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

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OFFICE OF
PREVENTION, PESTICIDES AND
TOXIC SUBSTANCES

MEMORANDUM

SUBJECT: Sulfentrazone: New Chemical Review

FROM: Anthony F. Maciorowski, Chief
EEB/EFED

TO: Sharlene Matten, Coordinator
SACS/EFED

EEB has completed its new chemical review of sulfentrazone (129081). The review and data requirements table are attached.

Use Patterns:

Sulfentrazone is a broad-spectrum herbicide for control of annual and biennial broadleaf weeds, annual grasses, and sedges (*Cyperus* spp.). Proposed uses are for preplant incorporated (1-2") or preemergence application for soybeans and pre- or post-emergence application in established turfgrass and lawns. Applications are by ground only.

Toxicity Summary:

The available acute toxicity data on the TGAI indicate that sulfentrazone is practically nontoxic to birds (LD_{50} >2250 mg/kg; LC_{50} >5620 ppm), slightly toxic to small mammals (LD_{50} = 711 mg/kg), freshwater fish (LC_{50} = 93.8 ppm) and freshwater invertebrates (EC_{50} = 60.4 ppm), and highly toxic to practically nontoxic to estuarine/marine organisms (LC_{50} = 1-114 ppm). Chronic toxicity studies provided the following NOEC values: 10 ppm for birds, 600 ppm for small mammals, and 0.20-2.95 ppm for freshwater organisms. EC_{25} values of 0.010-0.013 lbs ai/acre were established for the most sensitive terrestrial plant species and EC_{25} values of 28.8-31 ppb for the most sensitive aquatic plants.

1

Data Requirements:

The estuarine/marine oyster acute toxicity test (72-3b) is outstanding. Based on the acute toxicity of sulfentrazone to mysids, and because the freshwater invertebrate testing indicates the chronic-effect level is ≈300X more sensitive than the acute-effects level, a mysid life-cycle test (72-4b) is required. Avian reproduction tests (71-4a,b) must be repeated at higher test concentrations to support multiple applications on turf/lawn; however, if the number of applications is limited to two, further testing is not required.

Risk Assessment:

The proposed uses of sulfentrazone on soybeans and turf/lawn at maximum application rates of 0.125-0.375 lb ai/acre are presumed to pose acute risk to terrestrial, semi-aquatic, and aquatic plants. Although acute high risk is not presumed for mammals, the restricted use LOC is exceeded for small herbivores for the turf/lawn use (warm-season grasses only) for maximum EECs. Additionally, the endangered species LOC is exceeded for small herbivores for soybean and turf and small insectivores for turf when maximum EECs are presumed. No mammalian LOCs are exceeded when RQs are based on mean EECs. For birds, only chronic risk is presumed, and risk is greater for turf than for soybeans due to repeat applications on turf. No acute or chronic risks are presumed for freshwater fish, freshwater invertebrates, marine/estuarine fish, and some marine/estuarine invertebrates. However, a risk assessment for marine/estuarine invertebrates cannot be completed, because oyster acute toxicity data and mysid chronic data have not been submitted. Concerns for endangered plants and small mammals should be addressed via the Endangered Species Task Force, of which FMC Corporation is a member.

Labeling:

Manufacturing-use Products:

"This pesticide is toxic to marine/estuarine invertebrates. Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans or other waters unless in accordance with the requirements of a National Pollutant Discharge Elimination System (NPDES) permit and the permitting authority has been notified in writing prior to discharge. Do not discharge effluent containing this product to sewer systems without previously notifying the local sewage treatment plant authority. For guidance contact your State Water Board or Regional Office of the EPA."

End-use Products (agricultural use and non-residential turf):

"This pesticide is toxic to marine/estuarine invertebrates. Do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark. Drift and runoff may be hazardous to terrestrial and aquatic plants in neighboring areas. Do not contaminate water when disposing of equipment washwaters or rinsate."

End-use Products (residential turf):

"This pesticide is toxic to marine/estuarine invertebrates. Do not apply directly to water. Do not contaminate water when disposing of equipment washwaters or rinsate."

Contact Bill Erickson at 305-6212 or Harry Craven at 305-5320 if you have any questions.

ECOLOGICAL EFFECTS BRANCH
NEW CHEMICAL REVIEW
SULFENTRAZONE (129081)

ECOLOGICAL TOXICITY DATA

Toxicity to Terrestrial Animals

Birds, Acute and Subacute

An acute oral (LD_{50}) study (preferably with the mallard duck or northern bobwhite quail) and two subacute dietary (LC_{50}) studies (one species of waterfowl, preferably the mallard, and one species of upland game bird, preferably bobwhite quail) are required to establish the toxicity of a pesticide to birds. Results of these tests are tabulated below.

Table 1: Avian Acute Oral Toxicity Findings

Species	% ai	LD_{50} (ppm)	Toxicity Category	MRID No. Author/Year	Fulfills Guideline Requirement?
Northern Bobwhite Quail *(Colinus virginianus)*	94.3	>2250	practically nontoxic	419116-17 (Campbell et al., 1989)	yes

Table 2: Avian Subacute Dietary Toxicity Findings

Species	% ai	LC_{50} (ppm)	Toxicity Category	MRID No. Author/Year	Fulfills Guideline Requirement?
Northern Bobwhite Quail *(Colinus virginianus)*	94.3	>5620	practically nontoxic	419116-18 (Beavers et al., 1991)	yes
Mallard Duck *(Anas platyrhynchus)*	94.3	>5620	practically nontoxic	419116-19 (Beavers et al., 1991)	yes

These results indicate that sulfentrazone is practically nontoxic to avian species on an acute oral and subacute dietary basis. The guideline requirements (71-1 and 71-2) are fulfilled.

Birds, Chronic

Avian reproduction studies using the technical grade of the active ingredient are required when birds may be exposed to a pesticide repeatedly or continuously through its

persistence, bioaccumulation, or from multiple applications, or if mammalian reproduction tests indicate possible adverse reproductive effects. The preferred test species are the mallard duck and bobwhite quail. The conditions that apply for sulfentrazone are environmental persistence (aerobic soil metabolism half-life = 534-555 days) and multiple applications (turf/lawn). Results of these tests are tabulated below.

Table 3: Avian Reproduction Findings

Species	% ai	NOEC (ppm)	LOEC (ppm)	Endpoints Affected	MRID No. Author/Year	Fulfills Guideline Requirement?
Northern Bobwhite Quail *(Colinus virginianus)*	94.2	10	100	hen weight gain*	433559-01 (Pedersen and DuCharme, 1994)	no (see below)
Mallard Duck *(Anas platyrhynchus)*	94.2	100	>100	none	433559-02 (Pedersen and DuCharme, 1994)	no (see below)

* treated hens gained less body weight (232 g) by the end of the study than did untreated hens (251 g)

The results indicate that chronic exposure to sulfentrazone may adversely affect birds at dietary exposure levels as low as 100 ppm. The only measurement endpoint significantly adversely affected at 100 ppm was hen body-weight gain. However, at 100 ppm the number of eggs laid per hen (46.1) and the proportion of live embryos resulting in normal hatchlings (90.3%) also were less than for the control hens (53.6 eggs/hen and 95.9%, respectively). Although not statistically significant, these differences may be biologically important. Environmental residues (EECs) exceeding 100 ppm on short grass are likely on turf/lawn, because the proposed labeling allows an unlimited number of applications and sulfentrazone is highly persistent in the environment. The EEC projected for two applications is 120 ppm and for three applications is 180 ppm. Because the highest concentration tested (100 ppm) is below the projected EEC on turf/lawn for multiple applications, the guideline requirement (71-4) is not fulfilled.

