11-18-88

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

WASHINGTON, DC 20460

OFFICE OF
PESTICIDES AND
TOXIC SUBSTANCES

NOV 18 1988

MEMORANDUM

SUBJECT: Atrazine (Herbicide)
Second Round Review
Environmental Fate and Ground-Water Branch
Science Chapter

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Attached are the Environmental Fate and Ground-Water Branch (EFGWB) Second Round Review (SRR) Science Chapter and the EFGWB Data Requirements for the herbicide ATRAZINE. The first Registration Standard for this pesticide was issued in 1983.

ATRAZINE is the common chemical name for 2-chloro-4-ethylamino-6-isopropylamino-s-triazine. It is a herbicide belonging to the triazine family of herbicides that is used to selectively control annual broad-leaf and grass weeds in corn, sorghum, and other crops (sugarcane, pineapples, and macadamia nuts). It is also used in forests and in Christmas tree plantations, turf (warm season only), fence rows, and rights-of-way. However, agricultural uses comprise the largest consumption of atrazine-containing products.

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Single active-ingredient formulations consist of 0.42-8% Granular, 0.46-8% Pelleted/Tableted, 12-90% Wettable Powder, 22.5-90.1% Dry Flowable, 2-6 lb/gal and 14.2-43% Emulsifiable Concentrate, 1-6.25 lb/gal and 16.3% Flowable Concentrate, and 2-4 lb/gal and 40-48% Soluble Concentrate/Liquid. Atrazine may also be formulated together with other herbicides, such as alachlor, cyanazine, metolachlor, and simazine. The application rates in food crop sites varies from 0.3 to 8 lb of active ingredient per acre. In nonfood sites, the application rates vary from 0.11 to 40 lb of active ingredient per acre. Ground equipment and/or aircraft can be used to apply atrazine. Applications include preplant, preemergence, and postemergence broadcast or band treatments.

A comparison of the data deficiencies identified in the 1983 Registration Standard with their current status is given below:

1983 Data Deficiencies	1988 Second Round Review
161-1 Hydrolysis	Fulfilled
161-3 Photodegradation on soil	Submitted study unacceptable; new study required
162-1 Aerobic soil metabolism	Submitted study provides supplemental information only; new study required
162-2 Anaerobic soil metabolism	Fulfilled
162-3 Anaerobic aquatic metabolism	Fulfilled
163-1 Mobility in soil	Fulfilled. Acceptable batch-equilibrium adsorption/desorption studies of atrazine and its four major degradate
164-1 Field dissipation-soil	Submitted studies unacceptable. No studies to support uses on turf. New studies (including turf studies) required
164-3 Field dissipation-forestry	Submitted study may fulfill data requirements if requested additional information is acceptable

164-5 Field dissipation-soil (conditional to results of 164-1)	Reserved depending on results of 164-1
165-1 Rotational crops (confined)	No acceptable studies to support any rotation interval, but no new studies required (see below)
165-2 Rotational crops (field) (conditioned to results of 165-1)	No new studies required (see below)
165-4 Accumulation in fish	Fulfilled
165-5 Accumulation in aquatic, nontarget organisms	Submitted study provides supplemental information. No new studies required because of the relatively low maximum bioconcentration factors found from the accumulation in fish studies.

RATIONALE FOR CHANGES IN DATA REQUIREMENTS

In the 1983 Registration Standard, the photodegradation in water data requirements were considered fulfilled. This study, however, does not conform to current Subdivision N Guidelines. Major deficiencies found with the study were lack of material balance data, incomplete characterization of artificial light source, questionable sterility of solutions, incomplete degradate characterization, etc. A new study has been requested.

The submitted terrestrial field dissipation studies were considered unacceptable because of several deficiencies found in them. New studies have been requested. Although atrazine has been registered for uses on turf (warm season only), no field dissipation studies on turf have been previously requested/submitted to support registration for uses on turf. Therefore, the EFGWB is requesting the registrant to submit studies on field dissipation on turf.

