Shaughnessy No.: 128501

Date Out of EAB: JAN 17 1986

To: R. Taylor
Product Manager 25
Registration Division (TS-767)

From: Samuel M. Creeger, Chief
Review Section #1
Exposure Assessment Branch
Hazard Evaluation Division (TS-769)

Attached, please find the EAB review of...

Reg./File #: 476-EEEL and -EEEA

Chemical Name: Sulfosate

Type Product: Herbicide

Product Name: SC-0224 Concentrate Nonselective Foliar Systemic Herbicide

Company Name: Stauffer Chemical Co.

Submission Purpose: New chemical, request registration of product for use on non-crop areas (terrestrial nonfood, domestic outdoor, and forestry)

Date Received: 11/19/85

Action Code(s): 120

Date Completed: JAN 17 1986

EAB #(s) : 6084 and 6085

days: 7

Deferrals to: ________ Ecological Effects Branch
________ Residue Chemistry Branch
________ Toxicology Branch

Monitoring study requested by EAB: ☐

Monitoring study voluntarily conducted by registrant: ☐

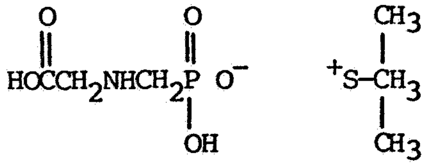
1. CHEMICAL:

Common name: sulfosate

Company codes: SC-0224; R-50224

Chemical name: trimethylsulfonium carboxymethylaminomethylphosphonate

Chemical structure:



$$\mathrm{HO\overset{\overset{O}{\|}}{C}CH_2NHCH_2\overset{\overset{O}{\|}}{\underset{\underset{OH}{|}}{P}}\,O^-\qquad {}^+\overset{\overset{CH_3}{|}}{\underset{\underset{CH_3}{|}}{S}}\!-\!CH_3}$$

Physical/Chemical properties for technical grade of the active ingredient, unless specified otherwise:

Physical state: liquid

Color: brown

Odor: faint, characteristic of sulfur-containing compounds

Boiling point: 110°C at 760 Torr

Density: 1.27 g/cc

Vapor Pressure [redacted]

8.2 torr at 10°C
14.6 torr at 20°C
24.9 torr at 30°C
41.3 torr at 40°C

Vapor Pressure of the active ingredient: $\leq 4 \times 10^{-7}$ torr at 25°C

pH: 3.5-5.0 (1 g in 20 ml water)

Viscosity: 38.2 centistokes at 25°C

Molar Water Solubility [pure active ingredient] (obtained from a previous submission see review of 3/1/84): 17.6×10^6 g

Kow [pure active ingredient] (obtained from a previous submission - see review of 3/1/84): <<10 [no sulfosate (<0.1 ppm) in the octanol phase]

INERT INGREDIENT INFORMATION IS NOT INCLUDED

2. TEST MATERIAL:

Hydrolysis study: unlabeled sulfosate (R-50224); no additional information provided.

Aqueous photolysis study: unlabeled sulfosate (SC-0224; WRC 8108-1; PMG [cation]-38.5% a.i.; TMS [anion]-20.2% a.i.)

Soil mobility study: ^{14}C-trimethylsulfonium glycine-N-methylphosphonate (20 mCi/mM; 94.4% pure)

trimethylsulfonium glycine-N-[^{14}C]methylphosphonate (30 mCi/mM; 96% pure)

Environmental run-off and soil dissipation study: a 4 lb/gal LC formulation

3. STUDY/ACTION TYPE:

Stauffer Chemical Co. is seeking conditional registration of SC-0224 concentrate (52.2% a.i.) for weed control in non-crop areas (terrestrial non-food, domestic outdoor, and forestry [forest planting] uses).

