal. May cause slight transient (temporary) corneal injury.

SKIN: Prolonged or repeated exposure may cause slight skin irritation. A single prolonged exposure is not likely to result in the material being absorbed in harmful amounts. The LD_{50} for skin absorption in rabbits is >5000 mg/kg.

INGESTION: Single dose oral toxicity is extremely low. The oral LD_{50} for rats is >5000 mg/kg. No hazards anticipated from swallowing small amounts incidental to normal handling operations.

INHALATION: Single exposure to dust is not likely *to* be hazardous.

SYSTEMIC (OTHER TARGET ORGAN) EFFECTS: Contains component(s), which, in animals, have been shown to cause liver and kidney effects. Repeated excessive exposure to crystalline silica may cause silicosis, a progressive and disabling disease of the lungs. Some evidence suggests that kidney effects may result from excessive exposure also.

CANCER INFORMATION: This mixture contains a component which, is listed as a carcinogen for hazard communication purposes under OSHA Standard 29 CFR 1910.1200. Component listed by IARC and NTP is crystalline silica. An increase in nonmalignant liver tumors was observed with isoxaben in one of two species tested.

TERATOLOGY (BIRTH DEFECTS): Isoxaben caused birth defects in laboratory animals only at doses toxic to the mother.

REPRODUCTIVE EFFECTS: Isoxaben has been shown to interfere with reproduction in animal studies.

4. FIRST AID:

EYES: Irrigate with flowing water immediately and continuously for 15 minutes. Consult medical personnel.

SKIN: Wash off in flowing water or shower.

INGESTION: No adverse effects anticipated by this route of exposure incidental to proper industrial handling.

INHALATION: Remove individual to fresh air if effects occur. Consult a physician.

NOTE TO PHYSICIAN: No specific antidote. Supportive care. Treatment based on judgment *of* the physician in response to reactions of the Patient.

Dec. 2000 - Jan. 2001

The Ventana welcomes letters. Send to:
LETTERS TO THE EDITOR
The Ventana, 1603 King Street
Santa Cruz, CA 95060
or email to <dfbulger@cruzio.com>
Please *include a phone number* with your letter. *Anonymous letters are not accepted. Letters may be edited for length.*

Stop toxic spraying along Highway 1

Despite pleas by residents and politicians, Caltrans continues to spray highways. in Santa Cruz and Monterey counties with pesticides. In October Caltrans sprayed the herbicide "Reward" from the Monterey County line on Hwy. 1 to the High Street overpass in Santa Cruz.

Reward is produced by the company Zeneca. The active ingredient in Reward is Diquat dibromide which is a suspected kidney toxicant, neurotoxicant, and skin or sense organ toxicant. Studies have shown Diquat dibromide to bioaccurnulate in plants, fish, and zooplankton. It is considered by the State of California to be a potential groundwater contaminant. There is not currently enough data avadable to determine national chemical safety standards for this chemical.

Caltrans has stopped entirely the use of toxic pesticides in District 1 including Mendocino and Humboldt counties. Residents of District 5 need to demand that they stop spraying here as well.

Call Roy Freer, the district landscape specialist for District 5 at *426-0396.* Tell him to stop the spraying. Tell him that you demand the sameecological landscaping that Caltrans practices in District 1.

Get involved in the campaign to stop Caltrans' toxic spraying. For more information call 688-4603.

-David Edeli
Santa Cruz

4-3-02

0294

As Roundup is CalTrans most utilized herbicide, and "Managing Roadside Vegetation without Herbicides" (article by Sheila Daar, the IPM consultant for the City of Santa Cruz), is in practice elsewhere, please include this data with the agenda item (for the 4-9-02 meeting) re: CalTrans referred to in Supervisor Wormhoudt's letter to the Board members.

Included: re: CalTrans

1. Humboldt "discontinue..." Bd. of Sups. resolution
2. City of Santa Cruz "cease" pesticide applications
3. "Stop the Poisons" petition/registry
4. CATs report excerpts: How Herbicides Blight Calif. Roads
5. CATs Roundup tox. profile
6. letter from Dave Blume, Pres. of Intl. Institute for Ecological Agriculture
7. Glyphosate (Roundup) by Caroline Cox, NCAP
8. Sheila Daar article in IPM Practitioner
9. My 3-18-02 letter to Mardi Wormhoudt

submitted by
Marilyn Garrett
688-4603

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BOARD OF SUPERVISORS, COUNTY OF HUMBOLDT, STATE OF CALIFORNIA

Certified Copy of Portion of Proceedings, Meeting of Tuesday, March 25, 1997

SUBJECT: INVITATION BY CALTRANS TO COMMENT ON VEGETATION MANAGEMENT ON STATE HIGHWAYS (PRESENTATION BY CALTRANS REGARDING HERBICIDE SPRAYING ALONG ROADSIDES)

ACTION: After hearing testimony from community members and a presentation by CalTrans at a regularly-noticed Board of Supervisors' meeting, the Board of Supervisors formally requests that CalTrans, themselves, discontinue all herbicide spraying for any state route or portion thereof within its jurisdiction.

At this time the County has no special program offered to respond to the vegetation control need.

Adopted on motion by Supervisor Dixon, second by Supervisor Woolley, and the following vote:

AYES: Supervisors Dixon, Rodoni, Woolley, Neely, and Kirk
NAYS: None
ABSENT: None
ABSTAIN: None

STATE OF CALIFORNIA)
County of Humboldt)

I, LORA FREDIANI, Clerk of the Board of Supervisors, County of Humboldt, State of California, do hereby certify the foregoing to be a full, true, and correct copy of the original made in the above-entitled matter by said Board of Supervisors at a meeting held in Eureka, California as the same now appears of record in my Office.

pc: Board Assistant
CalTrans
Public Works
Agricultural Commissioner
County Counsel
California Against Toxic Sprays (CATS)

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the Seal of said Board of Supervisors.

LORA FREDIANI

Clerk of the Board of Supervisors of the County of Humboldt, State of California

Lora Frediani

March 25, 1997

(E-4)

4267

41

CITY OF
SANTA CRUZ

0296

MAYOR AND CITY COUNCIL

809 Center Street, Room 10, Santa Cruz, CA 95060 • (831) 420-5020 • Fax: (831) 420-5011 • www.ci.santa-cruz.ca.us

July 26,2000

Mr. Jay Walter
CalTrans Director District 5
CalTrans District 5 Office
50 Higuera Street
San Luis Obispo, CA 93401

Dear Mr. Walter:

As Mayor of the City of Santa Cruz, on behalf of the entire City Council, I respectfully request that CalTrans cease application of pesticidesherbicides within the City limits of Santa Cruz and substitute the non-toxic methods used by CalTrans District 1 in Humboldt, Trinity and Mendocino Counties. This policy shift is requested to apply to CalTrans workers, future contracted maintenance and current maintenance contracts within the limits of contract law.

Recent studies link pesticidesherbicides to more illnesses and conditions, while California pesticide/herbicide use has soared. Other toxics are also increasing in our general environment. Growth in human population mandates that we reduce our pollution in order to maintain the status quo, let alone improve the health of our human and biological environment and restore our many endangered and threatened species.

As a Monterey Bay National Marine Sanctuary community, the City of Santa Cruz wishes to make every effort to preserve the life and health of our citizens and environment. Since non-toxic alternatives exist, it behooves us to make use of them and to further their development. Our roadways are public and must be safely accessible to all.

In your response to this request, please disclose to the City of Santa Cruz your current use of pesticidesiherbicides with specific information as to chemicals used, amounts, locations and frequency of applications. Thank you for your ongoing service to our community through maintenance of our State highways.

Sincerely,

Keith Sugar
Mayor

cc: Steve Price, CalTrans Division Chief of Maintenance and Operations
Santa Cruz County Board of Supervisors
Santa Cruz County Regional Transportation Commission
City Clerk

I\MAYORKS\LETTER\PESTICIDES.LTR

STOP THE POISONS

0297

I do NOT approve of CalTrans use of toxic pesticides for roadside spraying." .

I do NOT approve of the application of any toxic pesticides on public spaces in my community.

I do NOT approve of the use of any pubiic funds for the applicadon of toxic pesticides in my community.

I refuse to grant permission for the application of any toxic pesticides on my property/residence by the County of Santa Cruz or the State of California.

I further demand that the Agriculture Commissioner take all necessary measures to prevent ANY toxic pesticide drift onto my property/residence from other properties. No toxic trespass.

Consider my signature official notification for the County of Santa Cruz and State of California to exclude my prcperty/residence from any mandated spray program.

— Please Print NEATLY —

Printed Name/Signature	Address	Phone/Email
r	Address	Phone
Signature	City, Zip	E-mail
Printed name	Address	Phone
Signature	City, Zip	E-mail
Printed name	Address	Phone
Signature	City, Zip	E-mail
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Signature	City, Zip	E-mail
Printed name	Address	Phone
Signature	City, Zip	E-mail
name	Address	Phone
Signature	City, Zip	E-mail

Over 2,000 signatures have been publically submitted to your Bd. at Board of Supervisor's meetings a constituting an official registry.

Return full petitions to CPE, P.O Box 8467, Santa Cruz, CA 95061 • 831-459-1541
Eliminate Toxic Pesticides ASAP (Adopt Safe Alternatives to Pesticides.), Spring. 2001

*Ca trans has complied to not spray in Trinity, Mendocino, Humboldt. and part of Del Norte counties, as well as in the city jurisdictions of Ukiah, Trinidad, Arcata, Sebastopol, and Rohnert Park. The Yurok and the Hoopa tribes don't allow spraying.

[redacted]

The Poisoning of Public Thoroughfares: How Herbicides Blight California's Roads

Californians for
Alternatives to Toxics

1999

Marilyn Garrett 351 Redwood Mts. Rd. Aptos 95003 688-4603

Published In Spring 1999 by
Californians for Alternatives to Toxics
P.O. Box 1195 (990 I Street)
Arcata, California 95518
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email: catz@reninet.com
website: www.reninet.com/catz

For additional copies of this report,
send $12 plus $2 shipping to CATs at the above address.

About Californians for Alternatives to Toxics

Californians for Alternatives to Toxics (CATs) was founded in 1982 by community groups throughout Northern California to serve as a resource center for information and action about hazardous chemicals, especially pesticides, and to promote alternatives to their use.

CATs' Mission is to help the general public gain control over the use of toxic chemicals that adversely affect their environment. This is accomplished by encouraging community leadership and through education about the use and toxicity of chemicals. CATs develops and employs strategies to effect reform, brings people together for greater leverage in opposing chemical pollution and provides information about alternatives to toxics.

Membership is open to all who subscribe to CATs' mission. Annual membership is $15.

As a 501(c)(3) non-profit organization operating in the public's interest, CATs is supported by the donations of individuals, foundations and businesses who are part of the solution. All donations are tax-deductible. Please contact CATs for more information.

Dedication

This report is respectfully dedicated to the children of California (and everywhere) who deserve to grow up healthy, inherit a land that can sustain them and be free to drive, walk or catch the bus on our public roads without risking exposure to toxic herbicides.

Correction: Some tables have been changed due to typographical errors. 04/01/99.

Printed on 100% recycled paper.

Acknowledgments

0299

The principal author of this report is Patty Clary, Executive Director of CATs. Research Associate Laurynda Allison extracted and compiled information.

The following people were integral to the production of this report: toxicology research, Cynthia Archer; research associate, Nina Hapner; research assistants, Katie Bowman, Rebekah Funes, Cindy Reiter; content development, Elaine Weinreb, Rob Ameman; copy editing, Sid Dominitz; photographs, Michael Amsler, Cathy Underwood, Bill Verick, Josh Strange, David Polster. typing and email, Gina Klump; proofreading, Aisha Candrian, Catherine Leach; computer behavior, Matt Lang; communication network, Jay Tallman; cookies, Julie Rich; media relations, Communication Works; layout, Page One Publishers; printing, Arcata Kinko's; cover, Bug Press.

Many people contributed information and insights to this report. The most important were hundreds of North Coast people who wholeheartedly spoke out against Caltrans' herbicide spraying and succeeded in stopping this practice in their communities.

Support was provided by many individuals who donated money, services and equipment and by the Matteel Environmental Justice Foundation in Humboldt County. This combination of community and foundation support and participation is the secret of the success of many projects undertaken by CATs, for which we thank one and all.

The author bears responsibility for any factual errors. Point out an error and we will correct it in future editions.

Executive Summary

0300

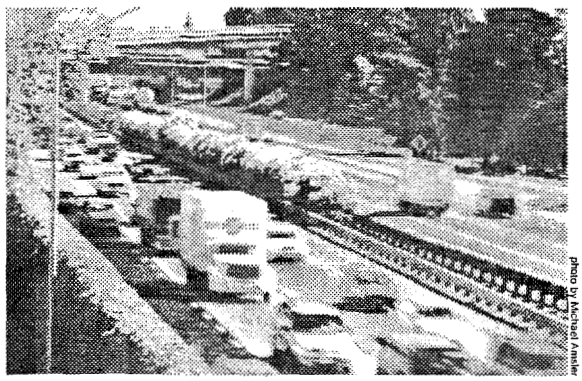


photo by Michael Amaler

Roads are the main arteries of life and commerce for most Americans. In California, close to 80,000 miles of state highways and county roads are used each day by millions of people who commute, transport materials or keep these roads open and safe. Each day of the year, 65% of the miles traveled by Californians are driven on state and county thoroughfares. Yet unknown to the communities through which they pass and the people who labor and travel on them, these roads are regularly sprayed with toxic herbicides.

California's Department of Transportation (Caltrans), a nearly $6 billion bureaucracy, discharges these dangerous chemicals onto state highways yet cannot provide even the most fundamental information regarding the size and extent of its herbicide spray program.

In *The Poisoning of Public Thoroughfares: How Herbicides Blight California's Roads*, Californians for Alternatives to Toxics (CATs) describes for the first time ever how state and county agencies douse California roads — especially in the most populous regions — with huge quantities of chemical herbicides. Research for this report was conducted throughout a two year period beginning in early 1997 when a groundswell of public outrage over roadside spraying on the North Coast forced Caltrans to stop drenching local highways with toxic chemicals.

Caltrans and county transportation agencies suppress the seasonal profusion of roadside weeds for safety and for appearance. Caltrans claims that its goals of increased driver visibility and reduced risk of fire demand the use of chemical herbicides, but communities on the North Coast showed no increase in automobile accidents or roadside fires during a four year hiatus from herbicide spraying.

In limited toxicological studies, chemicals used in roadside vegetation control have been shown to be harmful to humans, wildlife and the environment. Of the eight most popular herbicides used on California roads, one is confirmed under California law (Proposition 65) to be a proven human carcinogen and developmental toxicant, six are identified by the federal Environmental Protection Agency as possible human carcinogens and three are linked to birth defects. More than half have been found in groundwater and three quarters may pollute the air. The effects of these roadside poisons have not been sufficiently documented. Caltrans has refused to pursue further investigation of a controversial 1987 study that found elevated cancers among its employees or of a 1994 Department of Pesticide Regulation study that showed significant levels of herbicide residue on its applicators' clothing.

Several safe, effective and affordable ways to end the use of health threatening chemical herbicides exist. Caltrans and county road agencies can immediately reduce the amount of toxic chemicals they release by not spraying in areas managed solely for appearance. There are proven nontoxic alternatives to highly dangerous chemicals such as mowing, planting competitive vegetation, and mulching. Caltrans is also experimenting with steam spraying and corn gluten, but these efforts are constrained by the minimal financial commitment the agency is willing to make.

Based on the findings of CATs' research, it is recommended that Caltrans and county road agencies immediately budget sufficient funds to implement recognized alternative methods of vegetation control and explore new options. During the transition to nontoxic roadside maintenance, Caltrans and county agencies should notify affected populations of herbicide spraying and cease the use of toxic substances on roadsides where they are not needed for safety.

California's use of roadside herbicides is widespread

CATs' report discloses that Caltrans and country road agencies apply more than 132,000 gallons of herbicide in liquid formulation and 91,000 pounds of dry weedkillers to roadsides in a typical year. The more populated the area, the heavier the dose — despite danger to public health. Much of the spraying activity is condensed into a few weeks in late winter and early spring.

CATs found that Caltrans applies an average of about five gallons of liquid and more than two pounds of dry herbicide formulation per road-mile of the 15,000 miles of highways under its jurisdiction. In addition, the report found that 51 of the state's 58 county governments also rely on chemical poisons to kill weeds, averaging more than one pound and one gallon of herbicide per mile along the 64,000 miles of roads under county management.

Based on the combined herbicide applications of Caltrans and county road agencies, CATs found that people in Los Angeles, Orange, and Contra Costa counties were exposed to the greatest concentration of chemical weedkillers. In stark contrast, no toxic spraying was conducted either by Caltrans or local road agencies in the counties of Mendocino, Humboldt and Trinity, which are located in the most vegetated region of the state.

Roadside herbicides are harmful to people and the environment

The eight herbicides shown in the chart (opposite page) account for 86.5% of roadside spraying in California. Studies of these toxic substances are limited, but the trials which have

been conducted indicate that they possess a great potential for causing human illness and environmental degradation. None have proven non harmful to humans or animals.