Mammals

Wild mammal testing is required on a case-by-case basis, depending on the results of the lower tier studies such as acute and subacute testing, intended use pattern and pertinent environmental fate characteristics. Laboratory rat or mouse toxicity data obtained from the Agency's Health Effects Division (HED) is used whenever wild mammal toxicity data are not available. These toxicity values are tabulated below.

5

Table 4: Mammalian Toxicity Findings

Species	% ai	Endpoints Affected	Toxicity Values	Toxicity Category	MRID No.
Laboratory rat *(Rattus norvegicus)*	94	mortality	LD_{50} = 2855 mg/kg	practically nontoxic	419116-05
	94.2	body weight, food consumption	NOEC = 600 ppm LOEC = 1000 ppm	n/a	433454-09
Laboratory mouse *(Mus musculus)*	94	mortality	LD_{50} = 711 mg/kg	slightly toxic	419116-06

The results indicate that sulfentrazone is slightly toxic to small mammals on an acute oral basis.

Toxicity to Aquatic Animals

Freshwater Fish, Acute

Two freshwater fish toxicity studies using the technical grade of the active ingredient are required to establish the toxicity of a pesticide to freshwater fish. One study is conducted with a coldwater species (preferably the rainbow trout) and the other with a warmwater species (preferably the bluegill sunfish). Results of these tests are tabulated below.

Table 5: Freshwater Fish Acute Toxicity Findings

Species	% ai	LC_{50} (ppm)	Toxicity Category	MRID No. Author/Year	Fulfills Guideline Requirement?
Rainbow trout *(Oncorhynchus mykiss)*	94.3	>120	practically nontoxic	419116-20 (Graves and Peters, 1989)	yes
Bluegill sunfish *(Lepomis macrochirus)*	94.3	93.8	slightly toxic	419116-21 (Graves and Peters, 1989)	yes

The results indicate that sulfentrazone is slightly toxic to fish on an acute basis. The guideline requirement (72-1) is fulfilled.

Freshwater Fish, Chronic

Data from a fish early life-stage test using the technical grade of the active ingredient are required if the product is applied directly to water or expected to be transported to water from the intended use site, and when any one of the following conditions exist: (1) the

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pesticide is intended for use such that its presence in water is likely to be continuous or recurrent regardless of toxicity; (2) any acute LC_{50} or EC_{50} is less than 1 mg/L; (3) the EEC in water is equal to or greater than 0.01 of any acute EC_{50} or LC_{50} value; or (4) the actual or estimated environmental concentration in water resulting from use is less than 0.01 of any acute EC_{50} or LC_{50} value and any one of the following conditions exist: studies of other organisms indicate the reproductive physiology of fish may be affected, physicochemical properties indicate cumulative effects, or the pesticide is persistent in water (e.g. half-life greater than 4 days). The preferred test species is the rainbow trout. Data are required for sulfentrazone, because the chemical is stable in water and has a soil aerobic half-life of 534-555 days. Test results are tabulated below.

Table 6: Fish Early Life-Stage Toxicity Findings

Species	% ai	NOEC (ppm)	LOEC (ppm)	Endpoints Affected	MRID No. Author/Year	Fulfills Guideline Requirement?
Rainbow trout *(Oncorhynchus mykiss)*	94.2	2.95	5.93	survival and growth (length)	435886-04 (Boeri et al., 1994)	yes

The results indicate that sulfentrazone significantly affects young fish survival and growth at aquatic concentrations as low as 5.93 ppm. The guideline requirement (72-4a) is fulfilled.

Freshwater Invertebrates, Acute

A freshwater aquatic invertebrate toxicity test using the technical grade of the active ingredient is required to assess the toxicity of a pesticide to freshwater invertebrates. The preferred test organism is *Daphnia magna*, but early instar amphipods, stoneflies, mayflies, or midges may also be used. Results of this test are tabulated below.

Table 7: Freshwater Invertebrate Toxicity Findings

Species	% ai	EC_{50} (ppm)	Toxicity Category	MRID No. Author/Year	Fulfills Guideline Requirement?
Waterflea *(Daphnia magna)*	94.3	60.4	slightly toxic	419116-22 (Holmes and Peters, 1989)	yes

The results indicate that sulfentrazone is slightly toxic to aquatic invertebrates on an acute basis. The guideline requirement (72-2) is fulfilled.

Freshwater Invertebrate, Chronic

Data from an aquatic invertebrate life-cycle test using *Daphnia magna* are required if the product is applied directly to water or expected to be transported to water from the intended use site, and when any **one** of the following conditions exist: (1) the pesticide is intended for use such that its presence in water is likely to be continuous or recurrent regardless of toxicity; (2) any acute LC_{50} or EC_{50} is less than 1 mg/L; or (3) the EEC in water is equal to or greater than 0.01 of any acute EC_{50} or LC_{50} value; or (4) the actual or estimated environmental concentration in water resulting from use is less than 0.01 of any acute EC_{50} or LC_{50} value and any of the following conditions exist: studies of other organisms indicate the reproductive physiology of invertebrates may be affected, physicochemical properties indicate cumulative effects, or the pesticide is persistent in water (e.g. half-life greater than 4 days). *Daphnia magna* is the preferred test species. Data are required for sulfentrazone, because the chemical is stable in water and has a soil aerobic half-life of 534-555 days. Results of this test are tabulated below.

Table 8: Aquatic Invertebrate Life-Cycle Toxicity Findings

Species	% ai	NOEC (ppm)	LOEC (ppm)	Endpoints Affected	MRID No. Author/Year	Fulfills Guideline Requirement?
Waterflea *(Daphnia magna)*	94.2	0.20	0.51	survival	435886-05 (Boeri et al., 1994)	yes

The results indicate that survival of young daphnids is adversely affected at sulfentrazone concentrations as low as 0.51 ppm. The guideline requirement (72-4b) is fulfilled.

Estuarine and Marine Animals, Acute

Acute toxicity testing with estuarine and marine organisms (fish, shrimp and oyster embryo-larvae or shell deposition) using the technical grade of the active ingredient is required when an end-use product is intended for direct application to the marine/estuarine environment or is expected to reach this environment in significant concentrations. The preferred test organisms are the sheepshead minnow, mysid shrimp and eastern oyster. Testing is required for sulfentrazone because soybeans and turf/lawn may occur in areas where pesticide runoff from fields may impact the marine/estuarine environment. Results of these tests are tabulated below.

Table 9: Estuarine/Marine Acute Toxicity Findings

Species	% ai	LC_{50} or EC_{50} (ppm)	Toxicity Category	MRID No. Author/Year	Fulfills Guideline Requirement?
Oyster		no data			
Mysid shrimp *(Mysidopsis bahia)*	94.2	1	highly toxic	435886-03 (Boeri et al., 1994)	yes
Silverside *(Menidia beryllina)*	94.2	114	practically nontoxic	435886-02 (Boeri et al., 1994)	yes

The results are incomplete but indicate that sulfentrazone is highly toxic to marine/estuarine organisms on an acute basis. Because an oyster toxicity test has not been submitted, the guideline requirement (72-3b) is not fulfilled.

