United States
Environmental Protection
Agency

Office of Pesticides
and Toxic Substances
(H7501C)

540-FS-90-093

EPA

Pesticide Fact Sheet

Name of Chemical:	Primisulfuron-methyl
Reason for Issuance:	Registration
Date Issued:	June 12, 1990
Fact Sheet Number:	214

1. DESCRIPTION OF CHEMICAL

Generic Name: 3-[4,6-Bis-(difluoromethoxy)-pyrimidin-2-yl]-1-(2-methoxycarbonylphenylsulfonyl)urea
Common Name: CGA-136872 and primisulfuron-methyl
Trade Names: Beacon® Herbicide and Rifle® Herbicide
EPA Shaughnessy Code: 128973-5
Chemical Abstracts Service (CAS) Number: 86209-51-0
Year of Initial Registration: 1990
Pesticide Type: Herbicide
Chemical Family: Sulfonylurea
U.S. Producer: CIBA-GEIGY Corporation

2. USE PATTERNS AND FORMULATIONS

Application sites: Terrestrial food crops and terrestrial noncrop sites. Postemergence to actively growing weeds in corn; and in noncropland areas such as fence rows, airports, highway rights-of-way, industrial sites, lumber yards, petroleum tank farms, pipeline rights-of-way, plant sites, railroads, storage areas, and utility rights-of-way.

Types of formulations: The two end-use products (75.0% a.i) are identical in composition. They are water dispersible granules packaged in water soluble bags. The technical product which is a crystalline solid containing 95% a.i. is used in the manufacture of the two end-use products. The technical product is packaged in a metal container.

Amount and Method of Application: Maximum application of 0.56 oz. active ingredient per acre per season is claimed for postemergence weed control in the culture of corn. For low maintenance turfgrass sites along roadsides, airports, industrial sites, fence rows, etc. in common bermudagrass and buffalograss turf,

dosages of 0.4 to 2.5 ozs per acre may be applied. These same dosages are claimed for noncrop sites such as fence rows, highway rights-of-way, industrial sites, lumberyards, petroleum tank farms, pipeline rights-of-way, plant sites, railroads, storage areas, and utility rights-of-way. The dosage to be used depends on the target weed species to be controlled. Only ground application directions are given on the proposed labeling. Measures to avoid spray drift and washing onto nontarget areas are described on the labeling.

Carrier: Water

3. SCIENCE FINDINGS

Summary Science Statements:

Adequate toxicological, product and residue chemistry ecological effects environmental fate and ground water data have been submitted and reviewed to support the registration of primisulfuron-methyl for use as a postemergence herbicide in the culture of corn and perennial turf grasses. Registration as a postemergence, non-selective herbicide on noncropland such as fence rows, highway rights-of-ways, industrial sites, lumber yards, petroleum tank farms, pipe line right-of-ways, plant sites, railroads, storage areas, and utility rights-of-way is also supported. Primisulfuron-methyl is classified as a Toxicity Category III pesticide and is labeled with the signal word "CAUTION", based on acute dermal, acute inhalation and eye irritation studies. A 21-day dermal study in rabbits indicated a no observable effect level (NOEL) of greater than 1,000 mg/kg/day for systemic toxicity. Primisulfuron-methyl was non-mutagenic and in developmental toxicity studies it did not appear to be a potential teratogen. Based on results of a mouse oncogenic lifetime study it was classified as a Group D carcinogen - not classifiable as to human carcinogenicity. Ecological effects data characterize primisulfuron-methyl as practically nontoxic to birds on subacute dietary and acute oral bases. Toxicological data demonstrated that it is of low toxicity to mammals. Low levels of contamination of ground water is possible in vulnerable soils with high water tables. The chemical is essentially nontoxic to honey bees. It is stable to hydrolysis in neutral and mildly alkaline solutions (pH 7 and 9), and hydrolyzed slowly (half-life >30 days) in acidic (pH 5) solutions.