Of the eight herbicides listed in this chart, the U.S. EPA recognizes six as possible human carcinogens and four may cause birth defects. Seven, including glyphosate. are linked to toxicity in the liver and blood. Another, oxadiazon, is recognized by state and federal agencies as a liver and kidney toxicant which also causes birth defects and cancer. Seven exhibit varying degrees of toxicity to fish while four are harmful to birds. Four of the toxic chemicals on this list have been detected in groundwater by California's Department of Pesticide Regulation, and the University of Florida has determined that six possess a high potential for runoff.

Roadside spraying constitutes a serious threat to the health of those traveling or working on California's roads. At increased risk are children, people with compromised immune systems, and the 17% of Californians found in a survey conducted by the Department of Health Services to have symptoms of chemical sensitivity. Also, women and men whose careers keep them on the road may be subject to greater risk through frequent exposure. These unsuspecting thousands are not notified when toxic chemicals in the form of herbicides are released into their work environment.

Caltrans is not effectively curbing herbicide use

Caltrans serves as a model for much smaller county road agencies throughout the state, yet has failed to act as a responsible state agency. As CATs discovered, most of Caltrans' twelve district offices could not provide a basic summary of their use of toxic herbicides. Caltrans officials in Sacramento are not even sure how much the agency spends on herbicides — annual expenditures can only be estimated at $4 to $6 million for weedkilling chemicals.

A pledge made in 1992 to reduce its use of herbicides by 50% by the year 2000 is unlikely to be met by Caltrans despite millions of dollars spent on research studies. Promises to stop applying herbicides solely for the sake of appearances have been ignored, and the agency has not actively pursued the identification of school bus stops although it pledged to avoid spraying these areas.

Alternatives can replace toxic herbicides

Despite agency reluctance to halt the use of herbicides, several effective?affordable and nontoxic alternatives exist to kill weeds when it is deemed necessary. Most important is attention to what is actually required for adequate weed management. The use of chemical weedkillers can be eliminated where they are used merely to satisfy a particular aesthetic, possibly reducing the overall use of these poisons to a significant degree.

A viable alternative to toxic herbicide spray is Integrated Vegetation Management (IVM), a systemized approach to weed control in which different methods are integrated into a total vegetation management system. In its 1992 Environmental Impact Report, Caltrans pledged to adopt an IVM program, but even at this late date has conducted only extremely limited trials.

Caltrans and county road agencies could also use devices that spray nontoxic dry steam to lull weeds and their seeds. Steam spraying machines proved highly successful for British Columbia railways and have been developed by a California company for use on roadsides. Corn gluten, which stops weeds from sprouting, was intensively studied by Iowa State University before registration as an herbicide in California in 1998. Both alternatives are currently being explored in isolated, underfunded studies by Caltrans and the University of California, as is the use of fire-resistant native plants to choke out unwanted weeds.

There's even a venerable piece of equipment that has been in use since before chemicals herbicides were invented: the mower. Counties that have not used herbicides for years manage their roadsides with special mowers, and further research into equipment design could improve their utility.

Recommendations

Based on its investigation, CATs urges Caltrans and county road agencies to immediately make the following changes for the health and well being of all those who work or travel on California's roads:

- Invest at least as much as the agencies now spend on chemicals — up to $6 million annually for Caltrans — to implement alternative means of vegetation control and contract with IVM experts to recognize and eliminate unnecessary spraying.
- During the transition from chemical to nonchemical means of vegetation control, provide accurate advance notification, on-site warnings and records detailing herbicide use and audit already existing records to fully assess the actual cost of using herbicides to provide a basis for comparison to alternatives.

California State and County Roadside Weed Control Chemicals

State highways = 15,000 miles; maintained by Caltrans; spray herbicides in 55 out of 58 counties
County roads = 64,000 miles total; maintained by county governments; 51 counties spray, 7 do not

Herbicide[1]	gi	lb	Toxicology[2]
Diuron	36,691	20,469	Suspected carcinogen, birth defects; blood toxicant
Glyphosate	62,093		Enzyme inhibitor; damages mucous membranes
Simazine	4,798	16,044	Possible carcinogen; blood, kidney, nerve toxicant
Oxadiazon		15,457	Confirmed carcinogen, birth defects; kidney, liver toxicant
Norflurazon		19,257	Possible carcinogen, birth defects; reproductive toxicant
Oryzalin	10,088		Possible carcinogen; blood toxicant; skin sensitizer
Isoxaben		4,870	Possible carcinogen; enzyme inhibitor; testicular abnormalities
Bromacil		4,561	Possible carcinogen; endocrine, testicular, thyroid effects

[1] amounts represent total volume of formulations which contain the active ingredient
[2] according to federal and state regulatory agencies referenced in this report

Californians for Alternatives to Toxics (CATs) P.O. Box 1195, Arcata, CA 95518 (707)822-8497 e-mail: catz@reninet.com http://www.reninet.com/catz

Headway or Deadway?

At first it seemed that progress was being made. Official committees were formed to study alternative vegetation-control methods Members of the public even sat on one committee, but without a representative from the North Coast, communities that had fought for the promised changes remained without a voice in the proceedings.

Publication of the EIR allowed Caltrans to resume spraying in District 1, but herbicide use was kept to a minimum, perhaps because the memory of an outraged public was still fresh. For four mole years, from 1992 through 1995, mowing, not herbicides, continued to be the most-used method to keep grass down along over 1000 miles of North Coast highways.

In adjacent Trinity County, roadside spraying had ended without much fanfare. The population of the remote and isolated county has a long-established reputation for not tolerating herbicide use. Caltrans had found it less troublesome to mow roadsides since the mid-1980s, and no one

suggested reverting to spraying.

Also opposed were the Yurok and Hoopa Indian tribal governments which had resolved that Caltrans should not spray at all of their lands on the Trinity and Klamath rivers, and Caltrans agreed to honor the requests. Caltrans also stopped using herbicides in Redwood National Park when park rangers asked that adjacent park land be kept chemical free.

Despite the almost complete absence of herbicides in District 1 for eight years, the terrible consequences Caltrans had predicted — increased accidental fires, flooding and car wrecks — did not materialize. For example, Caltrans analyzed car accidents between 1988 and 1996 in Mendocino County and confirmed that the average rate of mishaps remained virtually the same as in years of heavy spraying. California Highway Patrol statistics for accident rates in all of District 1 during the same years support the conclusion reached by Caltrans. Contrary to the propaganda Caltrans had promoted for years, herbicides were proving not to be a factor AT ALL in improved road safety.

Nevertheless, Caltrans remained wedded to the notion that herbicides are cheaper, better and easier than the nontoxic means of weed control. Soon after the 1996 publication of its study of IVM alternatives, a full-scale spraying program was resumed in District 1. Although Caltrans headquarters had spent $700,000 on the IVM study, it failed to propose a time table or budget funds for actually implementing the various options it described. And in eight years of little or no spraying in District 1, the state agency explored no alternatives to chemical spraying other than mowing.

Outraged Again

In early summer 1996, the sight of newly dead grass and weeds on North Coast highways caused almost instant outrage among area residents. Months of contention ensued once spraying resumed at its former scale. Thousands of petition signatures were gathered. Protests took place regularly, sometimes before dawn outside the gates of Caltrans maintenance yards where spray rigs were parked. Elected officials of Mendocino County and the city of Arcata voted to tell Caltrans to stop spraying in their jurisdictions. Finally, four grandparents stepped out on a highway in front of a spray truck and were arrested.

Faced with all this conflict, District 1 Director Rick Knapp made an offer: if local governments in the district voted to stop spraying within their borders, the state agency would comply. The Humboldt County Board of Supervisors quickly voted unanimously to prohibit spraying, and city councils in Trinidad, Fort Bragg and Ukiah soon joined them. Spraying was stopped once more in most of District 1 in early 1997.

Knapp also agreed to CATs' request to create an agency and citizens committee to recommend alternative vegetation-control methods. The committee learned of two promising ideas — using steam or corn gluten instead of chemicals to keep down vegetation — and District 1 began actively investigating them.

Despite many meetings of the committee through 1998, a look at how much Caltrans plans to invest in District 1 on vegetation management options reveals that the deck is still stacked in favor of herbicides. $79,000 is earmarked for the pioneering studies of alternatives while $1.5 million is budgeted for a study on how to keep using the poisons near waterways without exceeding pollution standards.

Meanwhile, as described in the following pages of this report, Caltrans continues to use high levels of dangerous herbicides in most areas of the state. With just months to go, its promise to reduce spraying by 50% by the year 2000 appears doomed to fail.

In retrospect it's clear that with all its money and power, with all the potential to do well and fulfill its duty to the citizens of California, Caltrans has failed to make any progress toward reducing its chemical dependence except when constant public pressure has been directly applied.

Toxicological Profiles

Product: ROUNDUP
Active ingredient: CLYPHOSATE 41%
Other ingredients: 59% includes: polyethoxethyleneamine (POEA) and isopropylamine (amount undisclosed); identity of remaining ingredients withheld by manufacture as trade secrets.
Type: HERBICIDE (Systemic)
Mode of Action: Inhibits enzymatic activity of a process specific to plants; other enzyme systems in plants and animals are also affected by glyphosate. (Heitanen 1983)

Of pesticides used during 1994. glyphosate was #7 for overall total pounds of ***active*** *ingredient applied in California. Of the total glyphosate* ***used in*** *the state, 10% was used in grape production, yet grapes were the* ***number one crop*** *associated with glyphosate- related illnesses from 1984 to 1990 (Pease 1993).*

Toxicology

In California agriculture, Roundup's active ingredient, glyphosate, ranked 3rd for reported pesticide related skin and **eye** acute illnesses, 15th for reported systemic and respiratory acute illnesses and 3rd for reported pesticide related acute illnesses of any kind from 1984 to 1990. It was ranked 8th in acute illnesses per million pounds applied (ibid).

Roundup inhibits enzymes involved in the detoxification **of** chemicals in the body. Test animals exposed to glyphosate showed depressed function of cytochrome P450 and two other enzymes which are vital to the body's processing of toxicants (Heitanen 1983). At least two enzymatic steps are involved in the processing of toxicants in the liver of humans; the first involves cytochrome P450 enzymes and the second involves glutathione S tranferases (GSTs). People who do not possess certain GSTs due to genetic variation (estimated at approximately 50% of the Caucasian population; others unknown), may have a greater risk of some types of cancer (Perera 1996).

U.S. EPA recently reclassified glyphosate as a Group E chemical, meaning that evidence exists that the compound is not a human carcinogen. Yet studies submitted to the California Department of Pesticide Regulation indicate possible **adverse cancer** effects, with rare tumor formation in the kidneys and adrenal cortex of test animals. Other studies found an increase of testicular tumors, thyroid cancer in females, and a rare kidney tumor (U.S.EPA 1982;1983;1985;1991).

Metabolites and breakdown products of glyphosate include the known carcinogen formaldehyde (Lund 1986). Formaldehyde is listed as a **carcinogen** by California's Office of Environmental Health Hazard Assessment under Proposition 65. It also causes gene mutations and is a reproductive toxicant (MBTOC 1995).

N- nitrosoglyphosate, a contaminant of glyphosate, is a member of a chemical family of which approximately 75% are known carcinogens (Lijinsky 1974; Sittig 1980).

Glyphosate is a severe eye irritant. Symptoms of exposure include eye and skin irritation, which is sometimes severe and can persist for months (Temple and Smith 1992).

A study of humans documented a greater incidence of impaired lung function, throat irritation, coughing and breathlessness in workers exposed to dust of flax treated with Roundup, as compared to those exposed to untreated flax dust (Jamison 1986).

A low dose exposure study in experimental animals demonstrated salivary gland abnormalities related to changes in adrenalin levels. Changes were also observed in the kidney, liver, and thymus (U.S. Department of Health and Human Services).

An unknown percentage of Roundup's formulation is composed of polyethoxethyleneamine (POEA), a surfactant added to enhance the performance of glyphosate. POEA is three times as acutely toxic as glyphosate (Sawada 1988), is irritating to eyes and skin, and causes gastrointestinal problems (Monsanto 1992). POEA is contaminated by 1,4 dioxane during the manufacturing process (NCAP 1990). U.S.EPA regards 1,4 dioxane as a probable human carcinogen. California's Office of Environmental Health Hazard Assessment recognizes 1,4 dioxane as a carcinogen under Proposition 65.

In animal tests, a mixture of glyphosate and POEA caused cardiac arrest (UNEP/WHO/ILO 1994). The amount of Roundup — which is a combination of glyphosate and POEA — required to **kill** rats is about 1/3 of a lethal dose of either compound applied separately (Martinez 1990,1991), suggesting that **synergism** of the two chemicals may enhance toxicity.

Another portion of Roundup's formula is composed of isopropylamine, a neutralizing agent. It is extremely destructive to tissue **of** the mucous membranes and upper respiratory tract (Sigma Chemical 1994).

Environmental Fate and Effects

Glyphosate is a candidate for evaluation as a toxic air contaminant by the California Department of Pesticide Regulation. Formaldehyde, one of glyphosate's breakdown products, is listed as a toxic air contaminant. (DPR 1994)

Between 14% and 78% of glyphosate applied as a ground spray **drifts off** site (Freedman 1990,1991). It has been documented to affect plants as far as 131 feet away, and residues have been detected 1,312 feet downwind (Marrs 1993; Yates 1978).

Glyphosate is highly persistent in soil, taking from 24 to 249 days for one-half of it to transform or biodegrade (Lappe 1996).

Glyphosate has been found in surface water as the result of agricultural run-off Frank 1990; Edwards 1980) and in ground water (U.S.EPA 1992).

Roundup is highly toxic to fish and aquatic *organisms* (Product label). Juvenile fish are particularly sensitive to the toxic effects of Roundup. Physical and chemical factors such as temperature, pH and solute concentration in aquatic ecosystems influence the acute toxicity of glyphosate to aquatic organisms (Caltrans 1991).

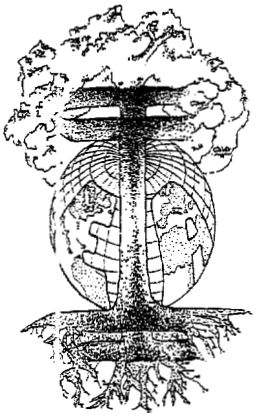
Glyphosate was shown in one study to inhibit the growth of mycorrhizal fungi, organisms which are essential to ecosystems and enhance plant survival (Sidhu 1990).

Acute toxicity to mammals, birds, and bees is low, but no information is available regarding long term effects of glyphosate to these organisms. No data is available regarding the toxicity of glyphosate to soil invertebrates, reptiles or amphibians (Caltrans 1991).

Fraud and Profit

Laboratories contracted by the manufacturer to conduct toxicological analysis on glyphosate have twice been documented as falsifying data for these tests (U.S. Congress 1984; EPA 1994).

Public perception of Roundup has largely been shaped by high profile advertising campaigns of its manufacturer, Monsanto, which has a high economic stake in its continued use. According to The Wall Street Journal (1/2/96), Roundup accounts for one half of Monsanto's earnings. Monsanto advertises that Roundup can be used, "where pets and kids play" and that it, "breaks down into natural materials when its work is done." But in 1996 the New **York** Attorney General fined Monsanto $50,000 for these false claims and extracted a promise from Monsanto to never again advertise in the state that Roundup is safe.



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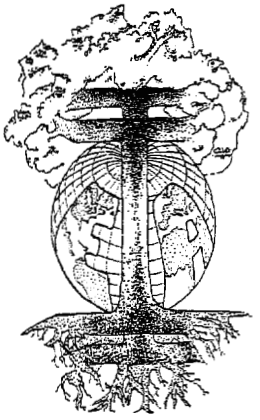
Web www.permaculture.com
Non Profit ID # 94-3257335



February 11,2002

Dear Board Members

I sat in on last week's IPM Departmental Advisory Group meeting. I will restrict my comments for clarity at this time to the question posed by Supervisor Wormhoudt, namely *"whether stronger action by the Board of Supervisors requesting Caltrans to* ***eliminate*** *the use of herbicides along Highway 1 in Santu Cruz County* ***would*** *have any greater impact that the actions already taken."*

Before any discussion of the issue could begin a member of the committee, who favors chemical control, immediately jumped in and said that the most the Board should do, would be to write a *polite letter requesting reduction.* This was totally inappropriate since the mandate of the IPM-DAG committee is to implement the County's directive to ELIMINATE pesticide use within the county. No testimony had yet been offered one way or the other as to whether there was any evidence that herbicides were even needed to control the weeds.

The polite letter already sent by the board last summer, requesting that Caltrans **eliminate** herbicide use has Fallen on deaf and arrogant ears. The September 22, 2000 response by Jay Walter of Caltrans to the board was also very polite. It was couched in terms to appear as **if** Caltrans was trying to accommodate our request, but the disturbing meaning of the letter was quite clear. Stripped of its "politeness" the letter says: We at Caltrans refuse to ever eliminate herbicide use in your County. Furthermore we don't even plan to approach a high level of reduction for **at** least 10 years! This letter is an insult to the Board and to the County. The time **for** "polite requests" is over.