Estuarine and Marine Animals, Chronic

Estuarine/marine fish early life-stage and invertebrate life-cycle toxicity tests are required if a pesticide is applied directly to the estuarine/marine environment or expected to be transported to this environment from the intended use site, and when any **one** of the following conditions exist: (1) the pesticide is intended for use such that its presence in water is likely to be continuous or recurrent regardless of toxicity; (2) any acute LC_{50} or EC_{50} is less than 1 mg/L; (3) the EEC in water is equal to or greater than 0.01 of any acute EC_{50} or LC_{50} value; or (4) the actual or estimated environmental concentration in water resulting from use is less than 0.01 of any acute EC_{50} or LC_{50} value and any of the following conditions exist: studies of other organisms indicate the reproductive physiology of fish and/or invertebrates may be affected, physicochemical properties indicate cumulative effects, or the pesticide is persistent in water (e.g. half-life greater than 4 days). The preferred test species are the sheepshead minnow and the mysid shrimp. An estuarine/marine invertebrate life-cycle test is required for sulfentrazone, based on its acute toxicity and because freshwater invertebrate testing indicates the chronic-effect level is $\approx$300 times more sensitive than the acute-effects level. However, because sulfentrazone is less acutely toxic to estuarine/marine fish than to freshwater fish, an estuarine/marine fish early life-stage test is not required.

Toxicity to Plants

Terrestrial Plants

Terrestrial plant testing (seedling emergence and vegetative vigor) is required for herbicides which have terrestrial non-residential outdoor use patterns and which may move off the application site through volatilization (vapor pressure $\geq 1.0 \times 10^{-5}$mm Hg at 25°C) or drift (aerial or irrigation); and/or which may have endangered or threatened plant species associated with the application site. Terrestrial plant testing is required for this pesticide

because endangered and/or threatened plant species may occur in the nearby vicinity of treatment sites.

For the seedling emergence and vegetative vigor testing the following plant species and groups should be tested: (1) six species of at least four dicotyledonous families, one species of which is soybean (*Glycine max*), and the second of which is a root crop, and (2) four species of at least two monocotyledonous families, one of which is corn (*Zea mays*).

Tier 2 tests measure the dose-response of the 10 plant species to various measurement endpoints at 5 or more test concentrations. Results of Tier 2 toxicity testing on the technical material are tabulated below.

Table 10: Nontarget Terrestrial Plant Seedling Emergence Toxicity Findings (Tier II)

Species	% ai	Endpoint Affected	EC_{25} (lb ai/A)	EC_{05} (lb ai/A)	MRID No. Author/Year	Fulfills Guideline Requirement?
Monocot - Corn	94.2	dry weight	0.067	0.0019	433454-11 (Chetram, 1992)	yes
Monocot - Oat		dry weight	0.017	0.0036		
Monocot - Ryegrass		dry weight	0.038	0.010		
Monocot - Onion		height	0.019	0.0041		
Dicot - Radish		dry weight	0.036	0.0079		
Dicot - Soybean		dry weight	0.35	0.11		
Dicot - Lettuce		dry weight	0.010	0.0028		
Dicot - Cabbage		dry weight	0.067	0.034		
Dicot - Cucumber		dry weight	0.039	0.014		
Dicot - Tomato		dry weight	0.013	0.0057		

For Tier II seedling emergence, lettuce is the most sensitive dicot and oat is the most sensitive monocot. The guideline requirement (123-1) is fulfilled.

Table 11: Nontarget Terrestrial Plant Vegetative Vigor Toxicity Findings (Tier II)

Species	% ai	Endpoint Affected	EC_{25} (lb ai/A)	EC_{05} (lb ai/A)	MRID No. Author/Year	Fulfills Guideline Requirement?
Monocot - Corn	94.2	dry weight	0.180	0.054	433454-12 (Chetram, 1992)	yes
Monocot - Oat		dry weight	0.033	0.0095		
Monocot - Ryegrass		dry weight	0.045	0.024		
Monocot - Onion		dry weight	0.012	0.0047		
Dicot - Radish		dry weight	0.057	0.0086		
Dicot - Soybean		dry weight	0.0044	0.0012		
Dicot - Lettuce		dry weight	0.025	0.013		
Dicot - Cabbage		dry weight	0.011	0.0021		
Dicot - Cucumber		dry weight	0.00052	0.00019		
Dicot - Tomato		dry weight	0.012	0.0068		

For Tier II vegetative vigor, cucumber is the most sensitive dicot and onion is the most sensitive monocot. The guideline requirement (123-1) is fulfilled.

Aquatic Plants

Aquatic plant testing is required for any herbicide which has outdoor non-residential terrestrial uses that may move off-site by runoff (solubility >10 ppm in water), by drift (aerial or irrigation), or that is applied directly to aquatic use sites (except residential). The following species should be tested: *Kirchneria subcapitata*, *Lemna gibba*, *Skeletonema costatum*, *Anabaena flos-aquae*, and a freshwater diatom. Aquatic plant testing is required for this pesticide because its solubility is 400 ppm. Results of Tier II toxicity testing on the technical material are tabulated below.

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Table 12: Nontarget Aquatic Plant Toxicity Findings (Tier II)

Species	% ai	EC_{50} (ppb)	NOEC (ppb)	MRID No. Author/Year	Fulfills Guideline Requirement?
Freshwater diatom *(Navicula pelliculosa)*	94.2	42.1	7.5	436510-04 (Ward et al., 1995)	yes
Duckweed *(Lemna gibba)*	94.2	28.8	18.9	436510-05 (Ward et al., 1995)	yes
Green algae *(Kirchneria subcapitata)**	94.2	31	16	433454-13 (Blasberg et al., 1994)	yes
Marine diatom *(Skeletonema costatum)*	94.2	1800	1350	436510-07 (Ward et al., 1995)	yes
Blue-green algae *(Anabaena flos-aquae)*	94.2	32,800	<15,900	436510-06 (Ward et al., 1995)	yes

*formerly *Selenastrum capricornutum*

The Tier II results indicate that duckweed is the most sensitive aquatic plant species. The guideline requirement (123-2) is fulfilled.

USE PROFILE

Sulfentrazone is a broad-spectrum herbicide for control of annual and/or biennial broadleaf weeds, annual grasses, and sedges (*Cyperus* spp.). Proposed uses are for preplant incorporated (1-2") or preemergence application for soybeans and pre- or post-emergence application in established turfgrass and lawns. Turfgrass/lawn use is specified as that ". . . intended for aesthetic purposes or climatic modification and being grown on interior plantscapes, ornamental gardens or parks, golf courses, lawns and grounds."

For soybeans, sulfentrazone will be applied only by fixed-boom ground equipment with properly calibrated low pressure (10-40 psi) nozzles and screens and strainers no finer than 50-mesh. The application rate, depending on soil texture and organic matter content, is 0.3125-0.375 lb ai/acre, mixed with 10-40 gallons of water. The total amount of sulfentrazone applied should not exceed 0.375 lb ai/acre per year. Sulfentrazone may be tank mixed with other soybean herbicides to broaden the weed control spectrum.

Sulfentrazone may be applied in soybean fields up to 30 days before planting, during planting, or after planting but before the crop emerges. It should be incorporated into the

top 1-2 inches of soil if applied prior to planting. Preemergence activity of sulfentrazone requires moisture for activation (enough moisture to wet the soil 1-2 inches deep). Dry soils should be thoroughly but shallowly cultivated if rainfall or irrigation is not adequate to activate sulfentrazone within 7 days after application.

For established turf and lawn, sulfentrazone may be applied before or after emergence of target species. Recommended application rates are 0.03-0.125 lb ai/acre for cool-season grasses, 0.06-0.25 lb ai/acre for warm-season grasses, and 0.125 lb ai/acre for *Cyperus* spp. Product should be applied in a minimum of 20 gal/acre of carrier and may be tank mixed with liquid fertilizers and/or other registered pesticides. The product label does not restrict the number of annual applications or limit the annual amount of sulfentrazone that can be applied on turf and lawn.