4. STUDY IDENTIFICATION:

Hydrolysis: Katague, D.B. (Stauffer Chemical Co.) December 17, 1983. Hydrolysis of R-50224. (Unpublished study; Accession No. 250547)

Aqueous Photolysis: Katague, D.B. (Stauffer Chemical Co.) April 18, 1983. Photolysis of SC-0224 in water. (Unpublished study; Accession No. 250548)

Soil Mobility: Spillner, C.J. (Stauffer Chemical Co.) Soil mobility studies. (Unpublished study; Accession No. 250548)

Run-off and Field Dissipation: Chappel, W.E. (Department of Plant Pathology and Physiology, Virginia Polytechnic Institute and State University, Blacksburg, Virginia) SC-0224 environmental run-off study. (Unpublished study conducted for and submitted by Stauffer Chemical Co.; Accession No. 250548)

5. REVIEWED BY:

Debra Edwards, Ph.D.
Review Section 1/EAB/HED/OPP

Debra Edwards
JAN 17 1986

6. APPROVED BY:

Samuel M. Creeger, Chief
Supervisory Chemist
Review Section 1/EAB/HED/OPP

Saml M Creeger
JAN 17 1986

7. CONCLUSIONS:

Environmental fate data requirements to support terrestrial non-food, forestry, and domestic outdoor uses of sulfosate are summarized in the table below:

	Terrestrial Non-food	Domestic Outdoor	Forestry
Hydrolysis	R[a]	R	R
Aqueous Photolysis	R	–	R
Soil Photolysis	–	–	R
Aerobic Soil Metabolism	R	R	R
Anaerobic Aquatic Metabolism	–	–	R
Leaching and Adsorption/-Desorption	R	R	R
Field Dissipation	R	R	–
Dissipation for Forestry Use	–	–	R
Fish Accumulation	CR[b]	–	CR
Accumulation in Non-target Aquatic Organisms	–	–	CR

[a] Required.
[b] Conditionally Required.

The present status of each data requirement is summarized below:

Hydrolysis:

The submitted study was previously reviewed (8/18/83) in connection with an EUP request and found to be unacceptable. However, the hydrolysis data requirement was satified in a subsequent submission (see review of 3/1/84). Hydrolysis of sulfosate was determined to be essentially nonexistent at pH 5-9.

Aqueous photolysis:

The validity of the submitted study cannot be ascertained due to the absence of experimental details regarding the intensity and emission spectrum of the light source; the light transmissibility of the photoreactor; and temperature, pH and sterility conditions. However, the aqueous photolysis data requirement was satisfied in a previous submission (see review of 3/1/84). The N-(phosphonomethyl)glycine (PMG) anion had half-lives of 14.6, 77.9 and 41.6 days at pH 5, 7 and 9, respectively. Photoproducts were phosphoric acid and aminomethylphosphonic acid. The trimethylsulfonium (TMS) cation was stable at pH 5 and 7, but degraded with a half-life of 31.7 days at pH 9.

Soil mobility:

The submitted soil TLC study was previously reviewed (8/18/83) in connection with an EUP request and found to be acceptable. However, although the study indicates low mobility of the parent compound in soil, this reviewer concludes that it only partially satisfies the leaching and adsorption/desorption data requirements for purposes of registration because the mobility of residues obtained from soil aged aerobically with the parent was not tested. Thus, the mobility of degradates, such as aminomethylphosphonic acid (see below - field dissipation), could not be determined.

Field dissipation:

Although the submitted study, conducted at a single test site, indicates that sulfosate and the degradate, aminomethylphosphonic acid (AMPA), have low leaching potential, the following missing data and information preclude a determination as to it's validity: (i) details of the analytical methods; (ii) sample and sample extract storage conditions, and data indicating stability under such conditions; and (iii) an aerobic soil metabolism study to indicate whether or not AMPA is the sole degradate for which analysis is required (see below). Also, the field dissipation data requirement is not fulfilled because testing was conducted at one site only [Subdivision N requires that field dissipation studies be conducted in at least two different sites representative of where the pesticide is expected to be used. Since three different use patterns are planned, more than two sites will probably be needed.]

Soil photolysis:

No data submitted.

Aerobic soil metabolism:

Two previously-submitted soil metabolism studies were reviewed (3/1/84) and found unacceptable.

Anaerobic aquatic metabolism:

No data submitted.

Dissipation data for forestry use:

No data submitted.

Fish accumulation:

This data requirement has been waived for the active ingredient (see review of 3/1/84), based on sulfosate's high water solubility and low Kow. However, depending on the water solubilities, Kow values, and relative persistence of degradates determined in the required aerobic soil metabolism study, data may be required to determine the potential for accumulation of degradate residues in fish.

Aquatic non-target organism field accumulation:

This data requirement is waived, with the same qualifications regarding degradates as in the fish accumulation study waiver discussed above.