Chemical Characteristics:

Phyical State:	Crystalline Solid
Color:	Colorless to yellow
Odor:	Odorless
Melting Point:	ca. 200° C (Decomposition at melting point)
Density:	1.62 gm/cm^3 at 20° (typical)

Solubility*	Solvent	Based on gm/100 cm^3/20°C
	Water	1 ppm (pH 5)
		9 ppm (pH 6)
		70 ppm (pH 7)
		600 ppm (pH 8)
		4500 ppm (pH 9)
	N-Octanol	120 ppm
	Acetone	3.6%
	Cyclohexanone	2.7%
	Methyl Chloride	0.4%
	Methanol	0.35%
	Toluene	0.05%
	Isopropanol	0.04%
	Xylene	0.03%

Vapor Pressure: $\leq 1.5 \times 10^{-10}$ Torr. at 25°C

Dissociation Constant: pK_a value = 5.1 (Acid)

Octanol/Water Partition Coefficient: P = 0.059

pH: 5.56 at 25°C + or - 1°C (Saturated Solution)

Stability

The technical material decomposes on melting. Technical primisulfuron-methyl is stable at room temperatures. At 35°C it degraded less than 1.0 percent during 12 months of storage. At 54°C there was no degradation up to 3 months of storage. The formulated products Beacon® Herbicide and Rifle® Herbicide were stable up to 28 weeks at 50°C and after 7 weeks at 70°C there occurred 2.0% degradation.

Toxicology Characteristics:

Acute Toxicity (Technical, 94% ai)

Acute oral toxicity (rat): LD_{50} > 5050 mg/kg, Toxicity Category IV.

Acute dermal toxicity (rabbit): LD_{50} > 2,010 mg/kg, Toxicity Category III.

Primary dermal irritation (rabbit): No edema, no erythema in male rabbits, Erythema in one female rabbit cleared within 72 hours, Toxicity Category IV.

Primary eye irritation (rabbit): No corneal opacity, conjunctivitis clearing within 3 days, Toxicity Category III.

Acute inhalation toxicity (rat): No deaths, LC_{50} > 4.81 mg/L for 4 hours, Category III.

Dermal sensitization (guinea pig): Negative for skin sensitization in male guinea pigs (not tested in females), not a skin sensitizer.

Acute Toxicity (Beacon® Herbicide, 75% ai)

Acute dermal toxicity (rabbit): No deaths, $LD_{50}50$ >2010 mg/kg, Category III.

Acute inhalation toxicity (rat): No deaths, $LC_{50}50$ >3.28 mg/L for 4 hours, Category III.

Primary eye irritation (rabbit): No corneal opacity, conjunctivitis calearing in day 4, Category III.

Primary dermal irritation (rabbit): No edema, slight erythema in one male and one female clearing by 24 hours, Category IV.

Dermal sensitization (guinea pig): Negative for skin sensitization in male guinea pigs, females not tested, not a skin sensitizer.

Subchronic Toxicity

A 21-day dermal study in rabbits was conducted using levels of 0, 10, 100 and 1,000 mg/kg/day. No effect was observed on any parameter examined, NOEL was > 1,000 mg/kg/day.

A 13-week dog feeding study at 0, 25, 1,000 and 10,000 ppm was conducted. Effects were increased platelet values in females and thickened gall bladder mucosa in one female dog macroscopicaly. One male and three female dogs had mild epithelial hyperplasia of the gall bladder. The NOEL was 25 ppm and the LEL was 1,000 ppm.

A 13-week rat feeding study at 0, 10, 300, 3,000, 10,000, 20,000 ppm was conducted. The effects were decreased body weight in males, decreased food consumption in males, decreased absolute and relative spleen weight in males. The NOEL was 300 ppm and the LEL was 3,000 ppm.

A 1-year dog feeding study was conducted at 0, 25, 1,000 and 10,000/5,000 ppm (changed after week 10). Results were decreased body weight gain at 10,000 ppm (weeks 1 to 10); anemia at 10/5,000 ppm; liver weight increases (absolute and relative) and vacuolar changes at 10/5,000 ppm; thyroid hyperplasia at 10/5,000 ppm; systemic NOEL was 1,000 (25 mg/kg/day) and the systemic LEL was 5,000 ppm (125 mg/kg/day). The effects were anemia, increase in platelets, lower chloesterol values, pale livers, moderate to trace vacuolar changes and thyroid hyperplasia.