Sulfentrazone may not be applied aerially or through any type of irrigation system. All product labels state that sulfentrazone should not be applied when wind speed exceeds 10 mph nor with a spray pressure exceeding 40 psi.

EXPOSURE AND RISK CHARACTERIZATION

Risk Quotients (RQs) and Levels of Concern (LOCs)

LOCs are criteria used to indicate potential risk to nontarget organisms. Exceeding the criteria indicate that a pesticide, when used as directed, has the potential to cause undesirable effects to nontarget organisms. Two general categories of LOC (acute and chronic) exist for the nontarget faunal groups and one category (acute) for nontarget floral groups. To determine if an LOC is exceeded, an RQ is derived and compared to the LOCs. An RQ is calculated by dividing an appropriate exposure estimate, e.g. the estimated environmental concentration (EEC), by an appropriate toxicity test effect level, e.g. the LC_{50}. The acute effect levels are:

EC_{25} - terrestrial plants
EC_{50} - aquatic plants and invertebrates
LC_{50} - fish and birds
LD_{50} - birds and mammals
EC_{05} or NOEC - endangered plants

The chronic test results are the:

NOEC - avian and mammal reproduction studies
NOEC or MATC - aquatic species

When the RQ exceeds the LOC for a particular category, risk is presumed. Risk presumptions and corresponding LOCs are tabulated below.

Risk Presumption	RQ	LOC
Birds		
Acute High Risk	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day	0.5
Acute Restricted Use	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day (or LD_{50} < 50 mg/kg)	0.2
Acute Endangered Species	EEC/LC_{50} or LD50/sqft or LD_{50}/day	0.1
Chronic High Risk	EEC/NOEC	1
Chronic Endangered Species	EEC/NOEC	1
Wild Mammals		
Acute High Risk	EEC/LC_{50} or LD50/sqft or LD_{50}/day	0.5
Acute Restricted Use	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day (or LD_{50} < 50 mg/kg)	0.2
Acute Endangered Species	EEC/LC_{50} or LD50/sqft or LD_{50}/day	0.1
Aquatic Animals		
Acute High Risk	EEC/LC_{50} or EC_{50}	0.5
Acute Restricted Use	EEC/LC_{50} or EC_{50}	0.1
Acute Endangered Species	EEC/LC_{50} or EC_{50}	0.05
Chronic High Risk	EEC/MATC or NOEC	1
Chronic Endangered Species	EEC/MATC or NOEC	1
Terrestrial and Semi-Aquatic Plants		
Acute High Risk (non-endangered)	EEC/EC_{25}	1
Acute Endangered Species	EEC/EC_{05} or NOEC	1
Aquatic Plants		
Acute High Risk	EEC/EC_{50}	1
Acute Endangered Species	EEC/EC_{05} or NOEC	1

EEB currently has no procedures for assessing chronic risk to plants, acute or chronic risks to nontarget insects, or chronic risk from granular and bait formulations to mammalian or avian species.

Exposure and Risk to Nontarget Terrestrial Animals

Birds

For non-granular pesticides, EECs on dietary food items following product application are compared to LC_{50} values to assess risk. The predicted 0-day maximum and mean EECs of sulfentrazone that may be expected to occur on selected avian and mammalian dietary items following product application are tabulated below.

Table 13: EEC Values on Avian and Mammalian Food Items

Site/Appl. Rate (lb ai/A)	Food Item	Maximum EEC (ppm)[1]	Mean EEC (ppm)[1]
Soybean (0.375)	Short grass	90	32
	Insects	51	17
	Seeds	6	<3
Turf/lawn: warm-season grasses (0.25)	Short grass	180[2]	64[2]
	Insects	101[2]	34[2]
	Seeds	11[2]	5[2]
Turf/lawn: cool-season grasses and sedges (0.125)	Short grass	90[2]	32[2]
	Insects	51[2]	17[2]
	Seeds	6[2]	3[2]

[1] predicted maximum and mean residues are based upon Hoerger and Kenaga (1972) as modified by Fletcher et al (1994).

[2] assumes 3 applications at 7-day intervals and, based on aerobic soil metabolism half-life of 534-555 days, no degradation between applications

Acute and chronic RQs are tabulated separately below for maximum (Table 14) and mean (Table 15) EEC values.

Table 14: Avian Acute and Chronic RQ Values for Non-granular Products Based on Maximum EEC Values, Mallard and Bobwhite Quail LC_{50}s of >5200 ppm, and the Bobwhite Quail Chronic NOEC of 10 ppm.

Site/Appl. Rate (lb ai/A)	Food Items	Maximum EEC (ppm)	LC_{50} (ppm)	Chronic NOEC (ppm)	Acute RQ (EEC/LC_{50})	Chronic RQ (EEC/NOEC)
Soybean (0.375)	Short grass	90	>5200	10	<0.018	9.0
	Insects	51	>5200	10	<0.010	5.1
	Seeds	6	>5200	10	<0.002	0.6
Turf/lawn: warm-season grasses (0.25) (3 applications)	Short grass	180	>5200	10	<0.035	18.0
	Insects	101	>5200	10	<0.020	10.1
	Seeds	11	>5200	10	<0.003	1.1
Turf/lawn: cool-season grasses and sedges (0.125) (3 applications)	Short grass	90	>5200	10	<0.018	9.0
	Insects	51	>5200	10	<0.010	5.1
	Seeds	6	>5200	10	<0.002	0.6

Table 15: Avian Acute and Chronic RQ Values for Non-granular Products Based on Mean EEC Values, Mallard and Bobwhite Quail LC_{50}s of >5200 ppm, and the Bobwhite Quail Chronic NOEC of 10 ppm

Site/Appl. Rate (lb ai/A)	Food Items	Mean EEC (ppm)	LC_{50} (ppm)	Chronic NOEC (ppm)	Acute RQ (EEC/LC_{50})	Chronic RQ (EEC/NOEC)
Soybean (0.375)	Short grass	32	>5200	10	<0.006	3.2
	Insects	17	>5200	10	<0.003	1.7
	Seeds	<3	>5200	10	<0.001	<0.3
Turf/lawn: warm-season grasses (0.25) (3 applications)	Short grass	64	>5200	10	<0.013	6.4
	Insects	34	>5200	10	<0.007	3.4
	Seeds	5	>5200	10	<0.001	0.5
Turf/lawn: cool-season grasses and sedges (0.125) (3 applications)	Short grass	32	>5200	10	<0.006	3.2
	Insects	17	>5200	10	<0.003	1.7
	Seeds	3	>5200	10	<0.001	0.3

The results indicate that acute high risk, restricted use, and endangered species LOCs are not exceeded when using either maximum or mean EEC values.

The chronic risk LOC for birds is exceeded at the proposed maximum application rates for both soybean and turf/lawn when RQs are calculated using either maximum (Table 14) or mean (Table 15) EEC values. Chronic impacts due to use of sulfentrazone in soybeans seems less likely than for turf/lawn. Only one application is made on soybeans, and contaminated grass and insects are likely present for only a brief period. The Agency is concerned about potential chronic effects from use of sulfentrazone on turf. However, the highest concentration tested in the avian reproduction studies was only 100 ppm, which is less than the maximum EEC of 180 ppm projected for short grass from three applications to turf/lawn (warm-season grasses). Therefore, the Agency cannot assess avian chronic risk for that use unless testing is conducted at higher concentrations or the number of applications is limited to two, which projects to a maximum EEC of about 120 ppm.

