11-18-88

1/25

DYNAMAC CORPORATION

ATRAZINE SRR

VOLUME III. EXECUTIVE SUMMARY AND STRUCTURES

Task 1: Review and Evaluation of Individual Studies

Task 2: Environmental Fate Assessment

November 18, 1988

Final Report

Contract No. 68-02-4250

Submitted to:
Environmental Protection Agency
Arlington, VA 22202

Submitted by:
Dynamac Corporation
The Dynamac Building
11140 Rockville Pike
Rockville, MD 20852

EXECUTIVE SUMMARY

o The following findings are derived from those reviewed studies which have met the requirements of 40 CFR Part 158.290 and the Subdivision N Guidelines, and were also deemed acceptable.

Hydrolysis

The results of this study (40431319) indicate that hydrolysis is not an important degradation mechanism for atrazine in the environmentally significant pH range 5-9, as no significant degradation was observed during a 30-day period.

Anaerobic Aquatic Metabolism

The combined water/sandy clay sediment half-life calculation gave a half-life for atrazine of 608 days (330 days in sediment; 578 days in water alone). Production of volatile materials was minimal. Bound residues in the sediment increased with time, but leveled to about 10% of applied dose by month 12. About 70% of the radioactivity in water and 4% in the sediment was still associated with parent atrazine after 12 months. In sterile samples, above 80% of the radioactivity remained as parent atrazine. Metabolites were present at low levels:

2-amino-4-chloro-6-isopropylamino-s-triazine (deethylatrazine; G-30033); 4.7%,
2-ethylamino-4-hydroxy-6-isopropylamino-s-triazine (hydroxy atrazine; G-34048); 5%, and
2-amino-4-chloro-6-ethylamino-s-triazine (demethylatrazine; G-28279); 1.4%.

The anaerobic aquatic metabolism study (40431323) can be used to fulfill data requirements for the anaerobic soil metabolism study.

Mobility in Soil - Batch Equilibrium Adsorption/Desorption Studies

The adsorption/desorption properties of atrazine and four of its major degradates were studied by batch equilibrium methods (40431324; 40431327; 40431325; 40431328; 40431326). Four different types of soils were used: sand, sandy loam, silt loam, and silty clay loam.

The calculated Freundlich adsorption constants (K_{ads}) were:

a. atrazine (from 0.427 in sand to 2.030 in silty clay loam),
b. 2-amino-4-chloro-6-ethylamino-s-triazine, G-28279 (from 0.225 in sand to 1.144 in silty clay loam),
c. 2,4-diamino-6-chloro-triazine, G-28273 (from 0.108 in sand to 0.800 in silty clay loam),
d. 2-ethylamino-4-hydroxy-6-isopropylamino-s-triazine, G-34048 (from 1.643 to 8.165 in silt loam), and
e. 2-amino-4-chloro-6-isopropylamino-s-triazine, G-30033 (from 0.116 in sand to 0.963 in silty clay loam).

The calculated Freundlich desorption constants (K_{des}) were:

a. atrazine (from 2.261 in silt loam to 14.90 in sandy loam),
b. G-28279 (from 1.784 in silt loam to 12.479 in sand),
c. G-28273 (from 1.172 in silty clay loam to 6.620 in sandy loam),
d. G-34048 (from 5.518 in sand to 22.26 in silty clay loam), and
e. G-30033 (from 7.900 in sand to 12.87 in silt loam).

The K_{oc} values (adsorption phase) were:

a. atrazine (from 55 in sandy loam to 135 in silty clay loam),
b. G-28279 (from 35.1 in sandy loam to 82 in silt loam),
c. G-28273 (from 11.6 in sandy loam to 59.5 in silt loam),
d. G-34048 (from 350 in sand to 680 in silt loam), and
e. G-30033 (from 12.8 in sandy loam to 66.5 in silt loam).

The results indicate (higher K_{ads} and $K_{oc,ads}$ values) that G-34048 ("hydroxy atrazine") is less mobile than either atrazine or its de-alkylated degradates.