Reproduction

A 2-generation reproduction study in rats was conducted at doses of 0, 10, 1,000 and 5,000 ppm. An effect noted at 5,000 ppm was decrease in testicular/spermatic function and decreased body weight gains in males. There was also a decrease in pup weights. The systemic parental NOEL was 1000 ppm and the LEL was 5,000 ppm based on decreased body weight gain. The reproductive NOEL was 1,000 ppm and the LEL was 5,000 ppm based on paternal decrease in testicular/spermatic function and a decrease in pup body weight.

Mutagenicity

The following mutagenicity studies indicated that primisulfuron-methyl is not mutagenic at doses tested:

- Ames Assays for mutagenicity with and without metabolic activation in Salmonella TA98, TA100, TA1535, and TA1537 up to 1024 ug/plate.

- Chromosome Aberration (micronucleus) in Chinese hamster up to 5,000 mg/kg. There was no evidence of toxicity.

- Unscheduled DNA synthesis (UDS) Assay with rat liver cells (hepatocytes) up to 400 ug/ml.

- UDS Assay with human fibroblasts up to 1,000 ug/ml without activation (without S-9).

Teratology

In a rabbit teratology study at doses of 0, 10, 300, 600 mg/kg/day by gavage there was no evidence of development effects. The effect observed in this study was abortion, decreased body weight, stool alterations. The maternal NOEL was 10 mg/kg/day and the LEL was 300 mg/kg/day.

In a rat study at doses of 0, 100, 500, and 1000 mg/kg/day by gavage there was delayed skeletal development and incomplete or lack of ossification of several bones. The developmental NOEL was 100 mg/kg/day and the LEL was 500 mg/kg/day.

In a second rat study at doses of 0, 10, 50 and 100 mg/kg/day there was possible increase in number of litters (not fetuses) having incomplete ossification of the os pubis at 100 mg/kg/day. Maternal NOEL was > 100 mg/kg/day at the highest dose tested (HDT).

These three studies indicate that primisulfuron-methyl is not a teratogen.

Oncogenicity

A 104-week rat feeding oncogenic study was conducted at doses of 0, 10, 300, 3,000 and 10,000/8,000 ppm. The systemic NOEL was 300 ppm (15 mg/kg/day) and the systemic LEL was 3,000 ppm (150 mg/kg/day) based on decreased weight gain in males. At 10,000/8,000 ppm testes of males were soft and atrophied; at 10,000/8,000 ppm food consumption in both males and female was decreased. The study was evaluated as showing a negative oncogenicity potential in rats.

An 80-week mouse feeding oncogenic study was conducted at doses of 0, 300, 3,000 and 10,000 (reduced to 7,000 at week 23). The systemic NOEL was 300 ppm (40.0 mg/kg/day) for males and less than 10 ppm (1.4 mg/kg/day) for females. The systemic LEL was 3,000 ppm (408 mg/kg/day) for males and 10 ppm (1.7 mg/kg/day) for females. The effects were increased mortality, body weight gain decreases, hypoplasia of teeth, liver weight increases, chronic nephritis and testicular degeneration/epididymal aspermia. There was an apparent increase in hepatocellular adenomas and hepatocellular carcinomas in both males and females at 3,000 and 10,000/7,000 ppm. Tumors were statistically significantly higher than concurrent controls, but only at dose levels exceeding the maximum tolerated dose (MTD).

The Agency Peer Review Committee classified primisulfuron-methyl as a Group D carcinogen - not classifiable as to human carcinogenicity.