Mammals

The potential for adverse effects to wild mammals is estimated according to EEB's draft 1995 SOP of mammalian risk assessment and the methods used by Hoerger and Kenaga (1972) as modified by Fletcher et al (1994). The dietary concentration of sulfentrazone expected to be acutely lethal to 50% of the test population (LC_{50} value) is determined by dividing the LD_{50} value (usually the most sensitive rat or mouse LD_{50}) by food consumption (%, expressed as a decimal, of body weight consumed). An RQ is then determined by

dividing the EEC by the derived LC_{50} value.

Mammalian (herbivore and insectivore) acute and chronic RQs for non-granular products are provided in the Tables below. RQs are calculated for three weight classes of mammals: 15 g, 35 g, and 1000 g, each presumed to consume three different food categories (grass, insects, and seeds). RQ values for herbivores and insectivores are tabulated for both maximum and minimum EEC values. RQ values for granivores were calculated but are not tabulated; no LOCs were exceeded.

Table 16: Mammalian (Hervivore and Insectivore) Acute RQ Values for Non-granular Products Based on Maximum EEC Values and the Laboratory Mouse LD_{50} of 711 mg/kg[1]

Appl. Rate (lb ai/A)	Mammal Body Weight (g)	% Body Weight Consumed	Lab. Mouse LD_{50} (mg/kg)	Max. EEC Short Grass (ppm)	Max. EEC Insects (ppm)	Acute RQ[2] Short Grass	Acute RQ[2] Insects
Soybean (0.375)	15	95	711	90	51	0.12	0.07
	35	66				0.08	0.05
	1000	15				0.02	0.01
Turf/lawn (warm-season grasses) (0.25) (3 applications)	15	95	711	180	101	0.24	0.17
	35	66				0.14	0.09
	1000	15				0.02	0.01
Turf/lawn (cool-season grasses and sedges) (0.125) (3 applications)	15	95	711	90	51	0.12	0.07
	35	66				0.08	0.05
	1000	15				0.02	0.01

[1] values for granivores are not tabulated; LOCs were not exceeded

[2] $RQ = \frac{\text{EEC (mg/kg)}}{LD_{50}\text{ (mg/kg)/ \% Body Weight Consumed}}$

17

Table 17: Mammalian (Hervivore and Insectivore)Acute RQ Values for Non-granular Products Based on Mean EEC Values and the Laboratory Mouse LD_{50} of 711 mg/kg[1]

Appl. Rate (lb ai/A)	Mammal Body Weight (g)	% Body Weight Consumed	Lab. Mouse LD_{50} (mg/kg)	Mean EEC Short Grass (ppm)	Mean EEC Insects (ppm)	Acute RQ[2] Short Grass	Acute RQ[2] Insects
Soybean (0.375)	15	95	711	32	17	0.04	0.02
	35	66				0.03	0.02
	1000	15				0.01	<0.01
Turf/lawn (warm-season grasses) (0.25) (3 applications)	15	95	711	64	34	0.09	0.04
	35	66				0.06	0.03
	1000	15				0.01	0.01
Turf/lawn (cool-season grasses and sedges) (0.125) (3 applications)	15	95	711	32	17	0.04	0.02
	35	66				0.03	0.02
	1000	15				0.01	<0.01

[1] values for granivores are not tabulated; LOCs were not exceeded

[2] $RQ = \frac{\text{EEC (mg/kg)}}{LD_{50}\text{ (mg/kg)/ \% Body Weight Consumed}}$

Table 18: Mammalian Chronic RQ Values for Non-granular Products Based on a Laboratory Rat NOEC of 600 ppm

Appl. Rate (lb ai/A)	Rat NOEC (ppm)	Max. EEC Short Grass (ppm)	Mean EEC Short Grass (ppm)	Chronic RQ Short Grass (Max. EEC)	Chronic RQ Short Grass (Mean EEC)
Soybean (0.375)	600	90	32	0.15	0.05
Turf/lawn (warm-season grasses) (0.25) (3 applications)	600	180	64	0.30	0.11
Turf/lawn (cool-season grasses and sedges) (0.125) (3 applications)	600	90	32	0.15	0.05

Based on maximum EECs, restricted use and endangered species acute LOCs are exceeded for turf/lawn (warm-season grasses). The endangered species LOC also is exceeded for soybeans and for turf/lawn (cool-season grasses and sedges). Based on mean EECs, acute LOCs are not exceeded. The chronic LOC is not exceeded for either maximum or mean EECs for any use pattern.

Exposure and Risk to Nontarget Aquatic Animals

Expected Aquatic Concentrations: EFED calculates EEC's using the GENeric Expected Environmental Concentration Program (GENEEC). The resultant generic GEEC's are used for assessing acute and chronic risks to aquatic organisms. Acute risk assessments are performed using either 0-day GEEC values (single application) or peak (GEEC) values (multiple applications). Chronic risk assessments are performed using the 21-day GEECs for invertebrates and 56-day GEECs for fish.

The GENEEC program uses a few basic environmental-fate values and pesticide label application information to provide an estimate of expected environmental concentrations. The model calculates the concentration of pesticide in a 1 hectare, 2 meter deep pond taking into account adsorption to soil or sediment, soil incorporation, degradation in soil before washoff to a water body, and degradation within the water body. The model also accounts for direct deposition of spray drift into the water body (assumed to be 1% and 5% of the application rate for ground and aerial applications, respectively). For turf, three applications at 7-day intervals was assumed.

The environmental-fate values used in the model for this pesticide were: soil K_{OC} = 26, solubility = 400 ppm, aerobic soil metabolism half-life = 555 days, hydrolysis = stable, and water photolysis half-life = 1 h.

GEECs based on runoff from a 10-hectare field to a 1- hectare x 2-meter deep water body are tabulated below.

Table 19: GEEC Values for Aquatic Exposure

Site	Application Method	Appl. Rate (lb ai/A)	No. Appl./ Intervals	Initial (PEAK) EEC (ppb)	21-day EEC (ppb)	56-day EEC (ppb)
Soybean	ground, incorporated 1-2"	0.375	1	19.1	6.6	2.6
	ground	0.375	1	19.1	6.6	2.6
Turf/lawn: warm-season grasses	ground	0.25	3*/7*	37.9	13.0	5.1
Turf/lawn: cool-season grasses and sedges	ground	0.125	3*/7*	19.0	6.5	2.6

* 3 applications at 7-day intervals assumed; no limitations specified on the product label

Freshwater Fish

Acute and chronic RQs for freshwater fish are tabulated below.

Table 20: RQ Values for Freshwater Fish Based on a Rainbow Trout LC_{50} of 93.8 ppm and an Early Life-Stage NOEC of 2.95 ppm

Site/Appl. Rate (lb ai/A)	LC_{50} (ppm)	NOEC (ppm)	EEC Initial (ppm)	EEC 56-Day Avg. (ppm)	Acute RQ (EEC/LC_{50})	Chronic RQ (EEC/NOEC)
Soybean (0.375)	93.8	2.95	0.019	0.003	<0.001	0.001
Turf/lawn: warm-season grasses (0.25) (3 applications)	93.8	2.95	0.038	0.005	<0.001	<0.002
Turf/lawn: cool-season grasses and sedges (0.125) (3 applications)	93.8	2.95	0.019	0.003	<0.001	<0.001

The results indicate that acute high risk, restricted use, and endangered species LOCs are not exceeded for freshwater fish for the proposed application rates on soybean and turf/lawn. The chronic risk LOC also is not exceeded for these uses.

Freshwater Invertebrates

The acute and chronic RQs for freshwater invertebrates are tabulated below.