8. RECOMMENDATIONS:

The registrant must submit the following information:

a. An aged leaching study in which the test substance is aged prior to use or consists of the parent and all major degradates found in the required aerobic soil metabolism study. The aging period should be for about one half-life or 30 days, whichever is shorter.

b. Experimental details of the submitted field dissipation study (see section 10.4 E.) and additional field dissipation studies representing domestic outdoor use. Forest dissipation studies will be needed for the forest use. The registrant should discuss the protocol for these studies with the Agency before initiating any work.

c. A soil photolysis study.

d. An aerobic soil metabolism study.

e. An anaerobic aquatic metabolism study.

In addition, fish accumulation and aquatic non-target organism field accumulation data may be required for degradates found in the aerobic soil metabolism study, unless the registrant provides evidence that the degradate will not reach water, will not persist in water, or has a relatively low potential for accumulation in fish, indicated by Kow and water solubility. If a fish accumulation study is conducted but reveals no potential for accumulation of residues, the aquatic non-target organism field accumulation data requirement may be waived.

The registrant is encouraged to submit test protocol for our comments before initiating any studies.

9. BACKGROUND:

A. Introduction:

Stauffer Chemical Co. is submitting environmental fate data for the new herbicide, sulfosate, as part of a request for registration of a 52.2% concentrate formulation for weed control in noncrop areas (terrestrial nonfood, domestic outdoor, and forest planting sites).

B. Directions for use:

A 52.2% concentrate formulation of the herbicide, sulfosate, is to be applied postemergent at 0.44-4.1 lb ai/A to control actively growing weeds. Spray, wiper, and hand-directed spot applications are proposed. For spray applications, the product is to be mixed with surfactant (2:1) and applied in 10-30 gal. water/A or in 1-2 gal./A if applied by Controlled Droplet Application equipment. For wiper application, two parts product are to be mixed with one part surfactant and six parts water. For hand-directed spot application, two parts of a 1-3% solution of the product in water are to be mixed with one part surfactant.

10 DISCUSSION OF INDIVIDUAL TESTS OR STUDIES:

10.1 A. Study Identification: Hydrolysis.

Katague, D.B. (Stauffer Chemical Co.) December 17, 1983. Hydrolysis of R-50224. (Unpublished study; Accession No. 250547)

[This study has previously been reviewed (8/18/83) in connection with an EUP request.]

10.2 A. Study Identification: Aqueous photolysis.

Katague, D.B. (Stauffer Chemical Co.) April 18, 1983. Photolysis of SC-0224 in water. (Unpublished study; Accession No. 250548)

B. Test Materials and Methods:

An equilibrated, filtered (Whatman No. 1 filter paper) solution of 97 ppm ai sulfosate in deionized water (prepared from a solution of 58.7% ai: 38.5% anion and 20.2% cation; thus, a solution of 64 ppm anion and 33 ppm cation was prepared) was placed in a photoreactor "essentially the same as that described by Crosby et al. [J. Agric. Food Chem. 17:1041 (1969)] except that a water-cooled condenser and an XAD-2 resin trap were attached to the outlet of the reactor to prevent loss due to evaporation and to collect any volatile photoproduct(s) that might be formed during the study." The source of irradiation was a 40-watt GE F40BL black light fluorescent lamp. The author claimed, "The light intensity and spectral distribution of the fluorescent lamp have been shown to be a reasonable simulation of natural sunlight [Crosby, D.G. and M.Y. Li. Degradation of Herbicides. Kearney, P.C and Kaufman, D.D., Editors, Dekker, NY, 1968, p. 328]." Part of the filtered solution was maintained in a dark bottle at room temperature to serve as a control. Sample aliquots were taken at intervals from 0-28 days. Each aliquot was analyzed immediately for PMG and aminomethylphosphonic acid (AMPA) by HPLC using a spectrofluorometric detector following derivatization with 9-fluorenylmethyl chloroformate. Aliquots were also analyzed for TMS by GC-FPD-S following dealkylation to dimethylsulfide. Aliquots were also monitored for previously-formed dimethylsulfide at each sampling interval.