Physiological and Biochemical Behavioral Characteristics

Metabolism

A rat radiolabeled primisulfuron-methyl metabolism study showed that 88 to 102% of radioactive primisulfuron-methyl was excreted in feces and urine within 9 days. Most of the radioactivity was in the form of unchanged parent compound. There were 6 major metabolites in the feces and urine. Hydroxylation of the pyrimidinyl ring occurs at the 5-position, and is followed by either an N- or O- rearrangement of a difluoromethoxy group. There appears to be little cleavage of the sulfonylurea bridge with the 5-hydroxylate primisulfuron-methyl to form an oxidized and/or oxidized and rearranged modified pyrimidinyl moiety. Some cleavage of the sulfonylurea bridge of the parent is evident by the isolation of a sulfonylbenzoate intermediate and its cyclized counterpart, saccharin, and the isolation of the bis(difluoromethyl) pyrimidinyl moiety. Similar metabolism of primisulfuron-methyl was observed in the goat and the chicken.

Mechanism of Pesticidal Action

Primisulfuron-methyl is a photosynthesis inhibitor. It inhibits growth and development by inhibiting the function of chlorophyll. It inhibits growth and development of susceptable weeds. It is applied postemergence to corn and weed species. Its selectivity is not completely understood. Susceptable plants become chlorotic and then necrotic at their growing points. The herbicidal activity of primisulfuron-methyl is influenced by temperature, moisture as associated with optimum growth of weed species both before and after application, weed species, weed size at time of application, rate applied and general growing conditions. Some weeds not killed are often stunted and are less competative to corn. Primisulfuron-methyl may provide some herbicidal activity as a premergence herbicide. Certain corn hybrids may be sensitive to Primisulfuron-methyl and respond to application with temporary injury at labeled dosages. A list of corn hybrids having good tolerance to this herbicide is available from CIBA-GEIGY Corporation.

Environmental Characteristics:

Hydrolysis: Primisulfuron-methyl does not hydrolyze in neutral and mildly alkaline solutions (pH 7 and 9), it hydrolized slowly (half-life > 30 days) in acedic (pH 5) solutions.

Photodegradation: Primisulfuron-methyl does not photodegrate in either water or on soil.

Aerobic Soil Metabolism: In aerobic soil maintained under controlled laboratory conditions phenyl ring-labeled [^{14}C] primisulfuron-methyl degraded with a half-life of 63 days and pyrimidine ring-labeled [^{14}C] primisulfuron-methyl degraded with a half-life of 30 days.

Anaerobic Soil Metabolism: In anaerobic soil maintained under controled conditions, phenyl ring-labeled [^{14}C] primisulfuron-methyl degraded with a half-life of 89 days and pyrimidine ring-labeled [^{14}C] primisulfuron-methyl degraded with a half-life of 41 days.

Field Dissipation: Dissipation occurred more rapidly under fild conditions where primisulfuron-methyl dissipated with half-lives of 3 to 12 days (detection limits of 0.01 ppm), and total phenyl and pyrimidine

ring-labeled [^{14}C] primisulfuron-methyl residues dissipated with initial half-lives of 12 and 30 days respectively.

Leach, Adsorption/Desorption: [^{14}C] Primisulfuron-methyl and its degradates were very mobile in both laboratory and field leaching studies, however unlabeled primisulfuron-methyl was not detected (>0.01 ppm) below a depth of 9 inches in field studies. Detection limits is a limiting factor in conducting such studies.

Accumulation Studies: Primisulfuron-methyl accumulates up to 0.011 ppm in wheat, soybeans, sugar beets, corn, or lettuce that were planted 103-334 days after corn plants growing in the plots had been foliarly-treated with primisulfuron-methyl.

Potential to Contaminate Groundwater: The use of primisulfuron as a postemergence herbicide in the culture of corn, turf and in vegetation control in low maintenance turf sites may result in low levels of contamination in groundwater in highly vulnerable soils with high water tables. The present analytical methodology for primisulfuron-methyl and its degradates with detection limits of only 0.01 ppm is not sufficiently sensitive to detect residues resulting from the uses of this chemical as a postemergence herbicide, as registered.

Ecological Characteristics

Avian Studies: Primisulfuron-methyl is practically non-toxic to birds based on the following studies:

Single Dose Oral Studies:
Bobwhite quail with 94.0% ai, LC_{50} > 2150 mg/kg.
Mallard duck with 94.0% ai, LC_{50} > 2150 mg/kg.

