CALIFORNIA DEPARTMENT OF PESTICIDE REGULATION
PUBLIC REPORT 2008-2

Active Ingredient: Sulfosulfuron
Tracking ID Number 207805, 207806

DESCRIPTION OF ACTION

Monsanto Company submitted applications for California registration of two products: Certainty Turf Herbicide, EPA Reg. No. 524-534, and Outrider Herbicide, EPA Reg. No. 524-500. Both products have identical formulations and contain the new pesticide active ingredient, sulfosulfuron. Certainty Turf Herbicide is intended for control of rough bluegrass in creeping bentgrass turf and Outrider Herbicide is intended for control of annual and perennial grasses and broadleaf weeds in non-crop areas. Both products may be used pre-emergent and post-emergent on non-food and non-feed sites. The U.S. Environmental Protection Agency (U.S. EPA) conditionally registered Certainty Turf Herbicide on December 11, 2001, and Outrider Herbicide on May 19, 1999.

The Department of Pesticide Regulation (DPR) evaluated the product labels and scientific data for Certainty Turf Herbicide and Outrider Herbicide and found them acceptable to support conditional registration in California. Precautionary language, first aid statements, and other protective measures on the product label adequately mitigate potential health risks to users. DPR does not expect significant adverse environmental impacts to result from the registration of Certainty Turf Herbicide and Outrider Herbicide. The data adequately supports both Certainty Turf Herbicide and Outrider Herbicide as providing effective control of a wide range of annual and perennial weeds.

BACKGROUND

Registrant:	Monsanto Company
Common name:	Sulfosulfuron
Chemical name:	1-(4,6-dimethoxypyrimidin-2-yl)-3-(2-ethylsulfonylimidazo[1,2-a] pyridine-3-ylsulfonyl)urea
Brand name:	Certainty Turf Herbicide and Outrider Herbicide
Uses:	Herbicide. May not be used on food or feed crops
Pests controlled:	Control of a wide range of annual and perennial weeds
Type of registration:	Certainty Turf Herbicide – Full Registration Outrider Herbicide - Conditional Registration

Certainty Turf Herbicide and Outrider Herbicide are comprised of white, odorless, water-soluble granules containing 75% sulfosulfuron. Sulfosulfuron, first discovered in 1995, is a member of the class of chemicals known as sulfonylureas. The mode of action for this systemic herbicide may be described as one in which the root system and/or the leaf surface first absorb the chemical where it is then translocated throughout the plant. Once in the plant, sulfosulfuron acts by stopping cell division and subsequently plant growth. While efficacy testing has proven

sulfosulfuron effectively controls annual broad-leaved weeds and grass weeds, users should be aware that it may take several weeks to kill the target weed after application.

SCIENTIFIC REVIEW

A. Chemistry

Monsanto Company submitted product chemistry and environmental fate data. DPR's chemists evaluated the submitted studies and identified certain deficiencies. In their initial Evaluation Report, staff recommended against registration of both Certainty and Outrider until the registrant provided DPR with all required data. Monsanto subsequently submitted the necessary data. This resulted in a final Evaluation Report recommending that submitted data supported registration of both products. The results are summarized below.

Product Chemistry**:** Product chemistry results are summarized in Table 1.

Table 1. Physical and Chemical Properties of Certainty Turf Herbicide and Outrider Herbicide

Properties	Values
Physical state	Solid granule
Color	Off-white
Density (20 ^{o}C)	1.55 grams (g)/milliliter (ml)
Odor	None
pH (1% solution)	4.76
Boiling point	334°C
Melting point	181 - 184 °C
Solubility	Soluble in methylene chloride, acetone, ethyl acetate
Partition coefficient (K_{ow}) at 25°C	Less than 10 at pH 5, 7, and 9
Vapor pressure	$<1 \times 10^{-7}$ mm Hg at 25ºC
Storage stability/corrosion	Stabile and non-corrosive for 14 days at 54°C