Two major problems were found with the submitted rotational crop studies. The first problem is that none of the studies were conducted at the maximum (or higher) application rate stated in the label for food crop uses (8 lb a.i./A) and, therefore, these studies (even if they had been acceptable studies) would not have

supported uses at application rates higher than 3 lb a.i./A. The second problem is that there are no reliable complete data to support any rotation interval. For example, in (unacceptable) small-plot studies in which the nominal application rate was 3 lb a.i./A, not fully characterized residues were still present at rotation intervals of one year or longer. Based on the rotational crop data reviewed, EFGWB concludes that residues are likely to occur in all crops rotated one year or more following application of atrazine at current use rates. As a consequence, appropriate rotational crop intervals for atrazine cannot be established. The registrant must petition the Dietary Exposure Branch (DEB/HED) for suitable tolerances for all crops to be rotated.

ENVIRONMENTAL FATE ASSESSMENT

Although some data gaps still exist to fully and accurately assess the environmental chemistry/fate of atrazine, the available data indicate the following characteristic behavior of atrazine:

a) Hydrolysis is not a major degradation mechanism for atrazine in the environmentally significant pH range 5 to 9. From an acceptable anaerobic aquatic metabolism study submitted to the Agency (MRID No. 40431323), it was found that under sterile, dark conditions in pH 8.2 water and sandy clay sediment, 80% of the applied atrazine remained unchanged in the water after a 12-month period. This fact again indicate the stability (persistence) of atrazine in aqueous media.

b) Although the reviewed aerobic soil metabolism studies (MRID No. 40629303) did not fulfill data requirements, there is indication that aerobic microorganisms contribute to the degradation of atrazine in soils. The major metabolites detected were 2-amino-4-chloro-6-isopropylamino-s-triazine (G-30033), 2-amino-4-chloro-6-ethylamino-s-triazine (G-28279), 2,4-diamino-6-chlorotriazine (G-28273), and 2-ethylamino-4-hydroxy-6-isopropylamino-s-triazine (G-34048, "hydroxy atrazine"). The half-life value reported by the registrant was 146 days.

c) An acceptable anaerobic aquatic metabolism study (MRID No. 404313223) showed a combined water/sandy clay sediment half-life of 608 days (330 days in sediment; 578 days in the aqueous phase), with G-30033, G-34048, and G-28279 detected as major degradates (4.7%, 5%, and 1.4%, respectively after a 12-month period). About 70% of the parent atrazine remained in the aqueous phase.

d) Acceptable batch-equilibrium adsorption/desorption studies conducted with atrazine and its four major degradates G-28273, G-28279, G-30033, and G-34048 (MRID Nos. 40431324, 40431327, 40431325, 4043128, and 4043126, respectively) in four different soils (sand, sandy loan, silt loam, and silty clay loam) have shown that the degradate G-34048 ("hydroxy atrazine") is less mobile than atrazine or its dealkylated degradates G-28273, G-28279, and G-30033. Sorption constants for atrazine and its four major degradates are summarized in Table I.

e) The photodegradation of atrazine is still unclear as both the photodegradation in water and on soil studies were considered unacceptable. As explained earlier, the photodegradation in water study (MRID No. 00024328), which was reviewed and accepted at the time of the 1983 Registration Standard, has been reevaluated and considered unacceptable under current Subdivision N Guidelines because of the numerous and important deficiencies noted in the study. Nevertheless, the reported results do indicate that the presence of sensitizers (acetone in this particular case) may increase the rate of photodegradation of atrazine.

f) There is relatively low tendency for accumulation in fish.

It should be pointed out that the dealkylated degradates G-28273 and G-28279 are also known to be degradates of SIMAZINE. The EFGWB Second Round Review for SIMAZINE is scheduled for completion on February 28, 1989.