C. Reported Results:

The "raw data" for photolytic degradation of PMG and TMS are appended as Attachments 1 and 2, respectively. By 28 days, approximately 60% photolysis of PMG was observed (the apparent half-life was approximately 26 days). AMPA accounted for 53.6% of the photolyzed parent after 28 days, resulting in a 93.6% "closure." At other sampling intervals throughout the incubation period, closure percentages (PMG + AMPA) were 94.7-100. "No degradation of dark control was observed at the end of 28 days."

By 28 days after initiation of irradiation, TMS had undergone only 5-6% photolysis. No dimethylsulfide was observed before dealkylation (<0.10 ppm) nor was any found in the resin trap attached to the photoreactor. "No photodegradation of dark control was observed..."

D. Study Author's Conclusions:

The author plotted PMG concentration versus time in days and concluded that the photolysis reaction was zero order. A calculated zero-order photodegradation of PMG was completed (see Attachment 3) which corresponded closely to actual analyses; the regression coefficient was 0.9949. The only observed photoproduct was AMPA. "TMS cation had photodecomposed only about 6% at the end of 30 days irradiation."

E. Reviewer's Discussion and Interpretation of Results:

Although the aqueous photolysis study indicates that PMG will photodegrade ($t_{1/2}$ of approximately 26 days) to AMPA, and TMS will be relatively stable in aqueous solution exposed to a black light fluorescent lamp, the validity of the study cannot be ascertained due to the absence of the following information and data: (i) a comparison of the emission spectra of natural sunlight and the black light fluorescent lamp; (ii) a comparison of the intensity of the lamp to that of natural sunlight; (iii) details of the analytical methods and method validation data (accuracy, sensitivity, etc.); (iv) data regarding the transmissibility of the glass in the photoreactor; (v) the temperature at which the study was conducted; (vi) the pH of the test solution; and (vii) whether or not the glassware and test solution were sterilized.

The cited reference pertaining to the irradiation apparatus was not submitted (Crosby and Tang. 1969.). The reviewer checked the article by Crosby and Li in Degradation of Herbicides (1968) to confirm the registrant's assertion, "The light intensity and spectral distribution of the fluorescent lamp have been shown to be a reasonable simulation of natural sunlight." Although the reference does state, "Exposure of a series of standard pesticides in solution to sunlight and to an F40BL General Electric lamp . . . revealed an almost identical array of photodecomposition products from the two types irradiation . . .", no data were presented. Furthermore, R.G. Zepp (Experimental Approaches to Environmental Photochemistry, pp.19-41 in The Handbook of Environmental Chemistry, Vol.2/Part B. 1982. Springer Verlag; Berlin, Heidelberg.) states, "Results obtained with the blacklight lead to underestimates of the photolysis rates of xenobiotics that absorb sunlight most strongly in the 300 to 320 nm region or in the visible region." Although the submitted study is inadequately supported by experimental detail, no additional aqueous photolysis data are required because the data requirement was satisfied in a previous submission (see review of 3/1/84).

10.3 A. Study Identification: Soil Mobility.

Spillner, C.J. (Stauffer Chemical Co.) Soil mobility studies. (Unpublished study; Accession No. 250548)

[This study was previously reviewed and found acceptable (8/18/83) for purposes of an EUP. However, the reviewer is reevaluating the study for purposes of registration.]

B. Test Materials and Methods:

Water slurries of four soils (see Attachment 4 for soil characteristics), screened through a 500 micron sieve, were applied to 20 x 20 cm^2 glass plates, adjusted to achieve a 0.5 mm thick layer, and allowed to air-dry. Plates were spotted with aliquots of aqueous solutions (35-36 mg/20 ml) of ^{14}C-trimethyl sulfonium glycine-N-methyl phosphonate (20 mCi/mM; 94.4% pure) and trimethyl sulfonium glycine-N-[^{14}C]methylphosphonate (30 mCi/mM; 96% pure). "The amount of material applied was calculated to approximate a field concentration of 4 3/8 lb ai/A, assuming that the spot on the plate had a 1 cm diameter." After drying overnight, the plates were developed to 12 cm or for 6 hours in distilled water. One plate/soil was also spotted with $[^{14}C]$2,4-D as a standard. After development, the plates were allowed to air dry, wrapped in plastic film, covered with Kodak SB-5 x-ray film and stored in the freezer until the film was developed. Rf values were determined by dividing the distance from the top of the origin spot to the leading edge by the distance from the top of the origin spot to the water front. Percent distribution was determined by scraping 1 cm sections of soil from one plate/soil and combusting to determine total radioactivity. Compound purity on the TLC plates was determined by extracting the soils from one Keeton and one Sorrento plate and analyzing the extracts by TLC with known standards (^{14}C-TMS extraction solvent = 1 N NH_4Cl; ^{14}C-PMG extraction solvent = 1 N Na_2CO_3).