Table 21: RQ Values for Freshwater Invertebrates Based on a *Daphnia magna* EC_{50} of 60.4 ppm and a Life-Cycle NOEC of 0.20 ppm

Site/Appl. Rate (lb ai/A)	LC_{50} (ppm)	NOEC (ppm)	EEC Initial (ppm)	EEC 21-Day Avg. (ppm)	Acute RQ (EEC/EC_{50})	Chronic RQ (EEC/NOEC)
Soybean (0.375)	60.4	0.20	0.019	0.007	<0.001	0.035
Turf/lawn: warm-season grasses (0.25) (3 applications)	60.4	0.20	0.038	0.013	<0.001	0.065
Turf/lawn: cool-season grasses and sedges (0.125) (3 applications)	60.4	0.20	0.019	0.007	<0.001	0.033

20

The results indicate that acute high risk, restricted use, and endangered species LOCs are not exceeded for freshwater invertebrates at the proposed application rates on soybean and turf/lawn. The chronic risk LOC also is not exceeded for these uses.

Estuarine and Marine Animals

The acute and chronic RQs for three estuarine and marine organisms are tabulated below.

Table 22: RQ Values for Estuarine/Marine Organisms

Site/Appl. Rate (lb ai/a)	Species	LC_{50} (ppm)	EEC Initial (ppm)	Acute RQ (EEC/LC_{50})
Soybean (0.375)	Oyster	no data	0.019	
	Mysid	1	0.019	0.019
	Silverside	114	0.019	<0.001
Turf/lawn: warm-season grasses (0.25) (3 applications)	Oyster	no data	0.038	
	Mysid	1	0.038	0.038
	Silverside	114	0.038	<0.001
Turf/lawn: cool-season grasses and sedges (0.125) (3 applications)	Oyster	no data	0.019	
	Mysid	1	0.019	0.019
	Silverside	114	0.019	<0.001

The results indicate that acute high risk, restricted use, and endangered species LOCs are not exceeded for estuarine fish at proposed application rates for soybean and turf/lawn. Risk to invertebrates cannot be adequately assessed until the required toxicity data for oysters are submitted.

Exposure and Risk to Nontarget Plants

Terrestrial and Semi-aquatic

Terrestrial and semi-aquatic plants may be exposed to pesticides from runoff, drift or volatilization. Runoff exposure for terrestrial plants is determined from a pesticide's water solubility and the amount of pesticide present on the soil surface of the application site. Runoff values are 0.01, 0.02, and 0.05 for water solubility of <10 ppm, 10-100 ppm, and >100 ppm, respectively. Runoff exposure for terrestrial plants is characterized as "sheet runoff" (1 acre treated onto an adjacent untreated 1 acre). Runoff exposure for semi-aquatic plants (plants that usually inhabit low-lying wet areas that may be dry at certain times of the

year) is determined using the same scenario, except this runoff exposure is characterized as "channelized runoff" (10 treated acres to a distant, low-lying untreated acre). Spray drift exposure from ground application is assumed to be 1% of the application rate. Formulae used for calculating EECs for the different scenarios are listed below.

EEC Formulae

Note: The calculations below are for a maximum application to soybean (0.375 lb ai/acre). Calculations for turf/lawn were made similarly, using maximum application rates of 0.25 lb ai/acre and 0.125 lb ai/acre for warm-season and cool-season grasses/sedges, respectively, but assuming cumulative runoff and drift from 3 applications for turf/lawn use.

Calculating EECs for terrestrial plants inhabiting areas adjacent to treatment sites

Unincorporated ground application:
Runoff = maximum application rate (lb ai/acre) x runoff value = 0.375 x 0.05 = 0.019 lb ai/acre
Drift = maximum application rate x 0.01 = 0.375 x 0.01 = 0.004 lb ai/acre
Total Loading = runoff (lb ai/acre) + drift (lb ai/acre) = 0.019 + 0.004 = 0.023 lb ai/acre

Incorporated ground application:
Runoff = [maximum application rate (lb ai/acre) ÷ minimum incorporation depth (in.)] x runoff value = 0.375/1 x 0.05 = 0.019 lb ai/acre
Drift = maximum application rate x 0.01 = 0.375 x 0.01 = 0.004 lb ai/acre
(Note: drift is not calculated if the product is incorporated at the time of application.)
Total Loading = runoff (lb ai/acre) + drift (lb ai/acre) = 0.019 + 0.004 = 0.023 lb ai/acre

Calculating EECs for semi-aquatic plants inhabiting wet, low-lying areas

Unincorporated ground application:
Runoff = maximum application rate (lb ai/acre) x runoff value x 10 acres = 0.375 x 0.05 x 10 = 0.188 lb ai/acre
Drift = maximum application rate x 0.01 = 0.375 x 0.01 = 0.004 lb ai/acre
Total Loading = runoff (lb ai/acre) + drift (lb ai/acre) = 0.188 + 0.004 = 0.192 lb ai/acre

Incorporated ground application:
Runoff = [maximum application rate (lb ai/acre)/minimum incorporation depth (in.)] x runoff value x 10 acres
Drift = maximum application rate x 0.01
(Note: drift is not calculated if the product is incorporated at the time of application.)
Total Loading = runoff (lb ai/acre) + drift (lb ai/acre)

EECs for terrestrial and semi-aquatic plants are tabulated below.

Table 23: EEC Values for Terrestrial and Semi-Aquatic Plants

Site/ Appl. Rate (lb ai/A)	Minimum Incorporation Depth (in)	Runoff Value	Sheet Runoff (lb ai/A)	Channelized Runoff (lb ai/A)	Drift (lb ai/A)	Total Loading to Adjacent Area[1]	Total Loading to Semi-aquatic Area[2]
Soybean (0.375)	0	.05	0.019	0.188	0.004	0.023	0.192
	1	.05	0.019	0.188	0.004	0.023	0.192
Turf/lawn: warm-season grasses (0.25) (3 applications)	0	.05	0.039	0.375	0.009	0.048	0.384
Turf/lawn: cool-season grasses and sedges (0.125) (3 applications)	0	.05	0.019	0.188	0.0045	0.024	0.193

[1] sheet run-off + drift

[2] channelized run-off + drift

The EC_{25} value of the most sensitive species in the seedling emergence study is compared to runoff and drift exposure to determine the RQ (EEC/toxicity value). The EC_{25} value of the most sensitive species in the vegetative vigor study is compared to the drift exposure to determine the acute RQ. EECs and acute risk quotients for terrestrial and semi-aquatic plants are tabulated on the following page (Table 24). EEB does not have a procedure for assessing chronic risk to terrestrial and semi-aquatic plants comparable to chronic risk estimated for terrestrial and aquatic animals at this time.

The EC_{05} value of the most sensitive species in the seedling emergence study is compared to runoff and drift exposure to determine the endangered species RQ. The EC_{05} value of the most sensitive species in the vegetative vigor study is compared to the drift exposure to determine the endangered species RQ. EECs and endangered species acute RQs for terrestrial and semi-aquatic plants are tabulated on the following page (Table 25).

The tabulated results indicate that acute and endangered species risk LOCs are exceeded for terrestrial and semi-aquatic plants at the proposed maximum application rates for soybean and turf/lawn.