In summary, the persistence of atrazine (in aqueous media as well as in soils) and the mobility of the parent pesticide and its degradates (more predominantly the dealkylated degradates) are concerns for potential ground-water contamination. A ground water contamination assessment on atrazine is presented in an attached MEMORANDUM prepared by Dr. Michael Barrett, Chemist, Ground-Water Section. However, the Ground-Water Section cannot make any detailed CONCLUSIONS and RECOMMENDATIONS at this time because it is awaiting additional data to be submitted to the Agency in response to the special data call-in sent to the registrant on November 2, 1988 (and due May 1989). Their CONCLUSIONS and RECOMMENDATIONS (as summarized from the MEMORANDUM) are as follows:

a. CONCLUSIONS

1. Atrazine is among the most commonly occurring pesticides in ground water.
2. Percentage of detections greatly increases in high-use areas with vulnerable hydrogeologic environments.

3. More importantly, the relatively high frequency of atrazine detections in ground water is related to is high volume of use. More pounds of atrazine active ingredient are applied in the United States annually than any other pesticide (with the possible exception of alachlor).

b. RECOMMENDATIONS

If the data submitted are insufficient to make recommendations concerning whether changes in use patterns, geographic restrictions, etc., are necessary, then the design for any additional retrospective ground-water monitoring studies required from the registrants will be tailored to satisfy remaining data gaps.

TABLE I
Sorption constants for ATRAZINE and its main degradates

Chemical species	Soil Type: sand K_{ads}	sand K_{des}	sandy loam K_{ads}	sandy loam K_{des}	silt loam K_{ads}	silt loam K_{des}	silty clay loam K_{ads}	silty clay loam K_{des}
Atrazine	0.427	5.948	0.990	14.90	1.455	2.261	2.030	3.629
G-28279	0.225	12.479	0.631	6.593	0.987	1.784	1.144	2.792
G-28273	0.108	5.750	0.209	6.620	0.714	4.340	0.800	1.172
G-34048	1.643	5.518	6.482	13.08	8.165	16.26	5.867	22.26
G-30033	0.116	7.900	0.231	10.51	0.798	12.87	0.963	8.104

K_{OC} Constants (oc= organic carbon content of the soil)

Chemical species	oc= 0.47% Ads	oc= 0.47% Des	oc= 1.8% Ads	oc= 1.8% Des	oc= 1.2% Ads	oc= 1.2% Des	oc= 1.5% Ads	oc= 1.5% Des
Atrazine	90.9	1266	55	828	121	188	135	242
G-28279	47.9	2655	35.1	366	82.3	149	76.3	186
G-28273	23.0	1220	11.6	368	59.5	362	53.3	78.1
G-34048	350	1174	360	727	680	1355	391	1486
G-30033	24.7	1681	12.8	584	66.5	1073	64.2	540

NOTE

NOV 15

FROM: Michael Barrett MRB
Chemist, Ground-Water Section, EFGWB

TO: Silvia Termes
Chemist, Environ. Chemistry Rev. Sect. 2

The following is our statement for the atrazine second round review regarding the leaching potential of this pesticide.

LEACHING ASSESSMENT FOR ATRAZINE

Conclusions:

Data from surveys of pesticides in drinking water wells indicate that atrazine is among the most commonly occurring pesticides in ground water. Although the overall percentage of detections is relatively small, the percentage greatly increases in high-use areas with vulnerable hydrogeologic environments. Environmental fate studies indicate that atrazine can be mobile in soils, especially those of coarse texture, and is moderately to highly persistent, depending on the environmental conditions. Nevertheless, perhaps an even more important factor in the relatively high frequency of atrazine detections in ground water is its high volume of use; more pounds active ingredient of atrazine are applied in the United States annually than any other pesticide, with the possible exception of alachlor. Detailed conclusions cannot be made at this time, however, because The Ground-Water Section is awaiting additional data that will be submitted to the Agency in response to the special data call-in sent to the registrants on November 2, 1988 as a part of the special review for atrazine. A response to this data call-in is due in May, 1989.