When members of the public began questioning the Caltrans representative, the following facts became clear. Other counties **with** even higher summer rainfall, and therefore greater weed growth, such as Humboldt county, have eliminated Caltrans spraying. Caltrans' own studies show that several years after spraying ceased, there bas been no increase in accidents or fire, the **two** reasons Caltrans states are its justification for herbicide use.

Further questioning produced the following deeper understanding. Landscape design currently in place on the highways was done at a time of fatter budgets which permitted much more labor intensive maintenance and fancy irrigation systems. Current budgets make high end maintenance difficult **but** Caltrans feels obligated to try to maintain obsolete landscaping which it refers to as its "facilities". Caltrans believes, although

independent studies have shown otherwise, that herbicide use is cheaper than mechanical weed control. Studies both on highways and in agriculture, show that the cost of controlling weeds chemically, or with labor, is roughly equivalent. But the more telling opinion expressed by the Caltrans representative was that Caltrans has substantial investment **in** its spray equipment, which it believes it must defend.

The net result of all this discussion was clear. There is no safety, fire, or technological reason to continue herbicide use. The representative from Caltrans confirmed to me that mechanical control is totally feasible but more expensive from Caltrans' point of view. So what we have is a huge state agency which is choosing to use dangerous toxic chemicals **in** the county rather than disturb **its** budget process. In so doing It is ignoring the health and environmental effects on the county.

Amazingly, none of this discussion was recorded in the minutes and my presence and proposals at the meeting were conspicuously omitted from the meeting minutes!

Make no mistake, these herbicides are dangerous. The EPA, says so, the FDA says so, and scientists around the world say so. Bear in mind that the State of New York fined Monsanto $50,000 for claiming that Roundup was safe. Roundup, in high professional concentrations, is Caltrans' poison of choice. Arguments about road safety and fire are clearly a smokescreen not borne out by the data, even Caltrans' own data.

'From the county point of view, paying people, even Workfare people, to mechanically control the weeds, is far superior even if the cost is roughly equivalent to herbicide control. When you pay people the money to do the control they tend to spend it in the local community. The benefit of this local spending ripples through the county. Some studies show money spent on local labor can be respent up to twelve times before it leaves the county. When you take an equivalent amount **of** money and spend **it** on expensive herbicide instead of labor the effect is quite different. In that case taxpayer dollars are simply exported from our state to Monsanto's corporate headquarters. None of this figures into the cost-benefit studies performed on this issue because it is deemed "outside of the box".

Since the method of weed control has clearly been shown to be a simple matter of money and who, whether local voters or corporations receive it, I suggest the board take the following approach.

The board should DEMAND, not request, that Caltrans cease using chemical control of weeds as of June 1, 2002 (The end of our weed growing season when everything dries up). The board should INSIST, not request, that if any weed control is actually needed due to a clear and present danger to traffic or property, that it be done non-toxically by mechanical means or with hand labor.

As in the case of Humboldt, Mendocino, and Trinity counties it is not necessary **for** Santa Cruz County to find a cost equivalent method of weed control before we insist that Caltrans take action. In fact, I believe once more counties exclude chemical control, the bright, capable engineers at Caltrans will develop any technology they need to reduce the costs of mechanical control. Better yet, they will listen to the more progressive voices within their own organization to change the current obsolete landscape design to drought tolerant, safe, **low** maintenance plantings in the future. But if communities like ours don't put the pressure on them to change, then change will never come.

Sincerely,

David Blume
President

@ HERBICIDE FACTSHEET

GLYPHOSATE (ROUNDUP)

Glyphosate is a broad-spectrum herbicide widely used to kill unwanted plants both in agriculture and in nonagricultural landscapes. Estimated use in the U.S. is between 38 and 48 million pounds per year. Most glyphosate-containing products are either made or used with a surfactant, chemicals that help glyphosate to penetrate plant cells.

Glyphosate-containing products are acutely toxic to animals, including humans. Symptoms include eye and skin irritation, headache, nausea, numbness, elevated blood pressure, and heart palpitations. The surfactant used in a common glyphosate product (Roundup) is more acutely toxic than glyphosate itself; the combination of the two is yet more toxic.

Given the marketing of glyphosate herbicides as benign, it is striking that laboratory studies have found adverse effects in all standard categories of toxicological testing. These include medium-term toxicity (salivary gland lesions), long-term toxicity (inflamed stomach linings), genetic damage (in human blood cells), effects on reproduction (reduced sperm counts in rats; increased frequency of abnormal sperm in rabbits), and carcinogenicity (increased frequency of liver tumors in male rats and thyroid cancer in female rats).

Glyphosate has been called "extremely persistent" by the U.S. Environmental Protection Agency, and half lives of over 100 days have been measured in field tests in Iowa and New York. Glyphosate has been found in streams following agricultural, urban, and forestry applications.

Glyphosate treatment has reduced populations of beneficial insects, birds, and small mammals by destroying vegetation on which they depend for food and shelter.

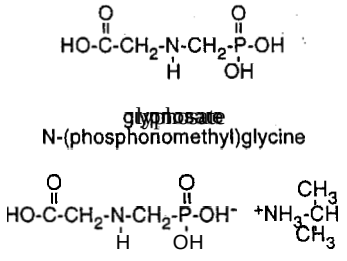
In laboratory tests, glyphosate increased plants' susceptibility to disease and reduced the growth of nitrogen-fixing bacteria.

BY CAROLINE COX

Described by their manufacturer as pesticides of "low toxicity and environmental friendliness,"[1] glyphosate-based herbicides can seem like a silver bullet when dealing with unwanted vegetation. However, glyphosate poses a variety of health and environmental hazards. The following article is a summary of those hazards.

Glyphosate, N-(phosphonomethyl) glycine (Figure 1), is a systemic and nonselective herbicide used to kill broadleaved, grass, and sedge species.[2] It has been registered in the U.S. since 1974 and is used to control weeds in a wide variety of agricultural, urban, lawn and garden, aquatic, and forestry situations.[3] Most glyphosate herbicides contain the isopropylamine salt of glyphosate.[4]

Figure 1
Glyphosate



isopropylamine salt of glyphosate

Glyphosate products are manufactured by Monsanto Company worldwide. They are marketed under a variety of trade names: Roundup, Rodeo, and Accord are the most common names in the U.S.[2]

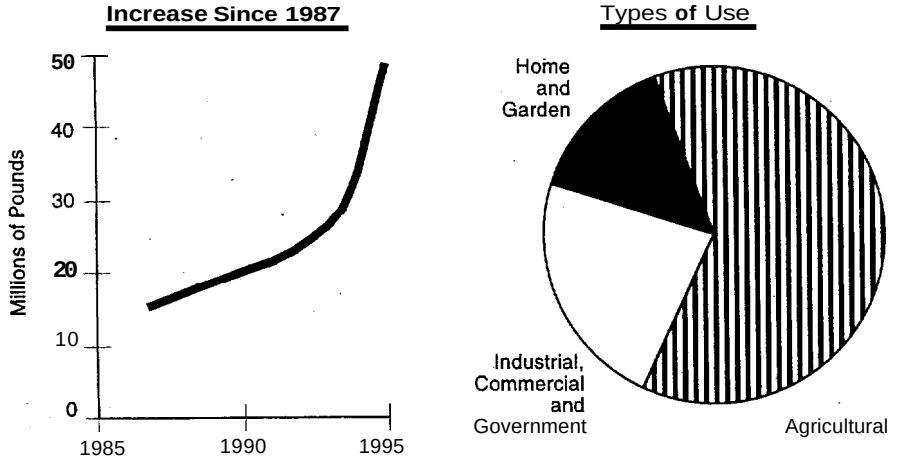
Unlike most other herbicides, chemicals which are closely related to glyphosate are not effective herbicides.[5]

Use

Glyphosate is the seventh most commonly used pesticide in U.S. agriculture, the third most commonly used pesticide on industrial and commercial land, and the second most commonly used home and garden pesticide. Estimated annual use according to the U.S. Environmental Protection Agency (EPA) is between 38 and 48 million pounds.[6] The largest agricultural uses are in the production of soybeans, corn, hay and pasture, and on fallow land.[7] Glyphosate use is currently (1998) growing at a rate of about 20 percent annually, primarily because of the recent introduction of crops which are genetically engineered to be tolerant of

Caroline Cox is JPR's editor.

Figure 2
Glyphosate Use in the U.S.



Aspelin, A.L. 1990; 1994; 1997. ***Pesticide industry sales and usage: 1988 market estimates; 1992 and 1993 market estimates; 1994 and 1995 market estimates.*** U.S. EPA. Office of Prevention, Pesticides and Toxic Substances. Office of Pesticide Programs. Biological and Economic Analysis Division. Washington, **D.C.**

Use of glyphosate increases about 20 percent each year.

the herbicide.[8] (See Figure 2.)

In the U.S., 25 million applications are made yearly on lawns and in yards.[9]

Mode of Action

Glyphosate's mode of action is "not known at this time,"[4] according to EPA. However, considerable research has established that glyphosate inhibits an enzyme pathway, the shikimic acid pathway, preventing plants from synthesizing three aromatic amino acids. These amino acids are essential for growth and survival of most plants. The key enzyme inhibited by glyphosate is called EPSP synthase.[10] Glyphosate also "may inhibit or repress"[4] two other enzymes, involved in the synthesis of the same amino acids.[4] These enzymes are present in higher plants and microorganisms but not in animals.[10]

Two of the three aromatic amino acids are essential amino acids in the human diet because humans, like all higher animals, lack the shikimic acid pathway, cannot synthesize these amino acids, and rely on their foods to provide these compounds. One is synthesized in animals through another pathway."

Glyphosate can affect plant enzymes not connected with the shikimic acid pathway. In sugar cane, it reduces the activity of one of the enzymes involved in sugar metabolism.12 It also inhibits a major detoxification enzyme in plants.[13]

Roundup affects enzymes found in mammals. In rats, Roundup decreased the activity of two detoxification enzymes in the liver and an intestinal enzyme.[14]

"Inert" Ingredients in Glyphosate-containing Products

Virtually every pesticide product contains ingredients other than what is called the "active" ingredient(s), the one designed to provide killing action. These ingredients are misleadingly called "inert." The purpose of these "inerts" is to make the product easier to use or more efficient. In general, they are not identified on the labels of pesticide products.

In the case of glyphosate products, many "inerts" have been identified. See "Toxicology of 'Inert' Ingredients of Glyphosate-containing Products," p. 5, for basic information about these "inerts."

Many of the toxicology studies that will be summarized in this factsheet have been conducted using glyphosate, the active ingredient, alone. Some have been conducted with commercial products containing glyphosate and "inert" ingredients. When no testing is done with the product as it is actually used, it is impossible to accurately assess its hazards.

We will discuss both types of studies, and will identify insofar as is possible what material was used in each study.

Acute Toxicity to Laboratory Animals

Glyphosate's acute oral median lethal dose (the dose that causes death in 50 percent of a population of test animals; LD_{50}) in rats is greater than *4,320* milligrams per kilogram (mg/kg) of body weight. This places the herbicide in Toxicity Category III (Caution).[4] Its acute dermal toxicity (dermal LD_{50}) in rabbits is greater. than 2,000 mg/kg of body might, also Toxicity Category III.[4]

Commercial glyphosate herbicides are more acutely toxic than glyphosate. The amount of Roundup (containing glyphosate and the surfactant POEA) required to kill rats is about 1/3 the amount of glyphosate alone.[15] Roundup is also more acutely toxic than POEA.[15]

Glyphosate-containing products are more toxic via inhalation than orally. Inhalation of Roundup by rats caused "signs of toxicity in all test groups,"[16] even' at. the lowest concentration tested. These signs included gasping, congested eyes, reduced activity," and body weight loss.[16] Lungs were red or blood-congested.[17] The dose required to cause lung damage and mortality following pulmonary administration of two Roundup' products and POEA (when forced into the trachea, the tube carrying air into the lungs) was only 1/10 the dose causing damage orally.[15,18]

Effects on the Circulatory System: When dogs were given intravenous injections of glyphosate, POEA, or Roundup so that blood concentrations were approximately those found in humans who ingested glyphosate, glyphosate increased the ability of the heart muscle to contract. POEA reduced the output of the heart and the pressure in the arteries.

Roundup caused cardiac depression.[19]

Eye Irritation: NCAP surveyed eye hazards listed on material safety data sheets for 25 glyphosate-containing products. One of the products is "severely irritating,"[20] 4 cause "substantial but temporary eye injury,"[21-24] 8 "cause eye irritation,"[25-32] 5 "may cause eye irritation,"[33-37] 1 is "moderately irritating,"[38] and 3 are "slightly irritating."[39-41] The other three products require addition of a surfactant (wetting agent) before use,[42-44] and the surfactant sold by glyphosate's manufacturer for this purpose "causes eye burns."[45]

Skin Irritation: Glyphosate is classified as a slightly irritating to skin. Roundup is a "moderate skin irritant," and recovery can take over two weeks.[16]

Acute Toxicity to Humans

The acute toxicity of glyphosate products to humans was first publicized by physicians in Japan who studied 56 suicide attempts; nine cases were fatal. Symptoms included intestinal pain, vomiting, excess fluid in the lungs, pneumonia, clouding of consciousness, and destruction of red blood cells.[66] They calculated that the fatal cases ingested on average about 200 milliliters (3/4 of a cup). They believed that POEA was the cause of Roundup's toxicity.[66] More recent reviews of poisoning incidents have found similar symptoms, as well as lung dysfunction,[67-69], erosion' of the gastrointestinal tract,[67,69] abnormal electrocardiograms,[69] low blood pressure,[67,69] kidney damage,[67,68,70] , and damage to the larynx.[71]

Smaller amounts of Roundup cause adverse effects, usually skin or eye irritation as well as some of the symptoms listed above: (See Table 1.) For example, rubbing of Roundup in an eye caused eye and lid swelling, rapid heartbeat and elevated blood pressure. Wiping the face after touching leaky spray equipment caused swelling of the face. Accidental drenching with horticultural Roundup caused eczema of the hands and arms lasting two months.[68] A spill resulted in dizziness, fever, nausea, palpitations, and sore

TOXICOLOGY OF "INERT" INGREDIENTS IN GLYPHOSATE-CONTAINING PRODUCTS

Three glyphosate products contain ammonium sulfate.[29,30,32] It causes eye irritation, nausea and diarrhea, and may cause allergic respiratory reactions. Prolonged exposure can cause permanent eye damage.[46]

One glyphosate product contains benzisothiazolone.[47] It causes eczema, skin irritation,[48] and a light-induced allergic reaction in sensitive people.[49,50]

Four glyphosate products contain 3-iodo-2-propynyl butylcarbamate (IPBC).[39-41,47] It is severely irritating to eyes and increases the incidence of miscarriages in laboratory tests.[51] It also can cause allergic skin reactions.[52]

One glyphosate product contains isobutane.[30] It causes nausea, nervous system depression, and difficulty breathing. It is a severe fire hazard.[53]

One glyphosate product contains methyl pyrrolidinone.[20] It causes severe eye irritation.[54] It has caused fetal loss and reduced fetal weights in laboratory animals.[55]

Three glyphosate products contain pelargonic acid.[29,30,32] It causes severe eye and skin irritation and may cause respiratory tract irritation.[56]

Nine glyphosate products contain polyethoxylated tallowamine (POEA).[21-24,31,35-38] It causes eye burns; skin redness, swelling, and blistering; nausea; and diarrhea.[23,45]

Three glyphosate products contain potassium hydroxide.[29,30,32] It causes irreversible eye injury, deep skin ulcers, severe digestive tract burns, and severe irritation of the respiratory tract.[57]

One glyphosate product contains sodium sulfite.[34] It may cause eye and skin irritation with vomiting and diarrhea[58] as well as skin allergies.[59] Exposure to small amounts can cause severe allergic reactions.[60]

Three glyphosate products contain sorbic acid.[35,36,37] It may cause severe skin irritation, nausea, vomiting, chemical pneumonitis, and sore throat.[61] It also causes allergic reactions.[62,63]

Isopropylamine is used in some Roundup products.[47,64] It is "extremely destructive to tissue of the mucous membranes and upper respiratory tract."[65] Symptoms of exposure are wheezing, laryngitis, headache, and nausea.[65]

Table 1
Symptoms Following Unintentional Exposure to Glyphosate Herbicides

eye irritation
painful eyes
burning eyes
blurred vision
swollen eye, face, joints
facial numbness
burning sensation on skin
itchy skin
tingling skin
recurrent eczema
blisters
skin rash
rapid heartbeat
heart palpitations
elevated blood pressure
chest pains
congestion
coughing
headache
nausea

Temple, **W.A.** and **N.A.** Smith. 1992. Glyphosate herbicide poisoning experience in New Zealand. *N.Z. Med. J.* 105:173-174.