Laboratory accumulation in fish

Total [^{14}C]atrazine residues accumulated in bluegill sunfish with maximum bioconcentration factors of 7.7x, 12x, and 15x in edible tissues (body, muscle, skin, skeleton), nonedible tissues (fins, head, internal organs), and whole fish, respectively, during 28 days of exposure to uniformly ring-labeled [^{14}C]atrazine (radiochemical purity >99%, specific activity 25.6 µCi/mg) at 0.10 ppm in a flow-through system. Maximum concentrations of [^{14}C]residues were 0.81 ppm in edible tissues (day 28), 1.6 ppm in nonedible tissues (days 7-28), and 1.3 ppm in whole fish (days 3, 14, and 28). Based on TLC analysis of 21- and 28-day fish samples, atrazine was 0.35-0.40 ppm in the edible tissues, 0.99-1.0 ppm in the nonedible tissues, and 0.085-0.087 ppm in the whole fish. One degradate, 2-amino-4-chloro-6-ethyl-amino-s-triazine (G-28279), comprised 5-11% of the total residues in the 21- and 28-day fish extracts. Three minor degradates, 2-amino-4-chloro-6-isopropyl-amino-s-triazine (G-30033), 2,4-diamino-6-chloro-s-triazine (G-28273), and 2-ethylamino-4-hydroxy-6-isopropylamino-s-triazine (G-34048) were isolated at <5% of the total residues. After 21 days of depuration, [^{14}C]residues were 0.21 ppm in edible tissues, 0.38 ppm in nonedible tissues, and 0.28 ppm in whole fish; depuration rates were 74, 76, and 78%, respectively. Throughout the study, the temperature of the treated water was 20-21°C, the pH ranged from 8.0 to 8.3, and the dissolve oxygen content ranged from 8.0 to 9.0 mg/L; values were comparable to the control aquarium. Total [^{14}C]residues in the treated water were 0.10-0.11 ppm during the exposure period (40431344).

o The following findings are derived from those reviewed studies which may meet the requirements of 40 CFR 158.290 and Subdivision N Guidelines upon submission of additional, acceptable information.

Mobility in Soil - Soil Thin-Layer Chromatography (TLC) Studies

Sorption coefficients (K) were calculated from frontal R_f values for ^{14}C-labeled atrazine and its four degradates G-28273, G-28279, G-30033, and G-34048 (40431329, 40431333, 40431331, 40431334, and 40431332, respectively) ran against ^{14}C-reference standards of Amiben, Prometon, 2,4-D, and Ethion. The calculated K values were used to classify the mobility of atrazine in the four different soils studied: sand, silt loam, sandy loam, and silty clay loam. Atrazine, G-28273, G-28279, and G-30033 were all highly mobile (mobility class 5) in sand. Mobile species (mobility class 4) were atrazine (silt loam soil), G-28273 (sandy loam soil), G-30033 (silt loam and sandy loam soils). Of intermediate mobility (mobility class 3) were atrazine (sandy loam and silty clay loam soils), G-28273 (silty clay loam soil), G-28279 (silty clay loam soil), G-30033 (silty clay loam soil). Low mobility (mobility class 2) was observed for G-28279 (silt loam and sandy loam soils), and G-34048 (sand and silty clay loam soils). G-34048 was immobile (mobility class 1) in silt loam and sandy loam soils. The results indicate that "hydroxy atrazine" (G-34048) is less mobile than parent atrazine or any of the dealkylated degradates.

A study on the mobility of soil-aged atrazine residues (32 days incubation time) in a loam soil indicated that the most mobile component was unchanged (parent) atrazine (404131330).

The soil TLC studies may be acceptable if the actual "room temperature" at which the plates were developed can be clarified.