Recommendations:

Additional data requirements to provide answers to questions concerning the impact of agricultural use of atrazine on ground-water cannot be specified at this time because of the outstanding data call-in to the registrants for information on past and current ground-water monitoring efforts and atrazine sales and usage data on a county level for 1985, 1986, and 1987. The data received from the registrants and the data currently in the Environmental Fate and Ground-Water Branch's "Pesticides in Ground-Water Database" will first be analyzed to determine what regulatory actions concerning atrazine are needed. If the data submitted are insufficient to make recommendations concerning whether changes in use patterns, geographic restrictions, etc. are necessary, then the design for any additional retrospective ground-water monitoring studies required from the registrants will be tailored to satisfy the remaining data gaps.

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Discussion

1. Environmental chemistry.

The environmental chemistry data for atrazine does not readily point to a ground-water contamination potential as high as would be indicated by some of the ground-water monitoring data now available.

Adsorption of atrazine in most soils is not particularly strong, but is stronger than highly mobile compounds such as aldicarb, picloram, and 2,4-D. The overall mobility of pesticides in soils can be estimated using an index combining the soil organic carbon adsorption coefficient, vapor pressure, and solubility on a molar basis of the pesticide along with soil intrinsic characteristics such as bulk density, organic carbon content, field capacity, and air-filled porosity (Rao et al., 1985). Using such an index, atrazine ranked 16th of 41 pesticides in a loamy sand soil. The soil mobilities of aldicarb, 2,4-D, picloram, carbofuran, and DBCP, for example, are ranked ahead of atrazine using the index of Rao, et al. Pesticides ranked behind atrazine included alachlor, linuron, trifluralin, and parathion. The mobilities of the other triazine herbicides, simazine and cyanazine, were rated very close to that of atrazine.

Leaching potential of pesticides is, of course, also related to their persistence in soil. Under conditions optimum for microbial degradation, i.e. temperature close to 25 C and soil water content close to 75% of field capacity as required for registrant-submitted soil metabolism studies, atrazine is somewhat persistent, with halflives in the published literature usually in the range of 1 to 4 months (Barrett, 1988). Atrazine can, however, be extremely persistent under conditions in which microbial activity is reduced, as evidenced for example by its persistence (estimated half-lives around 300 days) in field studies in Minnesota (Termes, 1988). Although these studies were inadequate for fulfilling data requirements for the field dissipation studies, they do clearly demonstrate atrazine is very persistent under the conditions of the tests.

Under strictly anaerobic conditions, atrazine is also persistent, as demonstrated by an anaerobic aquatic metabolism study (MRID no. 40431323) in which the half-life in a flooded sandy clay maintained at 25 C was 608 days, and an anaerobic soil metabolism study (inadequate to meet data requirements, but providing supplemental information) in which the half-life was calculated to be 159 days (MRID no. ~~40629393~~*. Atrazine is also extremely persistent in sterile buffered solution.

These environmental chemical characteristics of atrazine, are not clearcut enough to predict whether widespread contamination of ground water will occur in all major atrazine use areas. How-

* Correct MRID No. 40629303. 11/16/88

ever, it is clear that atrazine can be both mobile and highly persistent under field conditions; this combination often leads to ground-water contamination by a chemical.

Ground-Water Monitoring

Atrazine has been found in ground water more frequently than almost any pesticide that has been looked for. Atrazine is also one of the two most widely used pesticides in the United States (EAB/BEAD unpublished estimates), alachlor being the other top pesticide in terms of pounds active ingredient applied annually.

In the Environmental Fate and Ground-Water Branch Pesticides in Ground Water Data Base (Holden et al., 1988) atrazine has been reported in ground water from 21 states, with 11 states having confirmed quality data representing occurrence as a result of known or suspected agricultural use. Over 15,000 wells have been sampled, of these water samples from 773 were reported to contain atrazine (ca. 5%). Confirmation of these detections is still ongoing. So far 237 detections have been verified to be confirmed by gas chromatography - mass spectrometry or other techniques. These detections are also supported by evidence obtained in the study that the residues resulted from registered field uses. Concentrations for these data which are believed to represent normal field use range up to 40 ppb.