Calif. **EPA.** Dept. **of** .Pesticide Regulation. 1998. Case reports received by the California Pesticide Illness Surveillance Program in which health effects were attributed to glyphosate, 1993-1995. Unpublished report.

throat.[72]

Toxicology Overview

Glyphosate is often portrayed as toxicologically benign: "extensive investigations strongly support the conclusion that glyphosate has a very low level of toxicity..."[73] NCAP's review of glyphosate's toxicology comes to a different conclusion. Adverse effects have been identified in each standard category of testing (subchronic, chronic, carcinogenicity, mutagenicity, and reproduction). NCAP's review has been challenged by the assertion that these effects were found because standard test protocols ***require*** finding adverse effects at the highest dose tested. However, the following five sections of this article summarize adverse effects did ***not*** result from this requirement: they were all found at less than the highest dose tested. (The few exceptions are clearly identified.)

Subchronic Toxicity

In subchronic (medium term) studies of rats and mice done by the National Toxicology Program (NTP), microscopic salivary gland lesions were found in all doses tested in rats (200 - *3400* mg/kg per day) and in all but the lowest dose tested in mice (1,000-12,000 mg/kg per day). (See Figure 3.) A follow-up study by NTP found that the mechanism by which glyphosate caused these lesions involved the hormone adrenalin.[74]

The NTP study also found increases in two liver enzymes at all but the two lowest doses tested. Other effects found in at least two doses in this study were reduced weight gain in rats and mice; diarrhea in rats; and changes in kidney and liver weights in male rats and mice.[74]

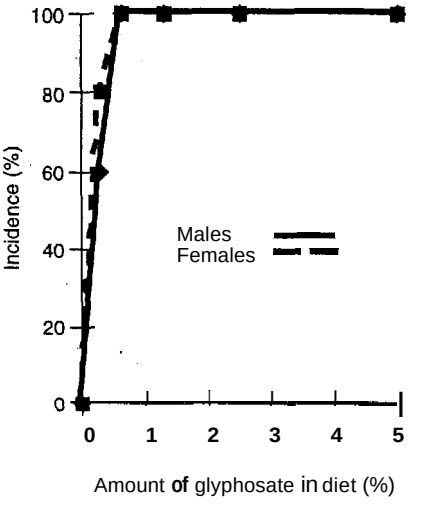
Another subchronic laboratory test found that blood levels of potassium and phosphorus in rats increased at all doses tested (60-1600 mg/kg/day).[4]

Glyphosate-containing products are more toxic than glyphosate in subchronic tests. In a 7 day-study with calves, 790 mg/kg per day of Roundup caused pneumonia, and death of 1/3 of the animals tested. At lower doses decreased food intake and diarrhea were observed.2

Chronic Toxicity

Glyphosate is also toxic in long-term studies. At all but the lowest dose tested, excessive cell division in the urinary bladder occurred in male mice[2] and inflammation of the stomach lining occurred in both sexes of rats.[2]

Figure 3
Salivary Gland Lesions in Rats Fed Glyphosate



U.S. Dept. of Health and Human Services. Public Health Service. National Institutes of Health. **1992.** NTP technical report on toxicity studies of glyphosate **(CAS** No. **1071-83-6)** administered in dosed feed to F344/N rats and B6C3F1 mice. Research Triangle Park, NC: National Toxicology Program.

Glyphosate causes salivary gland **lesions** in rats, mediated by the hormone adrenalin.

Carcinogenicity

The publicly available studies of glyphosate's ability to cause cancer were all conducted by or for its manufacturer.2 The first carcinogenicity study submitted to EPA (1981) found an increase in testicular tumors in male rats at the highest dose tested **as** well as an increase in the frequency of a thyroid cancer in females. Both results occurred at the highest dose tested **(30** mg/kg of body weight per day).[75,76] The second study (1983) found an increasing trend in the frequency of a rare kidney tumor in male mice.[77] The most recent study (1990) found an increase in pancreas and liver tumors in male rats together with an increase of the same thyroid cancer found in the 1983 study in females.[78]

. All of these increases in tumor or cancer incidence are "not considered compound-related"[78] according to EPA (This means that EPA did not consider glyphosate the cause of the tumors.) For the testicular tumors, EPA accepted the interpretation of an industry pathologist who said that the incidence in treated groups (12 percent) was similar to those observed (4.5 percent) in other rats *not* fed glyphosate.78 For the thyroid cancer, EPA stated that it was not possible to distinguish between cancers and tumors of this type, so that the two should be considered together. The combined data are not statistically significant.[76] For the kidney tumors, the manufacturer reexamined the tissue and found an additional tumor in untreated mice so that statistical significance was lost. This was despite the opinion of EPA's pathologist that the lesion in question was not really a tumor.[77] For the pancreatic tumors, EPA stated that there was no dose-related trend. For the liver and thyroid tumors, EPA stated that pairwise comparisons between treated and untreated animals were not statistically significant.[78]

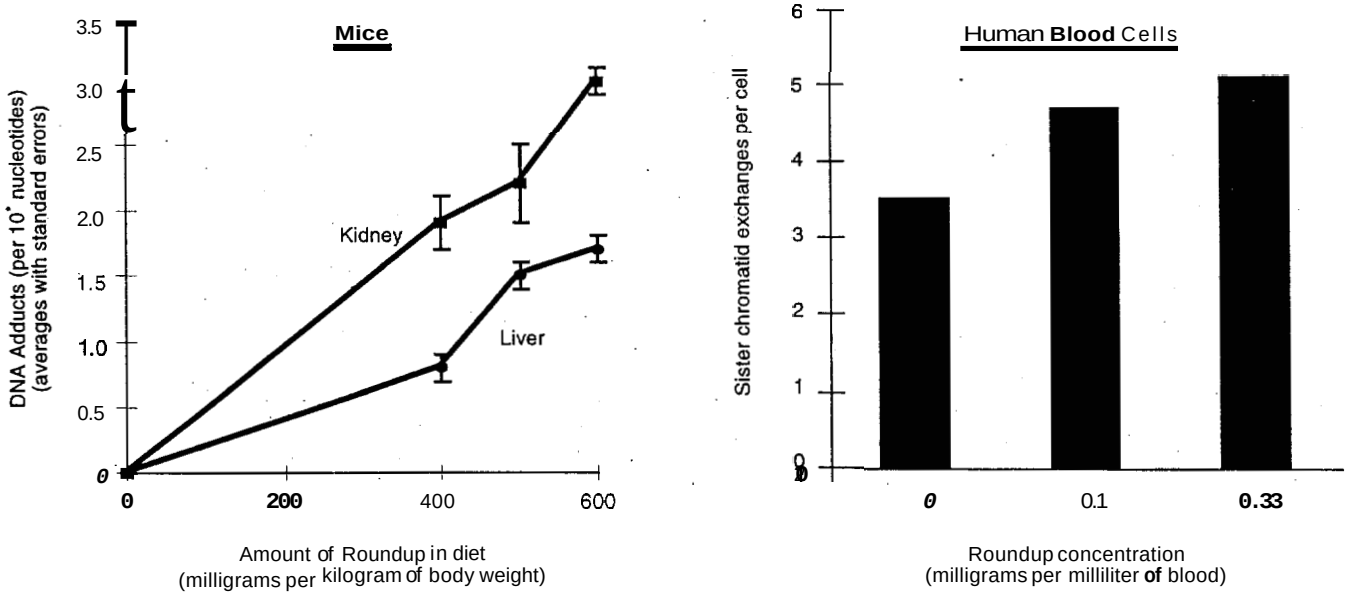
EPA concluded that glyphosate should be classified as Group E, "evidence of non-carcinogenicity for humans."[78] They added that this classification "should not be interpreted as a definitive conclusion."[78] The cancer tests leave many questions unanswered. Concerning one of the carcinogenicity studies, an EPA statistician wrote, "Viewpoint is a key issue. Our viewpoint is one of protecting the public health when we see suspicious data."[79] Unfortunately, EPA has not taken that viewpoint in its assessment of glyphosate's cancer-causing potential.

There are no publicly available studies of the carcinogenicity of Roundup or other glyphosate-containing products.

Mutagenicity

Although glyphosate's manufacturer

Figure 4
Genetic Damage Caused by Roundup



Peluso, M. et al. 1998. ^{32}P-Postlabeling detection of DNA adducts in mice treated with the herbicide Roundup. *Environ. Molec. Mutag.* 31:55-59.

Bolognesi, C. et al. 1997. Genotoxic activity of glyphosate and its technical formulation Roundup. *J. Agric. Food Chem.* 45:1957-1962.

Roundup causes genetic damage in laboratory animals and in human blood cells.

dsscribes "a large battery of assays"[80] showing that glyphosate does not cause genetic damage,[80] other studies have shown that both glyphosate and glyphosate products are mutagenic. Glyphosate-containing products are more potent mutagens than glyphosate.[81] The studies include the following:

• In fruit flies, Roundup and Pondmaster (an aquatic herbicide 'consisting of glyphosate and a trade secret surfactant[82]) both increased the frequency of sex-linked, recessive lethal mutations. (These are mutations that are usually visible only in males.) Only a single concentration was tested in this study.[83]

• A study of human lymphocytes (a type of white blood cell) showed an increase in the frequency of sister chromatid exchanges following exposure to the lowest dose tested of Roundup.[84] (Sister chromatid exchanges are exchanges of genaic material during cell division between members of a chromosome pair. They result from point mutations.) A 1997 study of human lymphocytes (see Figure. *4)* found similar results with Roundup (at both doses tested) and with glyphosate (at all but the lowest dose tested).[81]

• In ***Salmonella*** bacteria, Roundup was weakly mutagenic at two concentrations. In onion root cells, Roundup caused an increase in chromosome aberrations, also at two concentrations.85

• In mice injected with Roundup, the frequency of DNA adducts (the binding to genetic material of reactive molecules that lead to mutations) in the liver and kidney increased at all three doses tested.[86] (See Figure *4.)*

• In another study of mice injected with glyphosate and Roundup, the frequency of chromosome damage and DNA damage increased in bone marrow, liver, and kidney. (Only a single concentration was tested in this study.)[81]

Reproductive Effects

Glyphosate exposure has been linked to reproductive problems in humans. A study in Ontario, Canada, found that fathers' use of glyphosate was associated with an increase in miscarriages and premature births in farm families.[87] (See Figure 5.) In addition, a case report from the University of California discussed a student athlete who suffered abnormally frequent menstruation when she competed at tracks where glyphosate'had been used.[88]

Laboratory studies have **also** demonstrated a number of effects of glyphosate on reproduction.

In rats, glyphosate reduced sperm counts at the two highest doses tested. (See Figure **5.)** In male rabbits, glyphosate at doses of 1/10 and 1/100 of the LD, increased the frequency of abnormal and dead sperm.[89]

In a study of female rabbits, glyphosate caused a decrease in fetal weight in all treated groups.[90]

Toxicology of Glyphosate's Major 'Metabolite

In general, studies of the breakdown of glyphosate find only one metabolite, aminomethylphosphonic acid (AMPA).[2]

Although AMPA has low acute toxicity (its LD_{50} is 8,300 mg/kg of body weight in rats),[16] it causes a variety of toxicological problems. In subchronic tests on rats, PMPA caused an increase in the activity of an enzyme, lactic dehydrogenase, in both sexes; a decrease in liver weights in males at all doses tested; and excessive cell division in the lining of the urinary bladder in both sexes.[16] AMPA is more persistent than glyphosate; studies in eight states found that the half-life in soil (the time required for half of the original concentration of a compound to break down or dissipate) was between 119 and 958 days.[2]

Quality of Laboratory Testing

Tests done on glyphosate to meet registration requirements have been associated with fraudulent practices.

Laboratory fraud first made headlines in 1983 when EPA publicly announced that a 1976 audit had discovered "serious deficiencies and improprieties" in srudies conducted by Industrial Biotest Laboratories (IBT).[91] Problems included "countless deaths of rats and mice" and "routine falsification of data."[91]

IBT was one of the largest laboratories performing tests in support of pesticide registrations.[91] About 30 tests on glyphosate and glyphosate-containing products were performed by IBT, including 11 of the 17 chronic toxicology studies.[92] A compelling example of the poor quality of IBT data comes from an EPA toxicologist who wrote, "It is also somewhat difficult not to doubt the scientific integrity of a study when the IBT stated that it took specimens from the ***uteri*** (of *male* rabbits) for histopathological examination."[93] (Emphasis added.)

In 1991, EPA alleged that Craven Laboratories, a company that performed studies for 262 pesticide companies including Monsanto, had falsified tests.[94] 'Tricks" employed by Craven Labs included "falsifying laboratory notebook entries" and "manually manipulating scientific equipment to produce false reports."[95] Roundup residue studies on **plums,** potatoes, grapes, and sugarbeets were among the tests in question.[96]

The following year, the owner of Craven Labs and three employees were indicted on 20 felony counts.[97] The owner was sentenced to five years in prison and fined $50,000; Craven Labs was fined 15.5 million dollars, and ordered to pay 3.7 million dollars in restitution.95

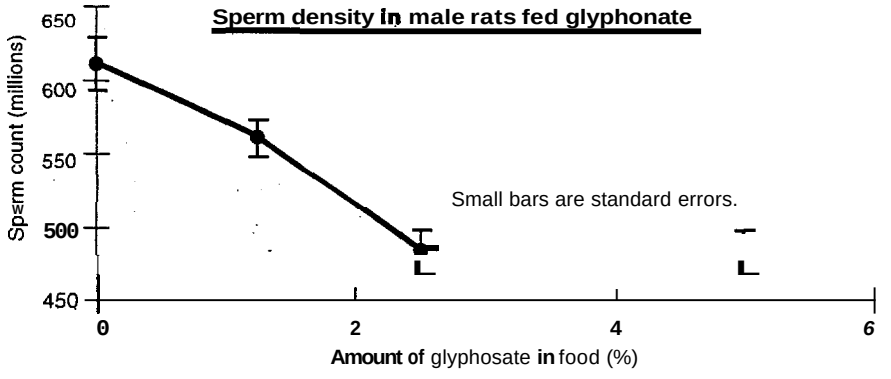
Although the tests of glyphosate identified as fraudulent have been replaced, this fraud casts shadows on the entire pesticide registration process.

Illegal Advertising

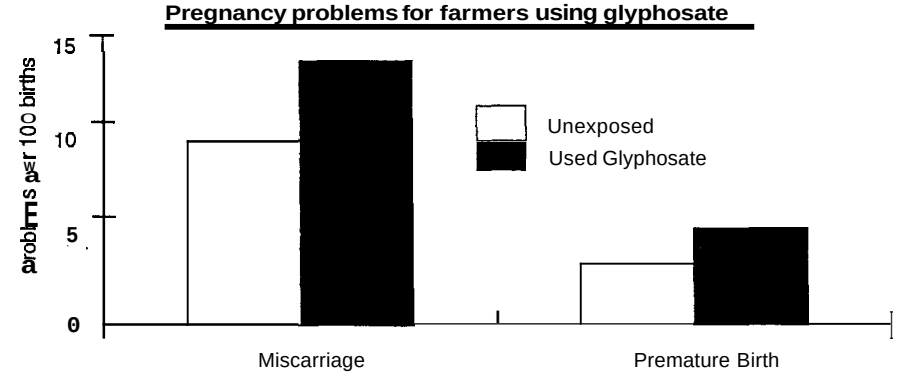
In 1976; Monsanto Co. negotiated an agreement with the New York attorney-general that required Monsanto to stop making certain health and environmental claims in ads for glyphosate products and pay the attorney general $50,000 in costs.[98] Claims that glyphosate products are "safer than table salt,"[98] safe for people, pets, and the environment, and degrade "soon after application"[98] were challenged by the attorney-general because they are in violation of the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), the national pesticide law.[98] According to the attorney-general, Monsanto had engaged in "false and misleading" advertising.[98]

EPA made a similar determination about Roundup ads in 1998, finding that they contained "false and misleading""

Figure 5
Effects of Glyphosate on Male Reproductive Success



U.S. Dept. of Health and Human Services. Public Health Serv. National Inst. Health. **1992.** NTP technical report on toxicity studies of glyphosate **(CAS No. 1071-83-6)** administered in dosed feed to F344/N rats and B6C3F1 mice. Research Triangle Park, NC: National Toxicology Program.



Savitz, **D.A.** et al. **1997.** Male pesticide exposure and pregnancy outcome. ***Am. J. Epidemiol*** 146:1025-1036.

Glyphosate exposure is associated with reproductive problems in both laboratory animals and farmers.

claims and were in violation of FIFRA. However, EPA took no action and did not even notify Monsanto Co. about the determination because two years had elapsed between the time that the ads were submitted to EPA and the time that EPA made the determination.99

Human Exposure

People are exposed to glyphosate through workplace exposure (for people who use glyphosate products on the job), eating of contaminated food, exposure caused by off-target movement following application (drift), contact with contaminated soil, and drinking or bathing in contaminated water. The next five sections of this factsheet summarize information about these five routes of exposure. The third section, discussing drift, also covers impacts on plants.

Contamination of Food

Analysis of glyphosate residues is "in general laborious, complex, and costly."[2] For this reason, it is not included in government monitoring of pesticide residues in food.2 The only information available about contamination of food comes from research studies.