Table 24: Acute RQ Values for Terrestrial and Semi-Aquatic Plants Based on a Lettuce Emergence EC_{25} of 0.010 lb ai/acre and a Cucumber Vegetative Vigor EC_{25} of 0.00052 lb ai/acre

Site/Appl. Rate (lb ai/A)	Seedling Emergence EC_{25} (lb ai/A)	Vegetative Vigor EC_{25} (lb ai/A)	Drift (lb ai/A)	Total Loading to Adjacent Area[1]	Total Loading to Semi-aquatic Area[2]	Emergence RQ Terrestrial Plants	Emergence RQ Semi-Aquatic Plants	Veg. Vigor RQ Terr. and Semi-Aquatic Plants
Soybean (0.375)	0.010	0.00052	0.004	0.023	0.192	2.3	19.2	7.7
Turf/lawn: warm-season grasses (0.25)	0.010	0.00052	0.009	0.048	0.384	4.8	38.4	17.3
Turf/lawn: cool-season grasses and sedges (0.125)	0.010	0.00052	0.0045	0.024	0.192	2.4	19.2	8.7

[1] sheet runoff + drift

[2] channelized run-off + drift

Table 25: Endangered Species RQ Values for Terrestrial and Semi-Aquatic Plants Based on a Corn Emergence EC_{05} of 0.0019 lb ai/acre and a Cucumber Vegetative Vigor EC_{05} of 0.0001 lb ai/acre

Site/Appl. Rate (lb ai/A)	Seedling Emergence EC_{05} (lb ai/A)	Vegetative Vigor EC_{05} (lb ai/A)	Drift (lb ai/A)	Total Loading to Adjacent Area[1]	Total Loading to Semi-aquatic Area[2]	Emergence RQ Terrestrial Plants	Emergence RQ Semi-Aquatic Plants	Veg. Vigor RQ Terr. and Semi-Aquatic Plants
Soybean (0.375)	0.0019	0.0001	0.004	0.023	0.192	12.1	101.1	40.0
Turf/lawn: warm-season grasses (0.25)	0.0019	0.0001	0.009	0.048	0.384	25.3	202.1	90.0
Turf/lawn: cool-season grasses and sedges (0.125)	0.0019	0.0001	0.0045	0.024	0.192	12.1	101.1	45.0

[1] sheet run-off + drift

[2] channelized run-off + drift

Aquatic Plants

Exposure to nontarget aquatic plants may occur through runoff or spray drift from adjacent treated sites. An aquatic plant risk assessment is usually made for aquatic vascular plants using toxicity findings from duckweed (*Lemna gibba*). Non-vascular aquatic plant risk assessments are performed using toxicity findings from the most sensitive algae or diatom species. Runoff and drift exposure (Table 19) is determined from GENEEC. The RQ is determined by dividing the pesticide's initial concentration in water by the aquatic plant EC_{50} value.

Acute RQs for vascular and nonvascular aquatic plants are tabulated below.

Table 26: Acute RQ Values for Aquatic Plants based on a duckweed (*Lemna gibba*) EC_{50} of 28.8 ppb and a nonvascular plant (*Kirchneria subcapitata**) EC_{50} of 31 ppb

Site/Appl. Rate (lb ai/A)	Test Species	EC_{50} (ppb)	EEC (ppb)	RQ (EEC/ EC_{50})
Soybean (0.375)	duckweed	28.8	19.1	0.66
	algae	31	19.1	0.62
Turf/lawn: warm-season grasses (0.25) (3 applications)	duckweed	28.8	37.9	1.32
	algae	31	37.9	1.22
Turf/lawn: cool-season grasses and sedges (0.125) (3 applications)	duckweed	28.8	19.0	0.66
	algae	31	19.0	0.61

*formerly *Selenastrum capricornutum*

Endangered species RQs for vascular aquatic plants are tabulated below.

Table 27: Endangered Species RQ Values for Aquatic Plants based on a duckweed (*Lemna gibba*) NOEC of 18.9 ppb

Site/Appl. Rate (lb ai/A)	Test Species	NOEC (ppb)	EEC (ppb)	RQ (EEC/ NOEC)
Soybean (0.375)	duckweed	18.9	19.1	1.01
Turf/lawn: warm-season grasses (0.25) (3 applications)	duckweed	18.9	37.9	2.01
Turf/lawn: cool-season grasses and sedges (0.125) (3 applications)	duckweed	18.9	19.0	1.00

The results indicate that acute risk LOCs are slightly exceeded for the proposed use on turf/lawn warm-season grasses, assuming three applications at 7-day intervals, but are not exceeded for the proposed use on soybean or turf/lawn cool-season grasses and sedges. Endangered species risk LOCs are equaled or exceeded for vascular and nonvascular aquatic plants at proposed maximum application rates for soybean and turf/lawn.

Endangered Species

Based on calculated RQ values ranging from 12-202 for terrestrial and semi-aquatic plants (Table 25) and from 1-2 for aquatic plants (Table 27), the Agency presumes that endangered plants may be adversely affected by the proposed applications of sulfentrazone to soybeans and turf/lawn. Based on maximum EECs, risk also is exceeded for some small herbivorous and insectivorous mammals in soybeans and turf/lawn uses. FMC Corporation should address these concerns via the Endangered Species Task Force before the Agency determines whether formal consultation with the U.S. Fish and Wildlife Service is necessary or if use limitations should apply.

LABELING

Manufacturing-use Products:

"This pesticide is toxic to marine/estuarine invertebrates. Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans or other waters unless in accordance with the requirements of a National Pollutant Discharge Elimination System (NPDES) permit and the permitting authority has been notified in writing prior to discharge. Do not discharge effluent containing this product to sewer systems without previously notifying the local sewage treatment plant authority. For guidance contact your State Water

Board or Regional Office of the EPA."

End-use Products (agricultural use and non-residential turf):

"This pesticide is toxic to marine/estuarine invertebrates. Do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark. Drift and runoff may be hazardous to terrestrial and aquatic plants in neighboring areas. Do not contaminate water when disposing of equipment washwaters or rinsate."

End-use Products (residential turf):

"This pesticide is toxic to marine/estuarine invertebrates. Do not apply directly to water. Do not contaminate water when disposing of equipment washwaters or rinsate."

CONCLUSIONS

The proposed uses of sulfentrazone on soybeans and turf/lawn at maximum application rates of 0.125-0.375 lb ai/acre are presumed to pose acute risk to terrestrial, semi-aquatic, and aquatic plants. Acute high risk is not presumed for mammals, but restricted use and endangered species LOCs have been exceeded for soybeans and turf/lawn uses when exposure is based on maximum EEC values. Chronic risk, but not acute risk, is presumed for birds. No acute or chronic risks are presumed for freshwater fish, freshwater invertebrates, or marine/estuarine fish. A risk assessment for marine/estuarine invertebrates cannot be completed until outstanding toxicity data for the oyster and mysid are submitted and reviewed.

Concerns for endangered plant species and small mammals should be addressed via the Endangered Species Task Force. FMC Corporation is a member of this Task Force.

Avian reproduction studies with the bobwhite quail and mallard should be addressed. The studies submitted support the proposed use of sulfentrazone on soybean. However, the studies do not support the proposed use on turf/lawn, because product labeling allows an unlimited number of applications. To support the turf/lawn use, the studies should be repeated using higher test concentrations. Alternatively, the currently proposed uses can be supported by these studies if the turf/lawn label specifies that no more than two applications can be made annually at the proposed application rate.

The "Environmental Hazards" labeling should be revised as specified above under "LABELING".

References

Fletcher, J.S., J.E. Nellessen, and T.G. Pfleeger. 1994. Literature review and evaluation of the EPA food-chain (Kenaga) nomogram, an instrument for estimating pesticide residues on plants. Environ. Toxicol. Chem. 13:1383-1391.