Environmental Fate**:** The sulfosulfuron environmental fate data included results from the following studies: hydrolysis, aqueous photolysis, soil photolysis, aerobic soil metabolism, anaerobic aquatic metabolism, and four separate field dissipation studies conducted in Washington, North Dakota, Texas, and California. DPR found the studies to be satisfactory. Both the U.S. EPA and DPR have developed sets of criteria that help predict the potential of a chemical to reach ground water. Staff conducted a comparison of the physiochemical and environmental parameters characteristic of sulfosulfuron using these criteria. Staff concluded that sulfosulfuron may, under some circumstances, leach to ground water. The registration

package was subsequently routed to DPR's Environmental Monitoring Branch for their assessment of any potential environmental problems that may result from the proposed use of sulfosulfuron. Analysis of irrigation and weather data found that potential leaching events occurred in only two of four submitted terrestrial field dissipation studies. Computer modeling of sulfosulfuron movement in a typical turf application scenario and a bare soil scenario determined that the compound, when used as prescribed on the label, is not likely to contaminate ground water. The potential to contaminate ground water (leach) is summarized in Table 2.

Table 2. Comparison of U.S. EPA and Cal/EPA Ground Water Leaching Criteria with Environmental Fate Study Results for Sulfosulfuron

Parameter	**Potential to Leach Value** (U.S. EPA)	**Potential to Leach Value** (Cal EPA)	**Experimental Value**	**Criteria Exceeded**
Water solubility	> 30 ppm	> 3 ppm	1,627 ppm	YES
Soil adsorption coefficient (K_d)	< 5 ml/g	---	0.076 – 0.710 ml/g	YES
K_{oc}		<1,900 ml/g	5.3 – 89 ml/g	YES
Hydrolytic half-life	> 30 days	> 14 days	168	YES
Photolytic half-life	>7 days	---	1.4 days (water) 50.6 days (soil)	YES
Aerobic soil metabolic half-life	> 21 days	> 610 days	31 – 37 days	NO
Anaerobic soil metabolic half-life	> 21 days	> 9 days	147 days	YES

B. Toxicology

Monsanto Company submitted adequate toxicology studies to conduct complete toxicological evaluations of Outrider Herbicide and Certainty Turf Herbicide. DPR evaluated the submitted data to determine the potential for adverse health effects. The product label adequately identifies the potential acute toxicity hazards indicated by the data reviewed. The first aid statements and personal protective equipment (PPE) requirements are adequate for the indicated acute toxicity hazards. The acute toxicity parameters for sulfosulfuron are summarized in Table 3, on page 4.

Table 3. Summary of Acute Toxicity of Sulfosulfuron

Type of Study	Acute Toxicity Values*	Acute Toxicity Category
Acute oral toxicity	LD_{50} > 5000 mg/kg	IV
Acute dermal toxicity	LD_{50} > 5000 mg/kg	IV
Acute inhalation	LC_{50} >3 mg/L	IV
Primary eye irritation	N/A	III
Primary dermal irritation	N/A	IV Not a dermal irritant
Dermal sensitization	N/A	Not a dermal sensitizer
Signal word	N/A	CAUTION

*Acute Toxicity Values expressed as:
LD_{50} = Lethal dose that kills 50% of the test population
LC_{50} = Lethal environmental concentration that kills 50% of the test population
N/A = Not applicable

DPR found the submitted toxicology studies for sulfosulfuron sufficient to satisfy the data requirements of the Birth Defects Prevention Act (Food and Agricultural Code section 13121, et al.). Among the studies submitted were a combined chronic toxicity/oncogenicity study in rats and a mouse oncogenicity study both of which were acceptable but showed possible adverse effects. Based on those adverse effects, DPR placed sulfosulfuron into the "moderate" priority category for risk assessment.

DPR prioritizes pesticide active ingredients for risk assessment based on the nature and number of potential adverse health effects, the number of species affected, the "no observable effect" levels (NOELs), the potential for human exposure, proposed use patterns, and other similar factors. Based on these criteria, pesticides with the greatest potential for adverse health effects are designated as "high" priority. Those chemicals having a lesser potential for adverse health effects are designated as moderate or low priority. As part of the risk assessment process, staff will develop a risk characterization document that identifies the seriousness of the adverse effects, determines the expected levels of human exposure, assesses the resulting risk to human health, and, if necessary, explores possible mitigation measures. A summary of all sulfosulfuron toxicology data is available on DPR's website at:
http://www.cdpr.ca.gov/docs/risk/toxsums/pdfs/5136.pdf.