"Significant residues,"[2] according to the World Health Organization, have been identified from pre-harvest use of glyphosate on wheat (to dry out the grain). Bran contains between 2 and 4 times the amount on whole grains. Residues are not lost during baking.[2]

Occupational Exposure

In California, the state with the most comprehensive program for reporting of pesticide-caused illness, glyphosate-containing herbicides were the third most commonly-reported cause of pesticide illness' among agricultural workers.[100] Among landscape maintenance workers, glyphosate herbicides were the most commonly reported cause.[101] (Both these statistics come from illness reports collected between 1984 and 1990.) Even 'when glyphosate's extensive use in California is considered, and the illness statistics presented as "number of acute illnesses reported per-million pounds used in California," glyphosate ranked twelfth.[100]

While many of the California reports involve "irritant effects,"[102] mostly to the eyes and skin, NCAP's survey of about 100 reports made in 1993, 1994, and 1995 found that over half of them involved more serious effects: burning of eyes or skin, blurred vision, peeling of skin., nausea, headache, vomiting, diarrhea, chest pain, dizziness, numbness, burning of the genitals, and wheezing.[103]

Other occupational symptoms were observed in a flax milling operation in Great Britain. A study compared the effects of breathing dust from flax treated with Roundup with the effects of dust from untreated flax. Treated dust caused a decrease in lung function and an increase in coughing, and breathlessness.[104]

"Glyphosate's manufacturer reported that drift from a ground application in Minnesota damaged 25 acres of corn, and the Washington Department of Agriculture reported damage to 30 acres of onions from a ground application of a glyphosate herbicide."

Drift

In general, movement of a pesticide through unwanted drift is "unavoidable."[105] Drift of glyphosate is no exception. Glyphosate drift, however, is particularly significant because drift "damage is likely to be much more extensive and more persistent than with many other herbicides."[106] This is because glyphosate moves readily within plants so that even unexposed parts of a plant can be damaged. Damage to perennial plants (when not exposed to enough glyphosate to kill them) is persistent, with some symptoms lasting several years.[106] In addition, plant susceptibility varies widely. Some wildflowers are almost a hundred times more sensitive than others; drift in amounts equal to 1/1000 of typical application rates will damage these species.[107]

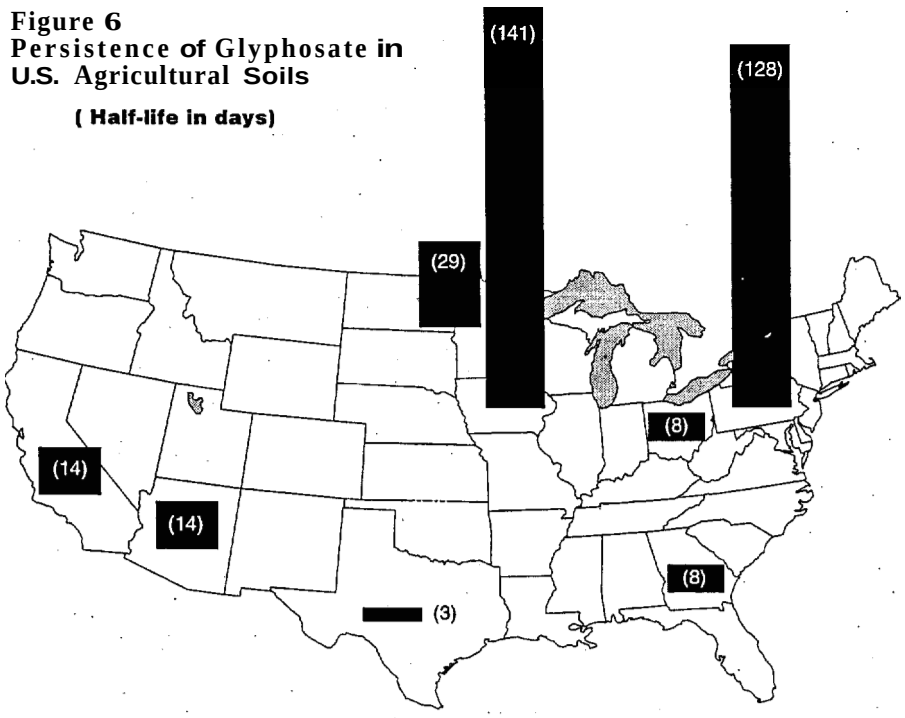
A simple answer to the question, "How far can I expect glyphosate to travel offsite?" is difficult, since drift is "notoriously variable."[108] However, extensive drift of glyphosate has been measured since the 1970s when a California study found glyphosate 800 m (2600 feet) from aerial and ground applications. Similar drift distances were found for the 8 different spray systems tested in this study.[109]

Drift distances that have been measured more recently for the major application techniques include the following:

- **Ground** Applications: A study of 15 noncrop plants found seedling mortality (killing about 10 percent of seedlings) for most of the species tested at 20 meters (66 feet) downwind when using a tractor-mounted sprayer. Seedlings of some sensitive species were killed at 40 meters (131 feet).[110] A drift model predicted some native species would be damaged at distances of 80 meters *(262* feet).[107] Glyphosate's manufacturer reported that drift from a ground application in Minnesota damaged 25 acres of corn,[111] and the Washington Department of Agriculture reported damage to 30 acres'of onions from a ground application of a glyphosate herbicide.'[12]
- Helicopter applications: A study done in Canada[113] measured glyphosate residues 200 meters (656 feet) from target areas following helicopter applications to forest sites. In this study, 200 meters was the farthest distance at which samples were taken, so the longest distance glyphosate travelled is not known.

Fixed-wing aircraft: Long drift distances occur following applications of glyphosate made from airplanes. Two

Figure 6
Persistence of Glyphosate in U.S. Agricultural Soils
(Half-life in days)



Note: Numbers, as well as the length of the columns, give the half-life, in days, of glyphosate in soil. Half-life is the length of time required for half the applied glyphosate to break down or move out of the test site.

Source: U.S. EPA. Environmental Fate and Effects Division. 1993. Pesticide environmental fate one line summary; Glyphosate. Washington, D.C., May 6.

Glyphosate's persistence in soil varies widely, but its half-life in agricultural soil can be over 4 months.

studies on forested sites conducted by Agriculture Canada (the Canadian agricultural ministry) showed that glyphosate was found at the farthest distance from the target areas that measurements were made (300 and 400 meters, or 984 and 1312 feet).[114,115] One of these studies115 calculated that buffer zones of between 75 and 1200 meters (246 feet - 0.75 miles) would be required to protect non-target vegetation. According to Monsanto, drift from single aerial applications of glyphosate has been extensive enough to damage 1000 trees in one case,[116] 250 acres of corn in another,[117] and 155 acres of tomatoes in a third incident.[118]

Persistence and Movement in Soil

Glyphosate's persistence in soil varies widely, so giving a simple answer to the question "How long does glyphosate persist in soil?" is not possible. Half-lives (the time required for half of the amount of glyphosate applied to break down or move away) as low as 3 days (in Texas) and as long as 141 days (in Iowa) have been measured by glyphosate's manufacturer.[119] (See Figure 6.) Initial degradation (breakdown) is faster than the subsequent degradation of what remains.[120] Long persistence has been measured in the following studies: 55 days on an Oregon Coast Range forestry site[121]; 249 days on Finnish agricultural soils[122]; between 259 and 296 days on eight Finnish forestry sites[120]; 335 days on an Ontario (Canada) forestry site[123]; 360 days on 3 British Columbia forestry sites[124]; and, from 1 to 3 years on eleven Swedish forestry sites.[125] EPA's Ecological Effect's Branch wrote, "In summary, this herbicide is extremely persistent under typical application conditions."[126]

Glyphosate is thought to be "tightly complexed [bound] by most soils"[127] and therefore "in most soils, glyphosate is essentially immobile."[127] This means that the glyphosate will be unlikely to contaminate water or soil away from the application site. However, this binding to soil is "reversible." For example, one study found that glyphosate bound readily to four different soils. However, desorption, when glyphosate unbinds from Soil particles, also occurred readily. In one soil, 80 percent of the added glyphosate desorbed in a two hour period. The study concluded that "this herbicide can be extensively mobile in the soil...."[128]

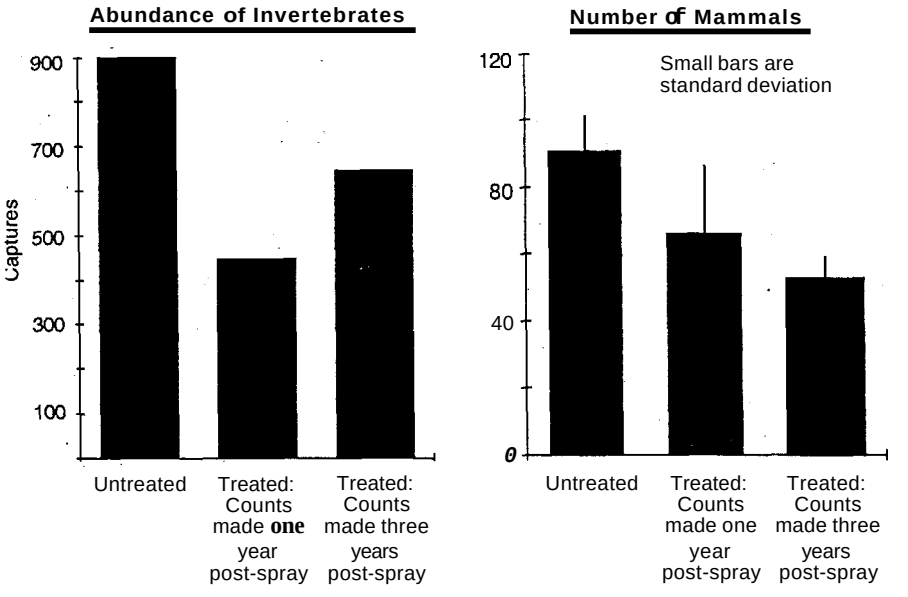
Water Contamination

When glyphosate binds readily to soil particles, it does not have the chemical characteristics of a pesticide that is likely to leach into water.[2] (When it readily desorbs, as described above, this changes.) However, glyphosate can move into surface water when the soil particles to which it is bound are washed into streams or rivers.[4] How often this happens is not known, because routine monitoring for glyphosate in water is infrequent.[2]

Glyphosate has been found in both ground and surface water. Examples include. farm ponds in Ontario, Canada, contaminated by runoff from an agricultural treatment and a spill[129]; the runoff from a watersheds treated with Roundup during production of no-till corn and fescue? contaminated surface water in the Netherlands[2]; seven U.S. wells (one in Texas, six in Virginia) contaminated with glyphosate[131]; contaminated forest streams in Oregon and Washington[132,133]; contaminated streams near Puget Sound, Washington[134]; and contaminated wells under electrical substations treated with glyphosate.[135]

Glyphosate's persistence in water is shorter than its persistence in soils. Two Canadian .studies found glyphosate persisted 12 to 60 days in pond water.[136,137] Glyphosate persists longer in pond sediments (mud at the bottom of a pond). For example, the half-life in pond sediments in a Missouri study was 120 days;

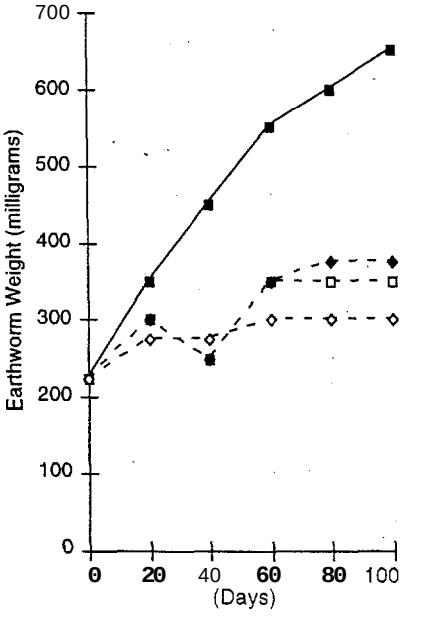
Figure 7
Impacts of Glyphosate on Nontarget Animals on Maine Clear-cuts



Santillo, D.J.. D.M. Leslie, and **P.W.** Brown. 1989. Responses of small mammals and habitat to glyphosate application on clearcuts. *J. Wildl.* Manage. 53(1):164-172.

Glyphosate treatment reduced invertebrate and small mammal populations for up to 3 years.

Figure 8
Effect of Glyphosate on the Growth of Earthworms



Springett. **J.A.** and **R.A.J.** Gray. 1992. Effect of repeated low doses of biocides on the earthworm Aporrectodea caliginosa in laboratory culture. Soil *Biol.* Biochem. 24(12):1739-1744.

Repeated applications of glyphosate reduce the **growth** of earthworms.

persistence was over a year in pond sediments in Michigan and Oregon.[4]

Ecological Effects

Glyphosate can impact many organism not intended as targets of the herbicide. The next two sections describe both direct mortality and indirect effects, through destruction of food or shelter.

Effects on Nontarget Animals

Beneficial insects:. Beneficial insects kill other species that are agricultural pests. The International Organization for Biological Control found that .exposure to freshly dried Roundup killed over 50 percent of three species of beneficial insects: a parasitoid wasp, a lacewing, and a ladybug. Over 80 percent of a fourth species~a predatory beetle, w& killed.[138]

Impacts on beneficial insects have also been shown in field studies, probably due to destruction of their habitat by the herbicide. In North Carolina wheat fields, populations of large carabid beetles declined after treatment with a glyphosate product and did not recover for 28 days.[139] A study of Roundup treatment of hedgerows in the United Kingdom also showed a decline in carabid beetles.[140]

Other insects: Roundup treatment of a Maine clear-cut caused an 89 percent decline in the. number of herbivorous (plant-eating) insects because of the destruction of the vegetation on which they live and feed. (See Figure 7.) These insects serve as food resources for birds and insect-eating small mammals.[141]

The U.S. Fish and Wildlife Service has identified one endangered insect, a longhorn beetle,. that would be jeopardized by use of glyphosate herbicides.[142]

Other arthropods: Glyphosate and glyphosate-containing products kill a variety of other arthropods. For example, over 50 percent of test populations of a beneficial predatory mite were killed by exposure to Roundup.[138] In another laboratory study, Roundup exposure caused a decrease in survival and a decrease in body weight of woodlice. These arthropods are important in humus production and soil aeration.[143] Roundup treatment of hedgerows reduced the number of spiders, probably by killing the plants'they preferred for web-spinning.140 The water. flea *Daphnia pulex* is killed by concentrations of Roundup between 3 and 25 ppm.[144-146] Young *Daphnia* are more susceptible than mature individuals.[145] The red swamp crawfish, a commercial species, was killed by *47* ppm of Roundup.[147]

Earthworms: A study of the most common earthworm found in agricultural soils in New Zealand showed that repeated applications of glyphosate significantly affect growth and survival of earthworms. Biweekly applications of low rates of glyphosate (1/20 of typical rates) caused a reduction in growth (see Figure 8), an increase in the time to maturity, and an

increase in mortality.[148]

Fish: Both glyphosate and the commercial products that contain glyphosate are acutely toxic to fish. In general, gtyphosate alone is less toxic than the common glyphosate product,. Roundup, and other glyphosate products have intermediate toxicity. Part of these differexes can be explained by the toxicity of the surfactant (detergent-like ingredient) in Roundup. It is 20 to 70 times more toxic to fish than glyphosate itself.[144]

Acute toxicities of glyphosate vary widely: median lethal concentrations (LC_{50}s; the concentrations killing 50 percent of a population of test animals) from 10 ppm to over 200 ppm have been reported depending on the species of fish and test conditions.[2]

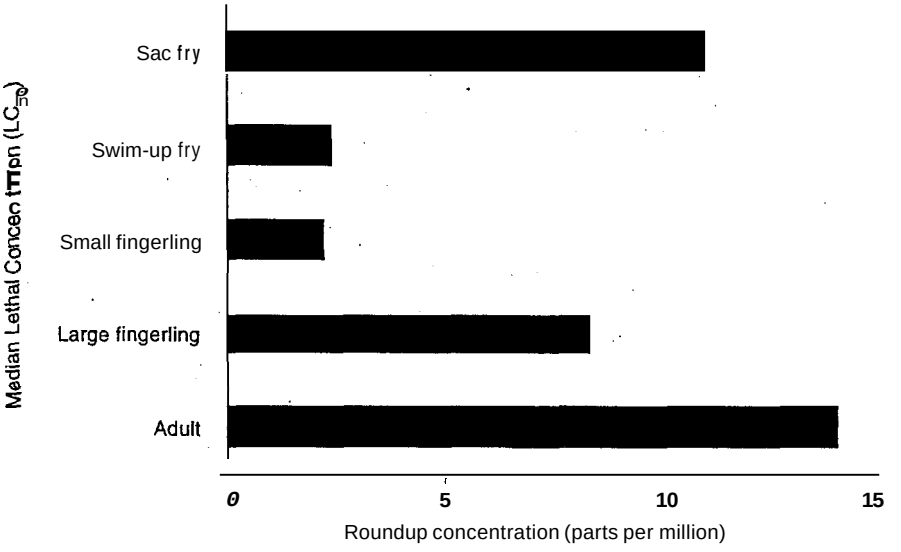
Acute toxicities (LC_{50}) of Roundup to fish range from 2 ppm to 55 ppm.[2] Part of this variability is due to age: young fish are more sensitive to Roundup than are older fish.[144] (See Figure 9.) Acute toxicities of Rodeo (used with the surfactant X-77 per label recommendations) vary from 120 to 290 ppm.[149]

In soft water there is little difference between the toxicities of glyphosate and Roundup.[150] Also, if fish have not recsntly eaten, the toxicity of giyphosate (LC_{50} = 2.9 ppm) is similar to that of Roundup.[151]

Roundup toxicity increases with inc-eased water temperature. In both rainbow trout and bluegills, .toxicity about doubled between 7 and 17°C (45 and 63°F).[144] Treatment of riparian areas with giyphosate causes water temperatures to increase for several years following treatment[152] because the herbicide kills shading vegetation. This means that use of giyphosate could cause increased toxicity to fish. In addition, the temperature inc-ease could be critical for fish, like juvenile salmon, that thrive in cold water.