C. Reported Results:

Recovery of applied ^{14}C was 91 ± 5% from all soils. Extraction efficiencies from soils removed from plates were 87% for $[^{14}C]$PMG and 93% for $[^{14}C]$TMS. TLC analysis of extracts, compared with known standards, revealed that the extracted material was solely PMG and TMS, rather than breakdown products or impurities. Rf values are presented in Attachment 5. The Rf values were confirmed by the absence of ^{14}C-activity (<1%) above the leading edge. The Rf values for 2,4-D were "consistent with previously-published data [Helling and Turner. Science. 162:562 (1968)] in which 2,4-D exhibited Rf values of 0.5-1.0 and was classified in mobility class 4 . . . " Rf values for $[^{14}C]$-TMS were 0.0-0.09 (class 1; immobile) and for $[^{14}C]$PMG were 0.08-0.20 (class 2; low mobility).

The author used the following equation, derived by Hamaker (in Environmental Dynamics of Pesticides, R. Hague and V.H. Freed, Eds., Plenum Press, NY. 1975), to calculate adsorption constants:

$$K = \frac{p^{2/3}(1 - Rf)}{(Rf)(ds)(1 - p^{2/3})}$$

Rf = Rf of the pesticide on the soil thin layer plate
K = Freundlich adsorption coefficient
p = soil pore fraction
ds = density of the soil

Calculated K values are presented in Attachment 6.

D. Study Author's Conclusions:

"Neither the cation nor anion of SC-0224 was significantly mobile in any of the soils tested. These results indicate that vertical or lateral movement of SC-0224 in the soil will not be an environmental problem."

"There does not appear to be an individual soil property which strongly influences the mobility of either cation or anion of SC-0224."

" . . . these K values indicate that the cation and anion of SC-0224 will be strongly adsorbed to the soil and will not be mobile."

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E. Reviewer's Discussion and Interpretation of Results:

The submitted study indicates that the mobility of the parent compound in soils is very low. However, the study only partially satisfies the registration leaching and adsorption/desorption environmental fate data requirements for terrestrial nonfood and forestry uses because in no case was the test substance aged in soil under aerobic conditions prior to use. Thus, the mobility of soil degradates was not determined. Although aerobic soil metabolism data requirements have not been satisfied, the submitted environmental run-off and field dissipation study (see section 10.4) revealed the presence of significant residues of aminomethylphosphonic acid in soil following application of a 4 lb/gal LC. Thus, a new soil mobility study must be submitted in which the test substance is aged aerobically in soil prior to use or consists of the parent and all major degradates found in the required aerobic soil metabolism study.

10.4 A. Study Identification: Environmental run-off and soil dissipation.

Chappel, W.E. (Department of Plant Pathology and Physiology, Virginia Polytechnic Institute and State University, Blacksburg, Virginia) SC-0224 Environmental run-off study. (Unpublished study conducted for and submitted by Stauffer Chemical Co., Accession No. 250548)

B. Test Materials and Methods:

On 8/17/82 at 9:30 a.m., three 20 x 20 ft^2 weed-covered plots in Montgomery County, Virginia were sprayed with a 4 lb/gal LC formulation of sulfosate at 6 lb ai/A. Soil pH at the test site was 5.5-7.6 and organic matter content was 0.7-2.8%. Soil and air temperatures at the test site were 24.3 and 25.4°C, respectively. At approximately 5 p.m. on the day of application, the plots received 0.40 in. of rain. The author claimed that this was the only natural precipitation that occurred throughout the trial. On the morning of the day following treatment, water was sprinkled onto the plots for 2 hours at a rate of 0.85 in/hr. The slope of the land at the test site was 20%. Plots (three treated and three check) were separated by a 6 ft buffer strip. Prior to treatment, a trench (2 feet wide x 1 foot deep) was dug 10 feet below the edge of the plots and a bulkhead of soil covered with black polyethylene plastic was installed between the trenches immediatly below each plot. After the plots were treated, the trenches were lined with black polyethylene plastic, covered with 2 inches of soil and filled with water. Soil and water samples were taken prior to treatment, immediatly after treatment and after 1, 2, 7, 14, 30, and 60 days. Soil cores were separated into 1-3, 3-6, and 6-12 inch segments prior to analysis. All samples were extracted 14 days after the last samples were collected and analyzed 12 days after extraction for residues of PMG, TMS, and AMPA. [Sample and extract storage conditions, and details of the analytical methods, other than detection limits and recovery values, were not provided.]