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ATTACHMENT: GENEEC VALUES

Soybean (incorporated):

INPUT VALUES

RATE (#/AC) ONE(MULT)	APPLICATIONS NO.-INTERVAL	SOIL KOC	SOLUBILITY (PPM)	% SPRAY DRIFT	INCORP DEPTH(IN)
.375(.375)	1 1	26.0	400.0	1.0	1.0

FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)

METABOLIC (FIELD)	DAYS UNTIL RAIN/RUNOFF	HYDROLYSIS (POND)	PHOTOLYSIS (POND-EFF)	METABOLIC (POND)	COMBINED (POND)
534.00	2	N/A	.04- 4.91	.00	4.91

GENERIC EECs (IN PPB)

PEAK GEEC	AVERAGE 4 DAY GEEC	AVERAGE 21 DAY GEEC	AVERAGE 56 DAY GEEC
19.11	15.66	6.55	2.59

Soybean (t incorporated):

INPUT VALUES

RATE (#/AC) ONE(MULT)	APPLICATIONS NO.-INTERVAL	SOIL KOC	SOLUBILITY (PPM)	% SPRAY DRIFT	INCORP DEPTH(IN)
.375(.375)	1 1	26.0	400.0	1.0	.0

FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)

METABOLIC (FIELD)	DAYS UNTIL RAIN/RUNOFF	HYDROLYSIS (POND)	PHOTOLYSIS (POND-EFF)	METABOLIC (POND)	COMBINED (POND)
534.00	2	N/A	.04- 4.91	.00	4.91

GENERIC EECs (IN PPB)

PEAK GEEC	AVERAGE 4 DAY GEEC	AVERAGE 21 DAY GEEC	AVERAGE 56 DAY GEEC
19.11	15.66	6.55	2.59

Turf/lawn (warm-season grasses):

INPUT VALUES

RATE (#/AC) ONE(MULT)	APPLICATIONS NO.-INTERVAL	SOIL KOC	SOLUBILITY (PPM)	% SPRAY DRIFT	INCORP DEPTH(IN)
.250(.743)	3 7	26.0	400.0	1.0	.0

FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)

METABOLIC (FIELD)	DAYS UNTIL RAIN/RUNOFF	HYDROLYSIS (POND)	PHOTOLYSIS (POND-EFF)	METABOLIC (POND)	COMBINED (POND)
555.00	0	N/A	.04	4.91	.00	4.91

GENERIC EECs (IN PPB)

PEAK GEEC	AVERAGE 4 DAY GEEC	AVERAGE 21 DAY GEEC	AVERAGE 56 DAY GEEC
37.89	31.05	12.99	5.13

Turf/lawn (cool-season grasses and sedges):

INPUT VALUES

RATE (#/AC) ONE(MULT)	APPLICATIONS NO.-INTERVAL	SOIL KOC	SOLUBILITY (PPM)	% SPRAY DRIFT	INCORP DEPTH(IN)
.125(.372)	3 7	26.0	400.0	1.0	.0

FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)

METABOLIC (FIELD)	DAYS UNTIL RAIN/RUNOFF	HYDROLYSIS (POND)	PHOTOLYSIS (POND-EFF)	METABOLIC (POND)	COMBINED (POND)
555.00	0	N/A	.04	4.91	.00	4.91

GENERIC EECs (IN PPB)

PEAK GEEC	AVERAGE 4 DAY GEEC	AVERAGE 21 DAY GEEC	AVERAGE 56 DAY GEEC
18.95	15.52	6.49	2.57

Date: 3/04/96
Case No: 044863
Chemical No: 129081

NEW CHEMICAL REVIEW
DATA REQUIREMENTS FOR SULFENTRAZONE
ECOLOGICAL EFFECTS BRANCH

Data Requirements	Composition[1]	Use Pattern[2]	Does EPA Have Data To Satisfy This Requirement? (Yes, No)	Bibliographical Citation	Must Additional Data Be Submitted Under FIFRA3(c)(2)(B)?
6 Basic Studies in Bold					
71-1(a) Acute Avian Oral, Quail/Duck	TGAI	ACK	Yes	419116-17	No
71-1(b) Acute Avian Oral, Quail/Duck					
71-2(a) Acute Avian Diet, Quail	TGAI	ACK	Yes	419116-18	No
71-2(b) Acute Avian Diet, Duck	TGAI	ACK	Yes	419116-19	No
71-3 Wild Mammal Toxicity					
71-4(a) Avian Reproduction, Quail	TGAI	ACK	Partially	433559-01	Yes[3]
71-4(b) Avian Reproduction, Duck	TGAI	ACK	Partially	433559-02	Yes[3]
71-5(a) Simulated Terrestrial Field Study					
71-5(b) Actual Terrestrial Field Study					
72-1(a) Acute Fish Toxicity Bluegill	TGAI	ACK	Yes	419116-21	No
72-1(b) Acute Fish Toxicity Bluegill					
72-1(c) Acute Fish Toxicity Rainbow Trout	TGAI	ACK	Yes	419116-20	No
72-1(d) Acute Fish Toxicity Rainbow Trout					
72-2(a) Acute Aquatic Invertebrate Toxicity	TGAI	ACK	Yes	419116-22	No
72-2(b) Acute Aquatic Invertebrate Toxicity					
72-3(a) Acute Estu/Mari Tox Fish	TGAI	A[CK][4]	Yes	435886-02	No
72-3(b) Acute Estu/Mari Tox Mollusk	TGAI	A[CK][4]	No		Yes
72-3(c) Acute Estu/Mari Tox Shrimp	TGAI	A[CK][4]	Yes	435886-03	No
72-3(d) Acute Estu/Mari Tox Fish					
72-3(e) Acute Estu/Mari Tox Mollusk					

Date: 3/04/96
Case No: 044863
Chemical No: 129081

NEW CHEMICAL REVIEW
DATA REQUIREMENTS FOR SULFENTRAZONE
ECOLOGICAL EFFECTS BRANCH

Data Requirements	Composition[1]	Use Pattern[2]	Does EPA Have Data To Satisfy This Requirement? (Yes, No)	Bibliographical Citation	Must Additional Data Be Submitted Under FIFRA3(c)(2)(B)?
72-3(f) Acute Estu/Mari Tox Shrimp					
72-4(a) Early Life-Stage Fish	TGAI	ACK	Yes	435886-04	No
72-4(b) Life-Cycle Aquatic Invertebrate	TGAI	A[CK][3]	Partial	435886-05	Yes
72-5 Life-Cycle Fish					
72-6 Aquatic Org. Accumulation					
72-7(a) Simulated Aquatic Field Study					
72-7(b) Actual Aquatic Field Study					
122-1(a) Seed Germ./Seedling Emerg.					
122-1(b) Vetative Vigor					
122-2 Aquatic Plant Growth					
123-1(a) Seed Germ./Seedling Emerg.	TGAI	ACK	Yes	433454-11	No
123-1(b) Vegetative Vigor	TGAI	ACK	Yes	433454-12	No
123-2 Aquatic Plant Growth	TGAI	ACK	Yes	433454-13, 436510-04,-05,-06,-07	No
141-1 Honey Bee Acute Contact					
141-2 Honey bee Residue on Foliage					

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

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

[3]These studies support the proposed use on soybean only; to support turf/lawn use, the studies must be repeated at higher test concentrations or the product label must limit the number of annual applications to no more than two

[4]Studies required because turf use (residential, golf corses) in coastal areas may result in runoff to the estuarine/marine environment, and because oyster toxicity data indicate that estuarine/marine oragnisms may be more sensitive to sulfentrazone than are freshwater organisms

[5]a mysid life-cycle test is required, based on the acute toxicity of sulfentrazone to mysids and because the freshwater invertebrate testing indicates the chronic-effect level is ≈300X more sensitive than the acute-effects level