Sublethal effects of glyphosate occur a: low concentrations. In rainbow trout and *Tilapia* concentrations of about 1/2 and 1/3 of the LC_{50} (respectively) caused e-ratic swimming.[153,154] The trout also exhibited labored breathing.[153] These effects can increase the risk that the fish will be eaten, as well as affecting feeding, migration, and reproduction.[154] Less than 1 percent of the LC_{50} caused gill damage in carp and less than 2 percent caused changes in liver structure.[155]

Figure 9
Toxicity of Roundup to Rainbow Trout of Different Ages



Folmar, L.C., H.O. Sanders, and A.M. Julin. 1979. Toxicity of the herbicide glyphosate and several of its formulations to fish and aquatic invertebrates. *Arch. fnviron. Contam. Toxicol.* 8:269-278.

Young rainbow trout (swim-up fry and small fingerlings) are more susceptible to Roundup than adult rainbow trout.

Birds: Glyphosate has indirect impacts on birds. Because glyphosate kills plants, its use can create a dramatic change in the structure of the plant community. This affects bird populations, since the birds depend on the plants for food, shelter, and nest support.

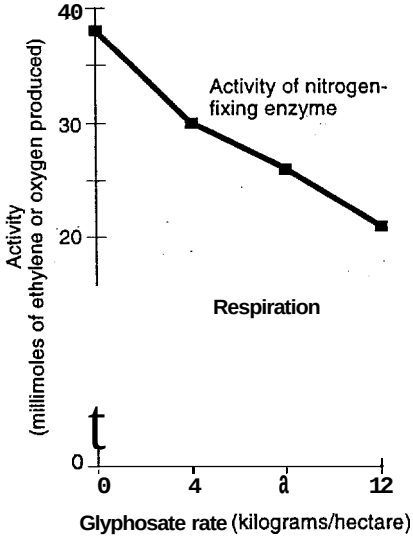
For example, a study of four glyphosate-treated clear-cuts (and an unsprayed control plot) in Nova Scotia found that the densities of the two most common species of birds (white-throated sparrow and common yellowthroat) decreased for two years after treatment. By the fourth year post-spray, densities had returned to normal for these two species. By then the unsprayed plot had been colonized by new species of birds (warblers, vireos, and a hummingbird) which were not found on the sprayed plots.[156]

An earlier three year study of songbird abundance following glyphosate treatment of clear-cuts in Maine forests showed similar results. Abundances of the total number of birds and three common species decreased. The decrease in bird abundance was correlated with decrease in the diversity of the habitat.[157]

Black grouse avoided glyphosate-treated clear-cuts in Norway for several years after treatment.[158] Researchers recommended that the herbicide not be used near grouse courtship areas.

Small mammals: In field studies, small mammals have been indirectly affected when glyphosate kills the vegetation they (or their prey) use for food or shelter. On clear-cuts in Maine,[141] insect-eating shrews declined for three years post-treatment; plant-eating voles declined for two. (See Figure 7.) A second study in Maine after a Roundup treatment[159] found similar results for voles. In British Columbia, deer mice populations were 83 percent lower following glyphosate treatment.[160] Another study from British Columbia found declines in chipmunk populations after Roundup treatment.[161] In Norway, there was a "strong reduction" in use of

Figure I O
Effect of Glyphosate on a Nitrogen-Fixing Bacteria



Santos, A. and M. Flores. 1995. Effects of glyphosate on nitrogen fixation of free-living heterotrophic bacteria. *Lett. Appl. Microbiol.* 20:349-352.

sprayed clear-cuts by mountain hare.[162] Other studies have not found impacts on small mammals,[163] suggesting that the particular characteristics of the site and the herbicide application are significant.

Wildlife: Canadian research has documented that plants serving as important food sources for wildlife are significantly damaged by glyphosate. "Severe" or "very severe damage" was recorded for *46* percent of the important food species eaten by moose, between *34* and *40* percent of the species eaten by elk, and 36 percent of the species eaten by mule deer.[164]

Effects on Nontarget Plants

As a broad-spectrum herbicide, glyphosate has potent acutely toxic effects on most plant species. There are also other kinds of serious effects. These include effects on endangered species, reduced seed quality, reduction in the ability to fix nitrogen, increased susceptibility to plant diseases, and reduction in the activity of mycorrhizal fungi.

Endangered species: Because many plants are susceptible to glyphosate, it can seriously impact endangered plant species. The U.S. Fish and Wildlife Service has identified 74 endangered plant species that it believes could be jeopardized by glyphosate. This list is based on the use of glyphosate on 9 crops, and does not include over 50 other uses.[142]

Seed Quality: Sublethal treatment of cotton with Roundup "severely affects seed germination, vigor and stand establishment under field conditions." At the lowest glyphosate rate tested, seed germination was reduced between *24* and *85* percent and seedling weight was reduced between 19 and 83 percent.[165]

Nitrogen fixation: Most living things cannot use nitrogen in its common form and instead use ammonia and nitrates, much rarer compounds. Ammonia and nitrates are created by processes called nitrogen fixation and nitrification. They are carried out by bacteria which can be found in soil and in nodules on roots of legumes and certain other plants.[166]

Studies showing effects of glyphosate on nitrogen fixation include the following: At a concentration corresponding to typical application rates, glyphosate reduced by 70 percent the number of nitrogen-fixing nodules on clover planted 120 days after treatment[167]; a similar concentration of a glyphosate herbicide reduced by 27 percent the number of nodules on hydroponically grown clover[168]; a similar concentration of glyphosate reduced by 20 percent nitrogen-fixation by a soil bacteria[169] (see Figure 10); a concentration of glyphosate approximately that expected in soybean roots following treatment inhibited the growth of soybean's nitrogen-fixing bacteria between 10 and *40* percent[170]; and treatment with a glyphosate herbicide at the lowest concentration tested (10 times typical application rates) reduced the number of nodules on clover between *68* and 95 percent.[171]

All of the studies summarized above were done in the laboratory. In the field, such effects have been difficult to observe. However, use of genetically-engineered glyphosate-tolerant crop plants means that nitrogen-fixing bacteria in field situations "could be affected by repeated applications of glyphosate."[170]

Glyphosate also impacts other parts of the nitrogen cycle. A Canadian study found that treatment of a grass field with Roundup increased nitrate loss up to 7 weeks after treatment. The increase was probably caused by the nutrients released into the soil by dying vegetation.[172]

Mycorrhizal fungi: Mycorrhizal fungi are beneficial fungi that live in and around plant roots. They help plants absorb nutrients and water and can protect them from cold and drought.[173] Roundup is toxic to mycorrhizal fungi in laboratory studies. Effects on some species associated with conifers have been observed at concentrations of 1 part per million (ppm), lower than those found in soil following typical applications.[174,175] In orchids, treatment with glyphosate changed the mutually beneficial interaction between the orchid and its mycorrhizae into a parasitic interaction (one that does not benefit the plant).[176]

Plant diseases: Glyphosate treatment increases the Susceptibility of crop plants to a number of diseases. For example, glyphosate increased the susceptibility of tomatoes to crown and root disease[177]; reduced the ability of bean plants to defend themselves against the disease anthracnose[178]; increased the growth of take-all disease in soil from a wheat field and decreased the proportion of soil fungi which was antagonistic to the take-all fungus[179]; and increased soil populations of two important root pathogens of peas.[180] In addition, Roundup injection of lodgepole pine inhibited the defensive response of the tree to blue stain fungus.[181]

Both the inhibition of mycorrhizae and the increased susceptibility to disease have been observed in laboratory, not field, studies. Given the serious consequences these kinds of effects could have, more research is crucial.

Plant Resistance

Plants that are resistant to glyphosate are able to tolerate treatment without showing signs of toxicity. Although many weed scientists argue that "it is nearly impossible for glyphosate resistance to evolve

in weeds,"[182] others argue that "there are few constraints to weeds evolving resistance." The second group of scientists appears to be correct. In 1996 an Australian researcher reported that a population of annual ryegrass had developed resistance and tolerated five times the recommended field application rate.[183]

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Managing Roadside Vegetation Without Herbicides

Photo courtesy of Audrey Palmer

Jeff Ackerman, lead mower operator for Jefferson County, Washington, stands on one of the mowers that are keystones in the County's 22-year old non-chemical roadside vegetation maintenance program.

By Sheila Daar

One of the greatest challenges facing managers of roadside vegetation today is finding alternatives to herbicides. From coast to coast, state departments of transportation, county road departments, parks, and other agencies are facing increasing public pressure and new laws that require them to reduce or eliminate herbicide applications.

While many transportation maintenance personnel nationwide struggle with the challenge, Jefferson County in Washington State bit the bullet 22 years ago and successfully eliminated all use of herbicides along its roadsides. The County's non-chemical maintenance practices continue today, and offer useful models for other jurisdictions. This article describes these methods, and the change in maintenance philosophy that underpinned their implementation.

Aubrey Palmer is Jefferson County's Operations Manager for the Maintenance Division. Among his array of responsibilities is supervision of the road maintenance program. His background in both construction engineering and forestry has given him a feel For the interface of vegetation biology and roadway engineering that sets the framework for roadside vegetation management.

A tall, affable man with a wry sense of humor, Palmer finds himself in the unaccustomed position of public spokesperson for the innovative vegetation management program. As word of the program is spreading, inquiries from within and outside Washington State are increasing to such a level that a PowerPoint™ presentation detailing the history and operation of the program has been developed for use at conferences and other venues.

Origins of the "No Spray" Program

Elimination of herbicides on the County's roadsides began in the late 1970s in response to concerns about the hazards of herbicides and other toxic materials. The discovery of carcinogenic dioxin contaminants in some of the herbicides then in use, such as 2,4,5-T, had focused community awareness on the dangers of certain herbicides. In response to significant community pressure, the County Commissioners in 1978 declared a temporary moratorium on the use of herbicides while alternatives were explored.

According to Palmer, the moratorium led to revision of the vegetation control program, which reduced herbicide drainage toward private wells and landscaping. The moratorium was also intended to reduce pesticide damage claims alleged to result from chemical application

In This Issue

The IPM Practitioner
Monitoring the Field of Pest Management

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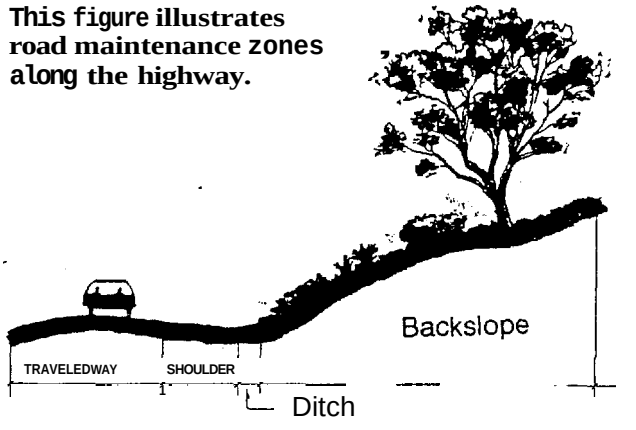
along County road rights-of-way.

Voluntary Program

While most herbicide reduction programs today result from legislative action, Jefferson County took another path. Palmer notes that an interesting aspect of the County's "no spray" program-is that there is no specific ordinance or resolution by the County that covers the use of roadside spraying or the use of herbicides. The Commissioners simply asked the road maintenance division personnel to see if they could manage the weeds without herbicides. The crews accepted the challenge, and after a year or two of transition, developed a primarily mechanical weed management pro#am that has remained in effect to this day.



This figure illustrates road maintenance zones along the highway.

Courtesy CA Dept. Transportation

County Roadways

County maintenance crews maintain approximately 400 miles of roads within the County, which equates to about 800 shoulder miles of roadway. Roughly 27 employees work to maintain the roadways as well as other facilities. In addition to road maintenance, County crews maintain stockpiles of sand and gravel located strategically throughout the County, and are periodically called upon to operate equipment at the County's Transfer Station.

Road Maintenance Responsibilities

The responsibilities associated with road maintenance in Jefferson County are comparable to those in any other County as well as to those of Washington's Department of Transportation. Tasks include: pavement crack sealing, road shoulder maintenance, roadway sweeping, culvert cleaning and repair, storm drain systems maintenance, siope repair, litter pickup. control of vegetation, bridge deck repair, and snow and ice control.

The County crews also provide disaster maintenance for the frequent storm events that occur. These tasks often disrupt the schedule for routine roadside maintenance — another aspect of maintenance realities the Jefferson County crews have in common with other jurisdictions.

Vegetation Maintenance

Since the majority of Jefferson County is situated within the Douglas fir/Sitka spruce/western hemlock vegetation zones of Washington's Olympic Peninsula, woody trees and shrubs are the vegetation types that require the majority of management along County roadsides. High rainfall characterizes most of the County's ecosystem and provides optimal conditions for active growth of the native woody vegetation. However, there are far drier areas in the County as well, including the County seat at Port Townsend, where rainfall averages only 18 inches annually. In these areas, annual broadleaf weeds take on greater importance.

The County's herbicide moratorium impacted the roadside vegetation management practices to a very significant degree. It increased both the cost and complexity of vegetation control. The County went from spraying yearly with chemicals at a very low cost, to an aggressive mechanical program at a greater cost. but with more environmental

Box A. Manipulation of Natural Plant Succession

Using roadside maintenance practices to create desired vegetation communities is both an art and a science. Although most of the maintenance equipment used by Jefferson County is also used on roadsides nationwide, what is special is the art involved in how, when, and for what objective the equipment is used.

Years of careful observations of vegetation response to maintenance practices has produced empirical "seat of the pants" protocols. For example, mowing/brushing activities are timed to occur at the most vulnerable stage of plant growth. Vegetation is mowed at a height that gives low-growing plant species the ecological advantage. Tree limbs are pruned at the branch collar intersection with the trunk to optimize rapid healing of wounds and prevent Future hazards (Shigo 1986).

Plant Succession

The work in Jefferson County is based on the scientific principle of plant or vegetation succession. The concept of plant succession was originally articulated by F.E. Clements in 1916 when he postulated that if left relatively undisturbed, plant communities will evolve slowly over time from the weedy grasses and broadleaf plant stage to the climax stage, usually forests (Clements 19161.

This succession theory has generated great debate among botanists over the years - not so much on whether or not succession occurs, but how and why (Egler 1954: Grime 1979; Odum 1969; van der Maarel 1988). For example, Odum (1969) defines succession as "an orderly, directional and predictable process of plant community development," while Grime (1979) defines it as *'a progressive alteration in the structure and species composition of the vegetation."

Unlike the case for undisturbed areas, however, the roadside vegetation succession process occurs in many fits and starts, depending on the degree and frequency of soil disturbance from maintenance practices, vehicle intrusions, or other forces. Construction many times leaves vegetation to develop on unamended cut or fill slopes: routine mowing, spraying, grading, or other soil disturbances often keep the successional process at a very early stage where weedy vegetation such as thistles, ragwort, knapweed, horsetail and annual grasses have the competitive edge.

Where soil disturbance is minimized, the cycle of growth and decomposition of these early successional plants gradually improves soil conditions enough that the competitive edge shifts to perennial grasses, forbs, shrubs, and trees. Eventually a climax vegetation develops that can remain quite stable for many years so Iong as soil disturbance is absent or kept to a minimum. Whether the climax vegetation is dominated by trees, shrubs, forbs, or grasses depends on many ecological factors as well as maintenance practices at a given site.

By understanding the dynamics of plant succession, vegetation managers can design maintenance treatments to keep plants at the successional stage most appropriate for roadside maintenance objectives. Managers can also manipulate plant succession to resist invasion by unwanted plants. The key to understanding this process is knowing the sources and locations of potential invading plant species and the competitive interactions among species (del Moral 1979).

When using plant succession principles to plan maintenance or revegetation activities, it is important to know that many roadside sites not disturbed by cut or fill operations already contained climax vegetation before they were cleared for road construction (Daar 1991). Thus, even though what is observed growing at a site are early-stage broadleaf weeds and annual grasses, there may be a seed bank in the soil representing all the successional stages, from pioneering annual weeds through shrubs to climax trees. These seeds *can* remain dormant but viable for many decades. This heritage from the seed bank explains why discontinuing herbicides can in some areas result in rapid germination of shrubs and trees in addition to herbaceous weeds.