C. Reported Results:

No residues (<0.05 ppm) of PMG, AMPA, or TMS were detected in water taken from the trench at any sampling interval. In the 3-6 and 6-12 inch soil samples, and in soil samples taken from the trench, no residues were found (<0.1 ppm PMG or AMPA and <0.05 ppm TMS), except that on the day of treat-

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ment, PMG was present at 0.396 ppm and AMPA at 0.12 ppm in the 3-6 inch portion of the soil core from one of the treated plots. In the 0-3 inch soil samples, no TMS was detected (<0.05 ppm) at any sampling interval. PMG and AMPA were found in most 0-3 inch soil samples at all sampling intervals (PMG = <0.1 ppm to 1.5 ppm; AMPA = <0.1 ppm to 1.4 ppm). A summary of the 0-3 inch residue data for PMG and AMPA from treated soils is presented below:

Time Interval (days)	Residues (ppm) Plot 2 PMG	 Plot 2 AMPA	 Plot 4 PMG	 Plot 4 AMPA	 Plot 6 PMG	 Plot 6 AMPA
0	0.64	0.51	-	-	-	-
1	0.489	<0.1	-	-	0.134	0.160
2	0.089	0.213	-	-	0.164	0.395
7	0.095	0.217	-	-	<0.1	<0.1
14	0.190	0.353	-	-	-	-
30	0.16 0.22[a]	0.67 1.31[a]	<0.1	<0.1 0.73[a]	<0.1 0.11[a]	<0.1 0.48[a]
60	<0.1 1.51[a]	<0.1 1.40[a]	<0.1	<0.1 0.12[a]	<0.1	0.21 0.25[a]

[a] Two samples analyzed.

D. Study Author's Conclusions:

"Although there is some variation in residue levels between replicate plots and between samples in the same plot taken at different time intervals, the data clearly show that SC-0224 does not leach below 3 inches into the soil, nor does it dissolve in surface water after the material is applied to the soil."

E. Reviewer's Discussion and Interpretation of Results:

The submitted field dissipation study indicates that PMG and its degradate, AMPA, have low leaching potential in soil while residues of TMS are relatively immobile. The results are basically in agreement with reported results for the soil TLC experiment (section 10.3) except no AMPA data were submitted with the TLC study. However, the submitted study cannot satisfy data requirements for field dissipation unless: (i) AMPA is found to be the only significant degradate of sulfosate in the required aerobic soil metabolism study; (ii) details of the analytical method(s) are submitted; and (iii) sample and extract storage conditions, accompanied by appropriate storage stability data validating the acceptability of such storage, are submitted.

Subdivision N of the Pesticide Assessment Guidelines requires that field dissipation studies be conducted in at least two different sites representative of the areas where the pesticide is expected to be used. The submitted study, conducted for a period of 2 months, may represent terrestrial nonfood uses of sulfosate, subject to the conditions specified above. However, field dissipation data requirements for domestic outdoor use requires that residue data be collected for 4 months or until patterns of formation and decline of the degradation products are established. Therefore, an additional field dissipation study must be submitted to represent domestic outdoor use.

In addition, forestry dissipation studies will be needed.

11. COMPLETION OF ONE-LINER:

No one-liner.

12. CBI APPENDIX:

No CBI appendix.

Sulfosate environmental fate/exposure assessment review

Page ______ is not included in this copy.

Pages 13 through 18 are not included in this copy.

The material not included contains the following type of information:

___ Identity of product inert ingredients

___ Identity of product impurities

___ Description of the product manufacturing process

___ Description of product quality control procedures

___ Identity of the source of product ingredients

___ Sales or other commercial/financial information

___ A draft product label

___ The product confidential statement of formula

___ Information about a pending registration action

X FIFRA registration data

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