C. Health & Safety

DPR compared the results of the acute toxicity study evaluations with the medical management information on the Outrider and Certainty Herbicide labels. Staff determined that the product label bears all of the required statements and warnings regarding safety to handlers and other persons who may be exposed to the pesticide. The product label bears an adequate First Aid statement and the PPE requirements are adequate for the indicated acute toxicity hazards. The product label requires applicators or other handlers to wear long-sleeved shirt and long pants and shoes plus socks. Applicators or handlers are to follow the manufacturer's instructions for cleaning and maintaining PPE. If instructions are not provided with the PPE, they are to use detergent and hot water. PPE is to be kept and washed separately from other laundry.

Workers may not enter into treated areas during the restricted-entry interval (REI) of 12 hours. PPE required for early entry to treated areas that is permitted under the Worker Protection Standard and that involves contact with anything that has been treated, such as plants, soil, or water, is:

- Coveralls
- Shoes plus socks
- Chemical-resistant gloves, such as nitrile rubber, neoprene rubber or polyethylene

D. Fish & Wildlife

The registrant submitted fish and wildlife toxicity studies, including studies on rainbow trout, *Daphnia magna*, Eastern oyster, mysid shrimp, bluegill sunfish, Northern bobwhite quail, and mallard duck. The submitted data are adequate to characterize the toxicity to wildlife and aquatic animals from an environmental exposure**.** Table 4, on page 6, summarizes the results of these studies.

Table 4. Summary of Fish & Wildlife Toxicity Values*

Test Animal	Type of Study	Acute Toxicity Value**	Relative Acute Toxicity
Rainbow trout	Water exposure (96 hrs)	>95 mg/l LC_{50} 95 mg/l NOEC	Slightly toxic
Rainbow trout	Early life stage (87 day)	100 mg/l NOEC	Slightly toxic
Daphnia magna	Water exposure (48 hrs)	>96 mg/l EC_{50} 96 mg/l NOEC	Slightly toxic
Daphnia magna	Chronic toxicity (21 day)	>102 mg/l NOEC	Relatively non-toxic
Eastern oyster	Water exposure (96 hrs)	>116 mg/l EC_{50} 116 mg/l NOEC	Relatively non-toxic
Mysid shrimp	Water exposure (96 hrs)	>106 mg a.i./l LC_{50} 106 mg a.i./l (NOEC)	Relatively non-toxic
Bluegill sunfish	Water exposure (96 hrs)	>96 mg/l LC_{50} 96 mg/l NOEC	Relatively non-toxic
Northern bobwhite quail	Feeding (8 day)	>5,620 ppm LC_{50} 5,620 ppm NOEC	Relatively non-toxic
Northern bobwhite quail	Feeding (14 day)	>2025 mg/kg LD_{50} 810 mg/kg NOEC	Relatively non-toxic
Northern bobwhite quail	Reproduction (8 weeks)	1,250 ppm NOEC	N/A
Mallard duck	Feeding (14 day)	>2,250 mg/kg LD_{50} 2025 mg/kg NOEC	Practically non-toxic
Mallard duck	Feeding (8 day)	>5,620 ppm LC_{50} 3,160 ppm NOEC	Relatively non-toxic
Mallard duck	Reproduction (8 weeks)	1,250 ppm NOEC	N/A

* The test substance used for the studies was the technical active ingredient.
** Acute Toxicity Values expressed as:
LD_{50} = Lethal dose that kills 50% of the test population
LC_{50} = Lethal environmental concentration that kills 50% of the test population
EC_{50} = Concentration of a toxicant causing a defined non-lethal effect in 50% of the test population
NOEC = No observed effect concentration
LOEC= Lowest observed effect concentration

Data indicate that sulfosulfuron is slightly toxic to rainbow trout and *Daphnia magna*, relatively non-toxic to Eastern oysters, mysid shrimp, bluegill sunfish, Northern bobwhite quail, and mallard ducks. To mitigate hazards to aquatic organisms both the Certainty Turf Herbicide label and the Outrider Herbicide label contain the following environmental hazards statement:

> "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 cleaning equipment or disposing of equipment wash waters or rinsate."

When used as directed, DPR does not expect sulfosulfuron to be released into soil or waterways.