Examples of Plant Manipulation

In coastal western Washington, the vegetation management objective for the backslope might be to develop a stable climax vegetation dominated by native trees and shrubs. If noxious weeds on the backslope required treatment, tactics minimizing soil disturbance could help prevent new weed seeds from germinating.

Thus, clumps of noxious weeds such as scotch broom, *Cytisus scoparius,* or gorse, *Ulex europaeus*, could be manually removed with weed wrenches, or mechanically removed by severing the stems at the root crown to prevent resprouting. Cleared areas could be allowed to regenerate naturally from native plant seeds stored in the soil, or could be planted with appropriate vegetation, and mulched to prevent erosion. Follow-up treatment to remove any seedlings of broom or gorse would occur annually for 2 to 3 years until the natives dominated the treated site.

On the road shoulder at the same site, an earlier perennial grass/forb stage of that plant community would be more suited to the operation of the drainage ditches and vehicle recovery. To keep the perennial grasses dominant, mowing treatments would be applied at heights of 8 to 14 inches depending on species and timed to insure that the site always maintained a dense grass/forb cover sufficient to shade out any invasive problem plants attempting to become established in the grassland (Daar and King 1997).

sensitivity. This transition brought into focus a comprehensive vegetation maintenance program.

Typical Vegetation Management Zones

Roadside vegetation professionals divide the roadside into three primary vegetation management zones. The three zones of shoulder; ditch, and backslope differ in size and configuration depending on many factors, including the width of the road and amount of roadside area present. However, most of the maintenance activity is focused on the shoulder and ditches.

The Roadside Shoulder

The shoulder starts at the edge of the pavement and extends 2 to 10 fee; (0.6-3.0m) outward, depending on a number of variables, including width of the right-of-way. The shoulder is sloped to drain water off the pavement. Ideally, the shoulder is also wide enough to allow vehicles to pull off the pavement for emergency stops, although on the rural roads that predominate in Jefferson County, this is often not the case.

In most roadside maintenance jurisdictions it is common practice to apply herbicides to create a clear strp of bare soil extending from the edge of the pavement out 2 to 8 feet (0.6-2.5 m) along the shoulder. There are three primary vegetation management rationales for these chemical treatments:

- To prevent the buildup of vegetation at the interface of the pavement and shoulder that could block drainage of water off the pavement;
- To prevent plant roots from undermining the pavement; and
- To reduce fires from cigarettes or other burning objects thrown from vehicles, and from catalytic converters on vehicles. Fire is usually a problem only in *dry* ecosystems, which cover only a small area in Jefferson County.

How Jefferson County's no spray program addressed these issues is discussed below.

The Drainage Ditch

Rainwater, melted snow, irrigation water, overflowing streams from adjacent watersheds, and other sources of water on, or near, the pavement are channeled into drainage swales or ditches. Ditches can vary from **1.5** to 2 foot deep (0.5-0.6 m) channels scraped into soil along the road edge to more permanent ditches considerably wider and deeper. The ditches are periodically cleared of vegetation that is slowing or blocking the flow of water.

The Backslope

The area beyond the ditch is referred to as the backslope or fill slope. It can be relatively flat or sharply sloped up or down if it occurs on a cut or fill area. The backslope usually receives far less intensive management than the shoulder or ditches. Where woody vegetation species dominate, they are usually "brush cut" periodically to suppress young trees and branches that overhang the road and reduce a driver's visibility of the road and signs.

Initial Vegetation Study

The current roadside management system of Jefferson County is based on a 1979 consultant report by Dr. Roger del Moral of the University of Washington's Department of Botany. The primary goal of the program is to produce relatively stable, low-growing plant communities which require little maintenance and possess other desirable traits. This goal is accomplished by identifying existing vegetation with the low-growing; spreading characteristics desired for the road shoulder, and mowing the shoulder in a manner that increases the population of these desirable species to the detriment of the problem plants.

The program is intended to accomplish the following general goals:

- To economically insure the efficient and safe operation of roads:
- To produce naturalized vegetation on the right-of-way that is self-sustaining and which blends into the surrounding vegetation:
- To control erosion from slopes and cutbacks;
- To provide cover for desirable species of wildlife: and
- To reduce the opportunities for migration and distribution of undesirable weeds.

Background on Jefferson County, Washington

Jefferson County is located in the middle of the Olympic Peninsula, and stretches from the Puget Sound to the Pacific Ocean. The responsibility for maintenance of roadways reaches from the city limits of Port Townsend, southerly to near the Duckabush River halfway down the Hood Canal, and from the Puget Sound to the Pacific Ocean. It takes about ***3*** hours of driving to reach the most westerly portion of the County out on the Coast.

The main maintenance office is located in Port Hadlock, approximately 10 miles south of Port Townsend. There are two satellite maintenance shops, one at Quilcene, ***35*** miles south of Port Townsend, and one on the Hoh river near the west coast, located approximately 120 miles away from the main maintenance shop. Elevations range from sea level to approximately 10,000feet.

The County roadsides are rural in nature, and contain a wide variety of plant species, most of which reflect the spruce/hemlock forest plant communities native to the area. Ocean currents laden with rain affect the local weather, and rainfall varies from about 18 inches near Port Townsend, which is in the rain shadow of the Olympics, to about 200 inches on the coast.

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Problem Vegetation

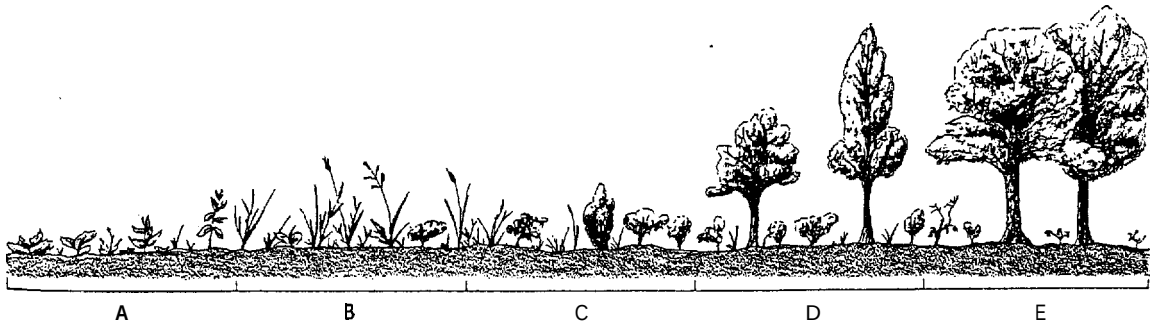
Dr. del Moral identified four key plant species requiring management when growing on the shoulder, impeding water flowing in or into a drainage ditch, or affecting road visibility. These species are: common horsetail, Equisetum *arvense*; Douglas fir, *Pseudotsuga menziesii*; red alder, *Alnus rubra*; and salmonberry, Rubus *spectabilis*.

Cattails, *Typha latifolia*; and hardhack, Spiraea *douglasii*; are also considered problems when growing in wet ditches. These woody plants are generally referred to as "brush by roadway maintenance crews, and consume the majority of time and cost to manage compared to softer "herbaceous"plants such as grasses or broadleaf weeds.

In addition to the target species that are cited in the 1979 del Moral report, County crews also consider additional vegetation species problematic today. These include willows, *Salix* spp.; oceanspray, *Holodiscus* discolor; scotch broom, *Cytisus* scoparius; and maples, Acer spp. Tall grasses and certain herbaceous broadleaf plants, including blackberries, Rubus spp.; stinging nettles, *Urtica dioica*; thimbleberry, *Rubus parviflorus*; and sword fern, *Polystichum munitum*, can also cause problems. These encroach onto the roadway or impede drainage when growing on the road shoulder or under guardrails and road signs. Federal and State-designated noxious weeds are a recent addition to the problem plant category.

Although the roadside plant community contains many more species than the ones listed here, most do not cause significant problems. Even Douglas firs, hardhack, maples. red alders. salmonberry, and willows are considered desirable native plants except when they come into conflict with road safety or undermine the structural integrity of the roadbed, shoulders, ditches, or appurtenances such as guardrails or culverts.

Vegetation Succession
This drawing shows a simplified sequence of vegetation succession. At **A,** bare, low-nutrient soil is colonized by broad-leafed plants such as thistles and some grasses. As the plants die and decompose, enriching the soil, grasses predominate (B). As the soil is further enriched, woody shrubs begin to appear (C), followed by trees **(D).** Eventually, the trees become the predominant vegetation type (E), shading out most competing vegetation.



For example, alders, Douglas fir, maples, and willows can block the sight lines of drivers, or shade pavement during winter, slowing the melting of ice and snow, thus increasing road hazards. Salmonberry, a shrub that can reach 9-12 feet (2.7-3.6m) in height, can colonize the road shoulder and grow to the edge of the pavement, eliminating the clear strip needed to enable vehicles to pull off the road in emergencies. Cattails, hardhack, and willows can block the flow of rainwater off the pavement and into drainage ditches. Horsetails can cause problems when they undermine asphalt or chip sealed road surfaces, or clog drainage ditches. These and other problems make it necessary to suppress or remove these plant species when they are growing in the wrong place.

Study Methodology

Once the key problem plant species were identified. del Moral characterized the types of habitats in which these target species typically grew, and created symbols representing each habitat type. The symbols were used to map the County's roadside vegetation. Del Moral's team collected data for the map by driving slowly down each County road and noting the type of vegetation habitats on both sides.

The map was designed to be advisory and to indicate general vegetation conditions with respect to each surveyed road section. Only 44% of the surveyed shoulder miles contained one or more target species for management, and in many cases the target species were causing only minimal problems. Thus, the mapping project provided County crews with a baseline tool for selective vegetation maintenance. Over time the roadcrews have become familiar with selective management, and now easily recognize what needs to be cut and what can be tolerated.

Manipulation of Plant Succession

The Del Moral report also suggested some non-chemical methods for managing vegetation problems. A key component of non-chemical management is manipulation of natural plant succession. Box A illustrates a simplified version of plant succession and discusses the way the process can be halted at a specific stage compatible with roadside maintenance objectives (Clements 1916; Egler 1954; Grime (1979); Odum 1969; van der Maarel 1988).

Various mechanical methods, along with hydroseeding of cleared soil with low-growing grasses and wildflowers, were recommended for solving vegetation problems. Only horsetails were seen by del Moral as an intractable problem without use of chemical controls. Thus, crushed oyster shells were appiied to raise the soil pH sufficiently to deter horsetails. Crushed shells were

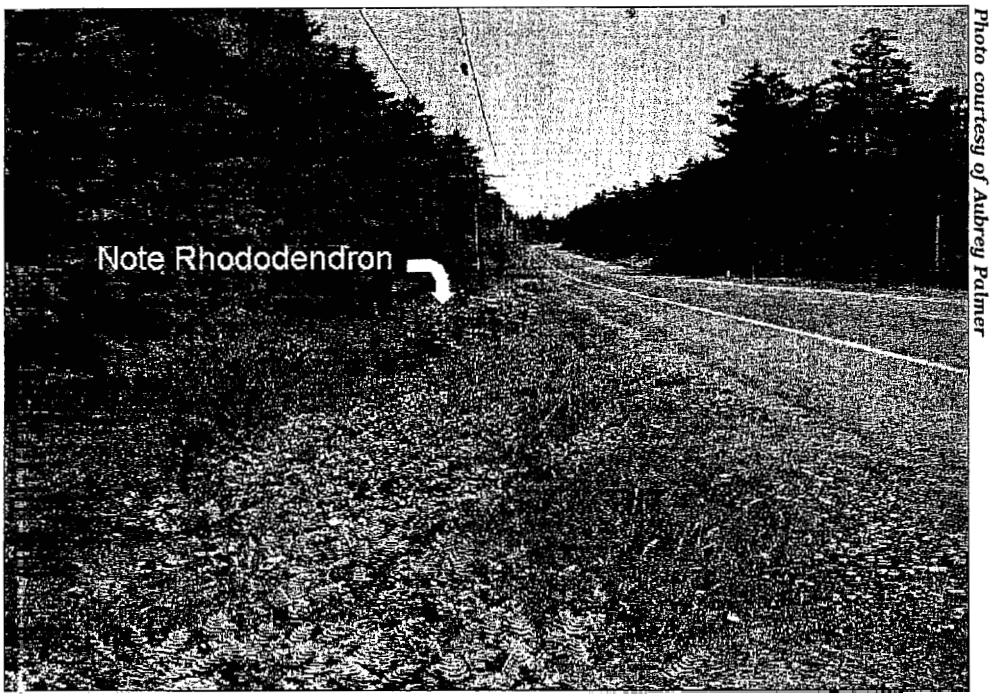


Photo courtesy of Aubrey Palmer

Years of skilled brushing and mowing have produced low-growing ground covers that outcompete weeds. The prostrate Oregon grape in the foreground and the flowering native rhododendron (arrow) will be skipped by the mower.

later replaced by applications of agricultural lime, or by grading to cut back an infestation.

Maintenance Changes

As a follow-up to these recommendations, Jefferson County established the following maintenance practices for managing roadside vegetation: machine mowing, machine brush cutting, machine brooming, manual control, tree trimming, grading, ditching, hydroseeding, and mulching. These vegetation management techniques have been practiced since the County Commissioners requested an herbicide moratorium 22 years ago.

Change in Philosophy

Implementation of the no-spray program also required County management and labor crews to change their road maintenance philosophy. Under the herbicide regime, most areas requiring vegetation control were routinely sprayed at least once each year. This program required expertise in herbicide technology, but no knowledge of vegetation biology and ecology. The road crews took pride in their proficiency with pesticide technology.

Under the no-spray regime, roadways could no longer be considered homogeneous management units that could be treated without an understanding of vegetation dynamics. Instead, road crews needed to see vegetation as a living, dynamic system that responds differently according to which mechanical or manual treatments are used and how and when they are applied. Keen observation of plant behavior, adjustments in "tolerance levels" for plant growth adjacent to the pavement, and innovation in operation of mechanical tools was required.

It took several years for the new philosophy to fully evolve and catch hold department-wide, and for innovations in non-chemical methods to be discovered. But there has been no turning back. By trial and error, Jefferson County road crews have developed a sophisticated understanding of vegetation dynamics and manipulation that is not usually found or required within their profession. They have also discovered new ways to use common mechanical equipment to achieve their vegetation goals.

Perhaps more importantly, road crews eventually learned to replace the pride they had felt for their mastery of herbicide technology with a new pride in their mastery of non-chemical vegetation management and the ethic of environmental protection.

Respect for Operators

Concurrent with the adoption of a mechanical control program for roadside vegetation was the development of increased respect for the equipment operators. The skill and willingness of these workers to adopt new methods was essential to the success of the program. In many public agencies, operation of mowers and brush cutters is seen as a low-status position. In Jefferson County, it is considered a privilege to be able to drive the mowers or other equipment. Road crew members receive training in non-chemical philosophy and methods, and are encouraged to continue developing non-chemical innovations in response to ever new vegetation challenges.

Integrated Pest Management

Although the term Integrated Roadside Vegetation Management (based on IPM concepts) was not yet popular in the late 1970s when the Jefferson County program began, the program nonetheless contains essential elements of IPM, including monitoring, tolerance levels, treatment thresholds, and an integration of control methods.

For example, road crews monitor vegetation and skip areas where low-growing vegetation dominates, or spot-mow areas where problems occur. Tolerance levels for allowing non-invasive grasses to grow on the shoulder up to the edge of the pavement have been increased. A mix of management methods is used to reduce or remove problem vegetation which threaten to exceed tolerance levels.

Mix of Techniques

The current County vegetation management program employs a mix of mechanical and manual

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techniques. These techniques are applied in varying degrees, depending upon specific vegetation problems. The wide variety of trees, shrubs, grasses, and broadleaf weeds that invade the roadways requires an integrated program in order to successfully suppress problem plants and encourage beneficial low-growing vegetation to dominate the roadside.

Mowing

Machine mowing is the most widely used management technique in the County's program. Mechanical mowers control grasses, broadleaf weeds, and immature woody vegetatioc. Virtually all County road shoulders and accessible backslopes are mowed annually. Mowing of road shoulders generally starts around April when grasses begin growing and stops about end of September when the dormant cycle beghs. Mowers are often followed by a large mechanical broom, whose use is discussed below.

Mowing is a relatively successful method for managing a diversity of vegstation types. It controls many young woody plants and annual weeds by stimulating and encouraging growth of desirable low-growing competing vegetation. The grassy shoulders are aesthetically pleasing when mowed, and mowing seems to stimulate spreading of the grass, which helps to control erosion and provides competition for weeds. Once desirable low-growing species become established, the mower operator skips those sections, focusing instead on problem areas.

The photo on page 6 shows how years of brushing and mowing has kept encroachment of unwanted vegetation at bay. In the foreground is Oregon Grape. Mahonia *aquifolium*, which is a good native ground cover and does not need to be mowed. The operator will skip this area. Further up the road is a single remaining native rhododendron plant (marked by the pair of tennis shoes on the powerline). Operators are trained not to mow these and other native flowering plants unless they impair road visibility. The Jefferson County Noxious Weed Control Board also provides annual information transfer, updates and noxious weed identification training to maintenance personnel.