In a recent compilation of ground-water monitoring data from state agencies (Parsons and Witt, 1988), atrazine was reported in 771 of 5569 wells sampled with 28 states reporting data and 17 states reporting one or more atrazine detections. The detection limits used for each study varied greatly or were not reported; so, it is difficult to determine the significance of the percent positives. Most, but not necessarily all, of these data are supported by evidence suggesting the atrazine source was associated with normal agricultural use. Of pesticides with widespread usage currently, atrazine was the most frequently detected (in samples from 14% of the wells). Alachlor, by contrast, which was usually looked for in the same wells (corn is a major use for both of these pesticides) was detected in ground-water samples of only 3% of the wells it was looked for. Positive percentages for other widely used pesticides such as butylate, trifluralin, malathion, carbaryl, metribuzin, glyphosate, and captan were all less than 3%.

Various surveys of drinking water wells completed recently or currently in progress are reporting atrazine as one of the pesticides most frequently detected. The following data were obtained from statistically-designed statewide surveys (data for alachlor, a herbicide widely used on corn and soybeans, are given for comparative purposes).

Atrazine was detected in 4 of 102 Kansas farmstead wells at

1.2 ppb or greater compared to 2 detections from the same number of wells for alachlor (Robbins, 1988).

In a Vermont survey of drinking water wells located within 500 feet of a field with a corn production use history, of 250 wells from which a total of 392 samples were analyzed there were eight wells for which one or more samples contained atrazine at ca. 1 ppb or higher levels (Plant Industry Section, Vermont Department of Agriculture, 1988). No samples were positive for alachlor, but samples from two wells were positive for metolachlor. Atrazine is estimated to be applied to 100% of the corn crop in Vermont (Gianessi, 1986). Combined pounds active ingredient of alachlor and metolachlor used were estimated in the Vermont study to be ca. 70 to 100% of the pounds of atrazine used, based on three years of reports from commercial applicators.

An extensive 5-year long survey of rural domestic drinking water wells is in progress in Nebraska (currently unpublished data were received from Candace A. Jacobs, Nebraska Department of Health, Lincoln.) In the first three years of the study, of 1341 wells sampled, atrazine was detected at 0.05 ppb or greater concentration in samples from 85 of the wells. Alachlor was detected in samples from only four of the wells, none of several other pesticides commonly used in Nebraska were detectable in any sample.

In a Iowa population-based survey of rural drinking water wells due to be completed in 1989, only a few percent of the wells sampled so far contain atrazine or atrazine metabolites at 0.1 ppb or greater, but atrazine is still so far the most frequently found pesticide (personal communication from Delon Mass, Institute of Agricultural Medicine, University of Iowa, Oakdale.).

A detailed survey of farmstead drinking water wells has been conducted in Floyd and Mitchell counties in northern Iowa, an area which includes karst geological features (Morgan, 1988). Of 184 wells sampled over four consecutive quarters, from 78 wells atrazine was detected in one or more samples at an average concentration of 1.16 ppb. Alachlor was detected in 8% of the samples collected using a 0.02 ppb lower detection limit compared to a 24% detection rate for atrazine with a 0.13 ppb limit (ca. 6x higher than alachlor). No other pesticide was detected as frequently as atrazine or alachlor, which were also estimated to be the heaviest use pesticides in the study area which is dominated by corn and soybean production agriculture.

In an Illinois statewide monitoring program of community drinking-water systems utilizing ground-water sources, atrazine was found at above the 0.02 ppb detection limit in only 3 of 368 well water samples; alachlor was detected in two samples. None of the several other pesticides analyzed for were detected more frequently (Cobb and Sinnot, 1988).

Interpretation of these ground-water monitoring data is complicated by the complex interaction of application method and timing, weather, soil characteristics, hydrogeology, and well construction characteristics influencing whether atrazine will leach to ground water. Any policies restricting the use of atrazine that may be needed must be developed with consideration of the relative importance of intensity of use, method and timing of application, and the leaching potential of atrazine in a particular soil in determining whether a significant impact on ground water might occur from agricultural use. If it is necessary to consider eliminating atrazine use in particular areas considered vulnerable to groundwater contamination, care must be taken that atrazine is not replaced for the same uses with other pesticides which might have a similar impact on ground water if used as frequently as atrazine currently is.

cc: P. Holden

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MRID no. ~~4862939.~~ Correct MRID No. 40629303, 11/16/88 *

MRID no. 40431323.