Subacute Dietary Study:
Bobwhite quail with 94.0% ai, LC_{50} >5000 ppm.

Avian Reproduction:
Mallard duck with 95.9% ai, NOEL was 500 ppm., No reproductive impairment occurred at 500 ppm dietary test level.

Aquatic Organisms: The following data indicate that primisulfuron-methyl is no more than slightly toxic to to freshwater fish, aquatic invertebrates and estuarine shrimp:

Fish Acute Toxicity:
Bluegill sunfish, LC_{50} > 48 ppm (supplementary study).
Rainbow trout, LC_{50} > 13 ppm (supplementary study).

Effects on Freshwater Invertebrates:
Acute Toxicity Study:
Daphnia magna, LD_{50} > 100.0 ppm.
Chronic Study:
Daphnia magna, NOEL of 0.41 ppm.

Effects on esturine organisms:
Acute Toxicity Study:
Mysid shrimp, LC_{50} of 16 ppm.

Effects on honey bees:
Acute Contact Toxicity Study:
Apis mellifera, LC_{50} > 100 ug/bee, practically non-toxic.

Effects on Nontarget plants:
Aquatic species, EC_{50} is 0.27 to 24.0 ppb
Terrestrial species, EC_{25} for:
Seed germination was 3.7 to 473.0 gm/ha,
Seed emergence was 0.15 to 44.0 gm/ha,
Vegatative vigor was 0.14 to 33.4 gm/ha.

Endangered Species Hazards:

Based on available data the registered uses of primisulfuron-methyl is unlikely to pose a hazard to endangered aquatic and avian species. There may be some hazard to endangered plants.

Residue Chemistry

A tolerance regulation has been established for residues of primisulfuron-methyl associate with its use as a postemergence herbicide in the culture of corn. The regulation is found under Section 180.452 in the Code of Federal Regulations. The regulation establishes tolerances for residues of primisulfuron-methyl in or on corn (forage) at 0.10 ppm; corn (fodder) at 0.10 ppm;

corn (grain) at 0.02 ppm; corn (sweet) (kernels plus cobs with husks removed) at 0.10 ppm; milk at 0.02 ppm; meat, fat, meat byproducts of cattle, goats, hogs, horses, and sheep at 0.10 ppm; poultry fat, meat and meat by-products at 0.10 ppm; and eggs at 0.10 ppm.

4. Summary of Regulatory Position and Rationale

Available data provided adequate information to support the conditional registration of Beacon® Herbicide, Rifle® Herbicide, and CGA-136872 Technical, that were first registered on May 11, 1990 under Section 3 of the Federal Insecticide, Fungicide and Rodenticide Act as amended.

Use, formulation, manufacturing process or geographic restrictions: Crop rotation restrictions are specified on the Beacon® Herbicide label. Aerial applications of Beacon® and Rifle® Herbicides are not permitted. Beacon® and Rifle® Herbicides are water dispersible granules that are in pre-measured quantities in water-soluble packets.

5. Summary of Data Gaps

Environmental Fate and Groundwater Data:

a. Information on the relative mobilities of primisulfuron-methyl in soil (EPA Guideline Date 163-1) and its major phenyl and pyrimidine ring-labeled [^{14}C] degradates must be submitted within 12 months from the date of registration.

b. A new field dissipation study in soil (EPA Guideline Date 164-1) in which residues at the level of 10% of the applied rate are measured with the appropriately sensitive methodology. In lieu of a new study, the registrant may submit data that characterize the residues detected in the submitted soil dissipation study. This study must be submitted within 27 months form the date of registration.

c. A small-scale prospective ground-water monitoring study that addresses the mobility of the parent compound and its degradates must be submitted within 30 months from the date of registration.

Ecological Effects Data:

Aquatic organism testing with a warmwater freshwater fish and a coldwater freshwater fish (EPA Guidelines data 72-1) must be submitted 9 months from the date of registration.

6. Contact Person at EPA

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