Mowing Height

Setting the mowing height at 6 to 8 inches (15-20 cm), rather than closer to the soil is a key strategy. This height favors establishment of both woody and herbaceous plants with low, spreading growth habits. Examples in Jefferson County include the native species creeping Oregon grape, Mahonia *nervosa*, and salal, *Gaultheria shallon*. Lower mowing heights tend to scalp the plants at the soil level, allowing sunlight to reach the bare soil surface. which encourages germination of weed seeds.

Modified Mower Tractors

The County uses Tiger® brand flail and rotary tractor/mowers to maintain the roadsides. A total of four mowers are used year-round. The rotary mowers are outfitted with an articulated brushing attachment. The mowing head has three blades attached to a circular dish. The flail tractor/mower carries a standard flail cutting head on the side.

Customizing and retrofitting some of the standard mowing and brushing equipment has maximized the efficacy of mechanical vegetation control. For example, the controls and seat have been modified for operator comfort. In addition, flail tractor/mowers have been substantially modified to increase operator safety. Bullet-proof Lexan™ glass protects the operator from flying debris on the mower side of the chassis. In the early days of the mowing program, rocks occasionally broke out the standard glass. Bars are also retrofitted onto the mower side of the chassis' forfurther protection from flying debris such as sticks, logs, and metal wire. An additional shield is welded on the inside of the wheel well. This shield was added after a piece of wire penetrated through the factory steel of the tractor, and into the leg of the operator.

When the County mechanics found that the bearings on the factory-supplied roller on the flail cutting head wore out too quickly, they replaced it with a guide wheel that works more efficiently.

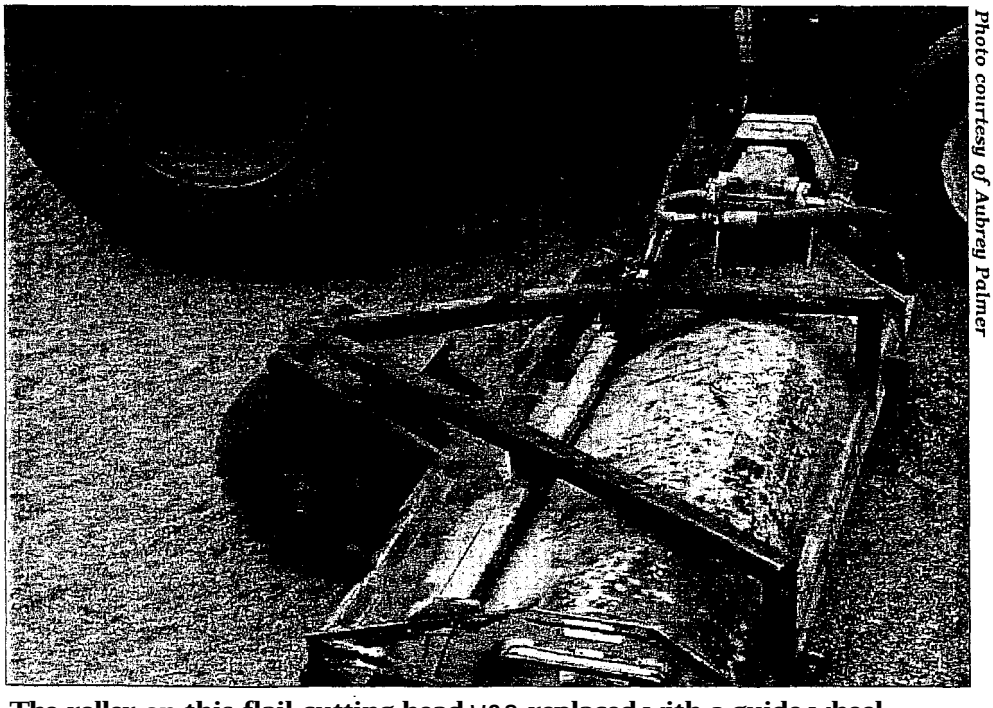

Photo courtesy of Aubrey Palmer

The roller on this flail cutting head was replaced with a guide wheel, which improved mowing efficiency.

Equipment Maintenance

Palmer stresses the necessity of f-equent maintenance of the mowing equipment. Rollers and pulleys are greased daily because they take a beating. Blades on the flail mower are replaced as soon as needed. The articulated brushing attachment is sharpened after every 400 hours of use.

Flaggers

Due to traffic, mowing is a 3-person operation. Two flaggers generally accompany the operator in order to direct traffic. On the larger arterials with adequate shoulder to contain the mower, flaggers are not needed.

Mowing Advantages and Disadvantages

There are advantages and disadvantages of mowing. Mowing stimulates spreading of grass, helps control erosion, provides competition for weedy species, and the results are aesthetically pleasing. Mowing also has disadvantages. There is repetition in the mowing cycle; multiple passes are required on uneven ground or steep drainage ditches. There is some invasion of gasses and weeds into asphalt edges.

Mechanical Brooms

One of the most innovative examples of a piece of mechanical equipment used to control roadside vegetation is the mechanical broom. The County has two such brooms: a Broce™ Tractor Broom and a similar Maxi-Sweep™ mechanical broom made by W-H Manufacturing. Each tractor/sweeper is fitted with a large heavy-duty plastic (spikey] tube-shaped broom (metal brooms are also avadable if needed).

In addition to sweeping mowed vegetation and other debris off the pavement, the mechanical brooms can dislodge and remove soil and vegetation at the interface of the pavement and shoulder. The brooms replace herbicides in clearing vegetation so that water can drain from the pavement. The brooms also play an important role in disiodging grasses and broadleaf weeds growing out of expansion joints along curbs and gutters.

Photo courtesy of Aubrey Palmer

This brushing machine is leveling a 4-foot alder. The first pass will take the tree down, and the second pass will **mulch it.**

Machine Brush Control

Mechanical control *of* brush **with** rotary tractor/mowers is used extensively along County roads where woody plant species limit visibility of the road and/or encroach on the asphalt or gravel surface. The treatment threshold for use of brushers on the shoulder and some backslopes is when trees or shrubs are growing a foot or two above adjacent grasses. Brush cutting is in operation virtually year round to complete the cycle on roadways needing treatment.

The most abundant shrubs and trees requiring cutting are alders, willows, maples, as well as salmonberry and other smaller shrubs. Brushing activities are practiced selectively in order to favor some species over others, and are used in part as a long-term strategy to deflect vegetation to more desirable forms. The County has found that brushing is the best management option at this time to increase the population of small competitive plant species.

On the down side, operation of the brush cutters is a slow and expensive process. Machinery costs are high, and in areas where flaggers are needed, the cost is increased. Some aesthetic problems have resulted from brush cutting operations, especially when cutting is done near rural residences and private drives where individuals prefer the green look and object to the occasional "brown-outs" caused by brush cutting. However, rapid regrowth usually relieves any browning or tree scarring effects of the brush cutter. Brush cutting needs can usually be met with annual treatment.

Air Saw

The Air Saw is a long-armed pneumatic saw operated from an aerial bucket. It is used to trim back lateral limb growth and excessive heights of alder and fir growing on backslopes and rights-of-way. Alder seems to be the major problem because it grows toward the open space of the County roads. Use of the air saw and the accompanying chipper is slow and expensive. A crew of five to six people, which includes flag personnel, is required for the operation. Safety of the crew is a major consideration.

The articulated boom is used to reach trees and limbs that encroacn over the roadway. A Veemer™ chip-

per is towed behind a modified 5-yard dump truck to collect the chips. Opening the canopy lets sunlight penetrate to roadway surface, which has a drying effect that helps to evaporate rainwater, and melt ice. This operation also takes out any dangerous trees that may have the potential to fall. The Operator maneuvers the boom in order to cut off limbs flush with their branch collar to facilitate rapid healing of the wound (Shigo 1986). Felled limbs are fed into a chipper. Chips are generally reused by the County Parks Department either on trails or landscaping. Any excess that they cannot use is given to local residents for horse barns, landscaping, or lightweight fill.

Manual Control

Manual control using gas-powered weedeaters, chainsaws and other tools has been used to cut back and pull out invasive problem plants such as alder, salmonberry, blackberry and annual grasses and weeds. During a 3-year period (1979 to 1982), Jefferson County used private professional crews to apply this technique of manual control to a total of 75 centerline miles. This technique must be repeated in a cyclic manner and was abandoned after the initial time period due to budget constraints. However, this program did succeed in employing local citizens and kept County dollars within the local economy. Manual control is still applied by road crews for vegetation control near signage, guardrails, and culvert inverts.

Grading

Periodic grading of roadside shoulders and annual clearing of drainage ditches helps prevent vegetation from filling the ditch line and keeps sod buildup from encroaching into the paved surface of the road. It also helps control the spread of noxious weeds and growth of other invasive plants.

The County has an aggressive ditch maintenance program. To clear the ditches of vegetation, two graders are used in tandem. One grades out soil and vegetation from the ditch and deposits it on the road pavement. The second grader places the spoils onto a conveyer belt that loads it into a truck for disposal. As a byproduct of annual ditch clearance, horsetails are kept under control in the vicinity of ditches.

Hydroseeding

Hydroseeding grasses and wildflowers onto all new road construction sites where disturbed soils have been left bare of vegetation has become policy in Jefferson County. This practice of competitive planting has helped eliminate problem vegetation, especially alders, that colonize bare soil. It is generally the policy of the County Public Works Department that wildflowers be added to the grass seed mix for all hydroseeding projects. The County has found the additional cost to be minimal, and the wildflowers add an eye-catching element to the newly constructed area once the plants establish and bloom. Hydro-seeding also helps prevent erosion of the post-construction bare soil.,

Cost of the No Spray Program

When asked to discuss the cost of Jefferson County's chemical-free roadside vegetation management program, Palmer is quick to provide the data. However, he cautions that these figures are based on conditions in Jefferson County. Using these figures to estimate what it might cost to operate a similar program in other areas could be misleading. "In general, when you talk costs per mile, you always end up Comparing apples and oranges," says Palmer. "Each Public Works Department has different equipment rental costs, different labor costs, and some may not figure in traffic control or other program costs."

Therefore, Jefferson County's maintenance costs for manual removal, machine mowing, and brush cutting for the 3-year period 1997 to 1999 are provided here as examples only. Total shoulder mile costs for manual control and machine mowing for a 3-year period averages about $81,000 dollars each year. Since about 3,065 shoulder miles of work are completed each year, the average cost per shoulder mile is about $26.43.

Shoulder mile costs for brush cutting for the 3-year period averages about $168,700 each year. About 481 shoulder miles of brush cutting are completed each year, and thus the average cost per shoulder mile is about $350.72.

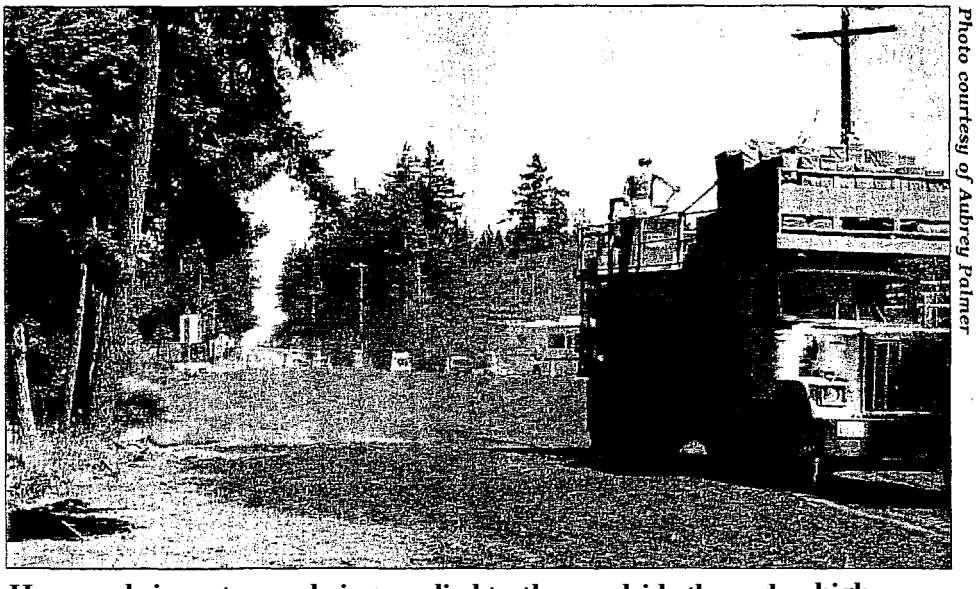

Photo courtesy of Aubrey Palmer

Here seeds in water are being applied to the roadside through a high pressure hose. Hydroseeding with native plants helps reduce weed problems.

Community Support

Palmer sums up the cost factor by saying that there is no question that the no-spray program costs the County more than the chemical program. However, "people in our community have been willing to pay the extra costs **all** these years in order to protect public health and the environment."

Responding to Changes

Palmer also points out that by having taken the environmentally cognizant path 22 years ago, the County is better prepared for the increasingly strict enforcement of clean water and endangered species legislation. Heightened environmental protection efforts statewide have required adjustments to the mechanical practices discussed in this article. But Palmer is confident that solutions are at hand. Needless to say, in terms of environmental compliance, the County is way ahead of agencies still relying primarily on herbicides to control their errant vegetation.

Recently the County established a noxious weed control program, which will require further innovations in roadside vegetation management.

What Does It All Mean?

Palmer is a realist. He does not consider the Jefferson County vegetation management program perfect, nor does he claim that it is a program custom made for others to adopt as is. He laughs as he says, We used to receive numerous claims from adjacent property owners about toxic sprays. Now we receive claims and complaints about our mowing and brushing practices."

But underlying the humor is an obvious pride. Palmer knows that the County's citizens and employees together have pulled off something pretty special. "It took a major change of an ingrained mindset for our maintenance crews to initiate and support a non-chemical vegetation management program. However, we consider it to be extremely successful. Vegetation control without chemicals is do-able."

Sheila Daar is an IPM Specialist and former Executive Director of BIRC. She is currently implementing non-chemical vegetation management programs for public agency clients in California. She can be contacted at daargroupQnetscape.net.Aubrey Palmer can be contacted at 360/385-9167: email apalmer@co.jefferson.wa.us.

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3/28/02 Submitted 4/2/02

351 Redwood Hts. Rd.
Aptos, Ca. 95003

0330

Dear Supervisor Wormhoudt,

RE: CalTrans continued herbicide roadside spraying on county roadways

When I read your. 3/20/02 letter to the Board, it was with a sense of surprise , dismay, and betrayal of those whose health and community concerns you represent *as* the "environmental candidate." At the meeting with you and Denise at Java Junction on 3/11/02, you stated that you would request that CalTrans ELIMINATE roadside spraying as has been accomplished in northern counties. You notedthe forthright wording of the Humboldt Bd. of Supervisors (3/25/97) in formally requesting that CalTrans "discontinue all herbicide spraying .. ." (attached.)

Unfortunately, except for your "hotline" request, the CalTrans poisoning policy continues essentially unchanged. Instead of "eliminate" you've flashed a green light for more toxic trespass. Inevitably, the people your represent will suffer harmful exposure to dangerous herbicides including Roundup (see attached data). In other words, the "hotline" is proof of "Beware, life threatening contaminants ahead." What caused you to change your mind, even though you "prefer" elimination of pesticides?

HUMBOLDT: On 7/26/02 and again on 4/1/02, I spoke briefly with Humboldt Co. Supervisor Neely who told me they viewed pesticide use as a public health not a maintenance issue. Since when does CalTrans stated and unsubstantiated "financial and physical constraints" compare to the health of the residents of Santa Cruz County? *The* Washington Toxics Coalition states that Staffing and funding are insufficient justification for use *of* pesticides. We have a right not to be poisoned and the exposure itself is unacceptable. We want you to be as courageous on issues as you have been in the past. PLEASE speak directly with Supervisor Neely and be encouraged, inspired and motivated Lo REWORD your letter to the Board to reflect protection *of* those over 2,000 community members who signed the "STOP THE POISONS" REGISTRY. This action is long overdue.

As you currently have the endorsement of the Green Party, we plan to contact Green Party members, many of whom signed *the* "Stop the Poisons" petitions/registry. Greens desire a verdant earth, not a poisoned death landscape. 'PLEASE TAKE A STRONG STAND ON THIS SIMPLE ISSUE. Represent those who endorsed you.

Please respond to these requests prior to the 4/9/02 Board meeting:

(1) Your consideration of the rewording of the CalTrans statement.

(2) Your consideration of Humboldt Supervisor Bonnie Neely's position. She can be reached at 707-476-2394. (who is anticipating your call)

(3) I am puzzled why the attached (and hand delivered) letter (2/11/02) of David Blume, President of the International. Institute of Ecological Agriculture re:CalTrans was omitted from the mailing you sent me. Will you include it in the Bd. Packet or shall I submit it?

Thank you,

Marilyn Garrett, on behalf of the Toxics Action Coalition
688-4603

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