*This study is contained in the Second Round Review package and not in the 2/25/88 review.

TABLE A
GENERIC DATA REQUIREMENTS FOR ATRAZINE (Herbicide)

Data Requirement	Composition[1]	Use Pattern[2]	Does EPA have data to satisfy this requirement?	Bibliographic citation[3]	Must additional data be submitted under FIFRA § 3(c)(2)(B)?
§158.290 Environmental Fate					
DEGRADATION STUDIES-LAB:					
161-1 - Hydrolysis	PAIRA or TGAI	A,B,G	Yes	40431319	No
Photodegradation					
161-2 - In water	PAIRA or TGAI	A,B,G	No	-	Yes[4]
161-3 - On soil	PAIRA or TGAI	A,G	No	-	Yes[5]
161-4 - In Air	PAIRA or TGAI	A	No	-	No[6]
METABOLISM STUDIES-LAB:					
162-1 - Aerobic Soil	PAIRA or TGAI	A,B,G	Partially	40629303	Yes[7]
162-2 - Anaerobic Soil	PAIRA or TGAI	A	Yes	40431323	No[8]
162-3 - Anaerobic Aquatic	PAIRA or TGAI	G	Yes	40431323	No
162-4 - Aerobic Aquatic	PAIRA or TGAI	n/a	No	-	No[9]

TABLE A
GENERIC DATA REQUIREMENTS FOR ATRAZINE (Herbicide)

Data Requirement	Composition[1]	Use Pattern[2]	Does EPA have data to satisfy this requirement?	Bibliographic citation[3]	Must additional data be submitted under FIFRA § 3(c)(2)(B)?
§158.290 Environmental Fate (continued)					
MOBILITY STUDIES:					
163-1 :					
a. Batch equilibrium adsorption/desorption	PAIRA or TGAI	A,B,G	Yes	40431324; 40431327 40431325; 40431328 40431326	No[10]
b. Soil TLC	PAIRA or TGAI	A,B,G	Partially	40431329; 40431330 40431333; 40431331 40431334; 40431322	No[11]
c. Column leaching	PAIRA or TGAI	A,B,G	Yes	-	No[12]
163-2 - Volatility (Lab)	PAIRA or TGAI	A	No	-	No[13]
163-3 - Volatility (Field)	TEP	A	No	-	No[14]
DISSIPATION STUDIES-FIELD:					
164-1 - Soil	TEP	A,B,G	No	-	Yes[15]
164-2 - Aquatic (Sediment)	TEP	n/a	No	-	No[16]
164-3 - Forestry	TEP	G	Partially	40431340	Yes[17]

TABLE A
GENERIC DATA REQUIREMENTS FOR ATRAZINE (Herbicide)

Data Requirement	Composition[1]	Use Pattern[2]	Does EPA have data to satisfy this requirement?	Bibliographic citation[3]	Must additional data be submitted under FIFRA § 3(c)(2)(B)?
§158.290 Environmental Fate (continued)					
164-4 - Combination and Tank Mixes	-	-	No	-	No[18]
164-5 - Soil, Long-term	TEP	A	No	-	Reserved[19]
ACCUMULATION STUDIES:					
165-1 - Rotational Crops (Confined)	PAIRA	A	No	-	No[20]
165-2 - Rotational Crops (Field)	TEP	A	No	-	No[21]
165-3 - Irrigated Crops	TEP	n/a	No	-	No[22]
165-4 - In Fish	PAIRA or TGAI	A,B,G	Yes	40431344	No
165-5 - In Aquatic Nontarget Organisms	TEP	G	Partially	40431340	No[23]
§154.440 Spray Drift					
201-1 - Droplet Size Spectrum	TEP	A,B,G	No	-	Yes[24]
201-2 - Drift Field Evaluation	TEP	A,B,G	No	-	Yes[24]