E. Efficacy

Submitted efficacy studies demonstrated that Outrider herbicide provides adequate control of the weeds listed on the label. Submitted efficacy studies also demonstrated that Certainty herbicide provides adequate control of the weeds listed on the label with the exception of ladysthumb, ragweed and sand vetch. Both herbicides are absorbed by the roots and the foliage of target plants and can be applied pre-emergent and post-emergent. Susceptible weed growth stops within 24 hours of treatment even though visual symptoms are slow to develop. Susceptible weeds usually show yellowing or browning within 2-3 weeks. Warm, moist conditions following application will accelerate herbicidal activity. Cold, dry conditions will delay herbicidal activity. Weeds stressed by drought are less susceptible to this product.

The label lists precautions the applicator should take to prevent off-target drift from applications and the environmental conditions that enhance the potential for off-site movement. Aerial applications are prohibited except under the supplemental label for forestry applications. Application through an irrigation system is prohibited. The label cautions the applicator to not allow the product to contact roots or foliage of desirable plants, or treat areas where roots of desirable plants may grow. Desirable plants may be damaged if planted into treated areas. The label bears precautionary language warning the applicator that the product is highly toxic to non-target crops.

Both labels recommend an application rate of 0.75 to 1.33 ounces per acre. Users may not exceed 1.33 ounces of product per acre per year. The label recommends that the higher rate of 1.33 ounces per acre be used for controlling large established weeds or when weed growth is heavy or dense. Hand-held spray guns, backpacks, or other similar sprayers may be used to apply this product. The label recommends that use of coarse sprays only and advises against spraying to the point of runoff.

ALTERNATIVES

Weeds are defined as plants that are out of place. A plant may be desirable in one situation and a weed in another. For example, creeping bentgrass plants can invade a Kentucky bluegrass lawn and cause unsightly patches. On a golf green, however, creeping bentgrass is highly desirable as

the predominant plant. Certainty Turf Herbicide is intended for control of rough bluegrass in creeping bentgrass turf. In this example, bluegrass will detract from the beauty of the turf due to the contrast in color and texture between the desired grass plants and the "weeds". In addition, bluegrass will compete with the desired bentgrass for available water and nutrients, usually resulting in thinning of the creeping bentgrass.

Outrider Herbicide is intended to control many annual and perennial broadleaf and grass weeds on non-crop sites. Non-crop areas include rights-of-way, airports, fallow areas, ditch banks, dry ditches, dry canals, fencerows, industrial sites, etc., and includes weeds that are a safety hazard, a nuisance, or are unsightly to the traveling public. They include those plants that impede the use and maintenance of the aforementioned areas, affect drainage, cause injury to workers, interrupt flow of electricity or communications, are declared a noxious weed under state laws, crowd out desired native plants, serve as fuel for fires, damage structures or injure livestock. Control methods must be part of a sound integrated weed management program that is sensitive to the environment and includes cultural (planting appropriate ground covers, use of mulch, rock, etc.), mechanical (mowing), and chemical (herbicides) weed control.

Currently, 129 herbicides are registered for use on various non-crop sites in California. These include herbicides that are selective versus non-selective, pre-emergent use versus post-emergent use, contact versus systemic (translocated through the plant), and persistent versus non-persistent. Some herbicides control only grasses, others control only broad-leaved weeds, and still others control both. Effective weed control can be accomplished by combining the characteristics of individual herbicides (assuming no incompatibility or label restrictions exist) with weed biology information.

CONCLUSION

DPR evaluated the product labels and scientific data submitted to support the registration of both Certainty Turf Herbicide and Outrider Herbicide. The label and data were found acceptable to support full registration of Certainty Turf Herbicide and conditional registration of Outrider Herbicide. The registrant must submit efficacy and phytotoxicity data, for review by DPR staff, before Outrider may be granted full registration.

The acute health risks to humans from exposure to sulfosulfuron are minimal due to its low mammalian toxicity. The precautionary and first aid statements on the product label, and the recommended protective measures, mitigate potential health risks to persons who may be exposed to these pesticides. If a risk assessment conducted by DPR determines that exposure to sulfosulfuron may result in unacceptable margins of exposure, further restrictions will be placed on the use of sulfosulfuron at that time.