TABLE A
GENERIC DATA REQUIREMENTS FOR ATRAZINE (Herbicide)

Data Requirement	Composition[1]	Use Pattern[2]	Does EPA have data to satisfy this requirement?	Bibliographic citation[3]	Must additional data be submitted under FIFRA § 3(c)(2)(B)?
§158.75 Other Data					
Ground water monitoring studies	-	-	Partially	-	Reserved[25]

TABLE A
GENERIC DATA REQUIREMENTS FOR ATRAZINE (Herbicide)

FOOTNOTES:

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

2 The use patterns are coded as follows: A= Terrestrial, Food Crop; B= Terrestrial, Non-Food; C= Aquatic, Food Crop; D= Aquatic, Non-Food; E= Greenhouse, Food Crop; F= Greenhouse, Non-Food; G= Forestry; H= Domestic Outdoor; I= Indoor

3 EPA MRID Numbers.

4 The photodegradation in water study (00024328), which was reviewed and accepted at the time of the 1983 Registration Standard, does not meet data requirements for this type of study under current Subdivision N Guidelines. Major deficiencies were noted in the study (material balance was not provided; artificial light source was incompletely characterized; degradate characterization was incomplete; solutions were unbuffered, etc.). A new study is required, for which submission of a protocol is recommended.

5 One study (40431320) was reviewed and found to be unacceptable. Significant amounts of radioactivity were left unidentified at the origin of the TLC plates and no other methodology was used to confirm the identity of the reported photodegradation products. A new study is required.

6 This study may be waived at the registrant's request based on the low vapor pressure of atrazine (3.0×10^{-7} mmHg at 20°C).

7 Four studies were reviewed. Study 00040663 was reviewed at the time of the 1983 Registration Standard and was considered unacceptable. Study 40431321 is only a preliminary report to the final report (40629303). The latter study was considered to provide supplemental information; the study did not fulfill data requirements because the characterization of degradates was incomplete. The study 40431322 was unacceptable because of the numerous deficiencies noted in the study. A new aerobic soil metabolism study is required.

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TABLE A
GENERIC DATA REQUIREMENTS FOR ATRAZINE (Herbicide)

FOOTNOTES (Continued):

8 An anaerobic soil metabolism is included in study 40629303; the anaerobic part of the study was considered to provide supplemental information only; the study did not fulfill data requirements because degradates comprising up to 7% of the applied dosage were not identified. However, an acceptable anaerobic aquatic metabolism study (40431323) was submitted and may be used to fulfill data requirements for an anaerobic soil metabolism study. Therefore, data requirements for anaerobic soil metabolism studies are fulfilled and no new studies are required.

9 No data are required because atrazine has no aquatic uses or any use involving direct discharges of treated water into outdoor aquatic sites.

10 The study 00027134 was reviewed and included in the 1983 Registration Standard; it was found to partially fulfill data requirements at that time. Another reviewed study (00116620) was unacceptable. New studies (40431324, 40431327, 40431325, 40431328, and 40431326) were submitted at a later date. These batch-equilibrium adsorption/desorption studies of atrazine and its four major degradates G-28273, G-28279, G-30033, and G-34048 were found acceptable to fulfill data requirements for the mobility in soil of atrazine and its four major degradates. Therefore, no new data are required.

11 The study 00044017 was reviewed and included in the 1983 Registration Standard and found to partially fulfill data requirements. Other reviewed studies (0098254, 00105942, 00114299) were unacceptable. Studies 40431329, 40431330, 40431333, 40431331, 40431334, and 40431322 (unaged/aged atrazine and the four major metabolites G-28273, G-28279, G-30033, and G-34048) may be acceptable if the actual "room temperature" at which the plates were developed can be clarified. However, because acceptable batch-equilibrium adsorption/desorption studies are available, data requirements for mobility in soil studies are fulfilled and no further studies are required.

12 Because acceptable adsorption/desorption (batch equilibrium) data are available, no new column leaching studies are required.

13 This study may be waived at the registrant's request based on the low vapor pressure of atrazine (3.0×10^{-7} mmHg at 20°C) and the current use patterns.

14 This study is not required if the laboratory volatility study is waived.

TABLE A
GENERIC DATA REQUIREMENTS FOR Atrazine (Herbicide)

FOOTNOTES (Continued):

15 Although the studies 40431336, 40431337, 40431338, and 40431339 appear to have been conducted according to current guidelines, the wide variation in recoveries of atrazine and its degradates and the inadequate method used to determine the concentration of atrazine and its degradates made the studies unacceptable. The study 40431335 was also found to be unacceptable. New studies are required, for which submission of a protocol is highly recommended. Atrazine is currently registered for uses on turf (warm season only). However, no dissipation studies on turf have been submitted. Therefore, dissipation studies on turf (conducted in two, different, typical-use sites) are required. Submission of a protocol is recommended.

16 No data were required because atrazine has no aquatic food crop use, aquatic nonfood use or aquatic impact use involving direct discharge of treated water into outdoor aquatic sites at the present time.

17 This study may fulfill data requirements if acceptable information on freezer storage stability of samples and an adequate description of the forest site are submitted.

18 No data are required because data requirements for combination products and tank mix uses are currently not being imposed.

19 This study may be required if results from acceptable field dissipation/aerobic soil metabolism studies demonstrate that residues do not reach 50% dissipation in soil prior to the recommended subsequent application.

20 Confined rotational crop studies (40431342 and 40431343) were reviewed. In these studies, the rotation crops were planted after the target crop (corn) was harvested and removed from the pails. The study was conducted at an application rate of 2 lb a.i./A. The maximum application rate stated in the label for food uses is 8 lb a.i./A. Even if these studies were acceptable (the studies were not acceptable because ^{14}C-residues in plant materials were not completely characterized and laboratory/greenhouse methods were not completely described), the studies would not support the use of application rates higher than 2 lb a.i./A. More importantly, at the two rotation intervals when crops were planted (108-days for lettuce, sugar beets, and soybeans; 363-days for spring wheat) residues were still detected in the crops at maturity. Based on the rotational crop data reviewed, EFGWB concludes that residues are likely to occur in all crops rotated one year or more following application of atrazine at current use rates. As a consequence, appropriate rotational crop intervals for atrazine cannot be established. The registrant must petition the Dietary Exposure Branch (DEB/HED) for suitable tolerances for all crops to be rotated.

TABLE A
GENERIC DATA REQUIREMENTS FOR ATRAZINE (Herbicide)

FOOTNOTES (Continued):

21 The reviewed (small plot) rotational crop studies (00103164, 00103163, 00118936, 00103167, and 00103170) were found unacceptable because in none of the studies the application rates were confirmed (other deficiencies were also noted in the studies). The maximum application rate used was 3 lb a.i./A and the studies, even if they had been acceptable, would have not supported uses at higher rates. Although the studies were unacceptable, the reported results indicate that (uncharacterized) residues were still detected in rotation planted one year or longer after treatment. Because the registrant has been requested to petition tolerances for all crops to be rotated (See FOOTNOTE 20), no new field rotational crop studies are required.

22 No data are required because atrazine is not intended for aquatic food crop or aquatic nonfood uses in and around holding ponds used for irrigation purposes, or for uses involving effluents or discharges to water used for crop irrigation.

23 The reviewed study (40431340) was considered to provide supplemental information. However, because the maximum bioconcentration factors found in the acceptable fish accumulation study (40431344) are relatively low, a new study is not required.

24 The spray drift droplet spectrum and field evaluation may be done together in order to evaluate the droplet spectrum associated with actual field use patterns.

25 Additional data will be submitted to the Agency in response to the special data call-in sent to the registrant on November 2, 1988. If the data submitted are insufficient to make recommendations concerning whether changes in use patterns, geographic restrictions, etc. are necessary, then the design for additional restrospective ground-water monitoring studies required from the registrants will be tailored to satisfy the remaining data gaps.