Forestry dissipation and field accumulation on nontarget organisms

Atrazine (Aatrex Nine-O, 90% G) was applied aerially (40431340) at 4 lb ai/A to 10 acres of an immature Douglas fir forest located in Oregon City, Oregon, on April 4, 1985. In tree foliage samples, atrazine was 168.2-294.2 ppm immediately posttreatment, 76.7-88.0 ppm at 7 days, 6.6-10.5 ppm at 29 days, and 1.6- 3.2 ppm at 88 days posttreatment. The registrant-calculated half-life for atrazine in foliage was 13 days. At 88 days posttreatment, the degradates 2-amino-4-chloro-6-isopropylamino-s-triazine (G-30033) and 2-amino-4-chloro-6-ethylamino-s-triazine (G-28279) were isolated at maximum concentrations of 0.357 ppm (11% of the recovered) and 0.061 ppm (2% of the recovered), respectively. In leaf litter samples, atrazine was 73.1-114.2 ppm immediately posttreatment, 21.8-27.9 ppm at 29 days, 7.2-8.1 ppm at 88 days, and 0.60-3.4 ppm at 364 days posttreatment; the registrant-calculated half-life was 66 days. 2-Amino-4-chloro-6-isopropylamino-s-triazine was isolated at a maximum concentration of 0.73 ppm (3.3% of the recovered) at 14 days posttreatment; 2-amino-4-chloro-6-ethylamino-s-triazine was isolated at a maximum concentration of 0.30 ppm (1% of the recovered) at 29 days posttreatment. In soil (0- to 6-inch depth) that was not covered with leaf litter, atrazine concentrations were variable with no discernible pattern, ranging from 0.075 to 4.3 ppm. 2-Amino-4-chloro-6-isopropylamino-s-triazine was isolated at up to 0.118 ppm (10.7% of the recovered; 128 days) in the 0- to 6-inch depth; the degradate 2-amino-4-chloro-6-ethylamino-s-triazine was <0.05 ppm (not detected) at all sampling intervals. In the 6- to 12- and 12- to 18-inch soil depths, atrazine was <0.05-0.432 ppm and <0.05-0.110 ppm, respectively. In soil under leaf litter, atrazine concentrations were variable in the 0- to- 6-inch depth, ranging from 0.077 to 4.7 ppm, and were ≤0.088 ppm in the 6- to 12- and 12- to 18-inch depths. Atrazine was <0.1 ppb in stream water (sampled up to 88 days posttreatment), <0.05 ppm in stream sediment (sampled up to 90 days posttreatment, and <0.05 ppm in fish (sampled up to 29 days posttreatment).

The forestry dissipation study may fulfill data requirements if acceptable freezer storage stability data and an adequate description of the forest site is submitted. The field accumulation on nontarget organisms can be considered as a supplemental study only (see below).

o The following findings are derived from those reviewed studies which have not met the requirements of 40 CFR 158.290 and/or the Subdivision N Guidelines, but which have been deemed good studies following generally sound scientific practice. They thereby provide supplemental information on the fate of the pesticide.

Aerobic soil metabolism

Uniformly ring-labeled [^{14}C]atrazine (radiochemical purity ≥95.4%, specific activity 20.6 μCi/mg), at 10.2 ppm, degraded with a half-life of 94-181 days in loam soil incubated aerobically in the dark at 25°C and 75% of 0.33 bar moisture; the registrant-calculated half-life was ≈146 days. [^{14}C]Atrazine decreased from 90.7% of the applied immediately posttreatment to 56.5% at 94 days, 33.1% at 181 days, and 21.2% at 300 days. The major organosoluble degradate was 2-amino-4-chloro-6-isopropylamino-s-triazine (G-30033), at up to 4.6% of the applied on day 300. Other degradates were 2-amino-4-chloro-6-ethylamino-s-triazine (G-28279) at up to 2.0% of the applied (maximum on day 244), 2,4-diamino-6-chloro-triazine (G-28273) at up to 0.7% (day 3), and 2-ethylamino-4-hydroxy-6-isopropylamino-s-triazine (G-34048) at up to 0.7% (days 62 and 94). One degradate was isolated at 0.2-0.3% of the applied (0.03 ppm) but not identified. The degradates 2-amino-4-hydroxy-6-isopropylamino-s-triazine (GS-17794) and 2-amino-4-ethylamino-6-hydroxy-s-triazine (GS-17792) were not detected at any sampling interval. At 300 days posttreatment, 21.2% of the applied was [^{14}C]atrazine, 4.6% was G-30033, 1.8% were other unidentified organosoluble degradates, 6.7% were water-soluble degradates, 6.0% had been evolved as $^{14}CO_2$, and 62.8% was unextractable. The material balance ranged from 95.1 to 102.6% of the applied during the 300-day study.In sterile soil, [^{14}C]atrazine was 77.4% of the applied at 94 days posttreatment. G-30033 was the major degradate (1.7% of the applied at 14 days); G-28279, G-28273, G-34038, and one unknown were also detected. The reason this study (40629303) did not fulfill data requirements was that degradates comprising up to 7% of the applied dosage (the water-soluble compounds and one degradate in the organosoluble fraction) were not identified.

Anaerobic soil metabolism

Uniformly ring-labeled [^{14}C]atrazine (radiochemical purity ≥95.4%, specific activity 20.6 μCi/mg) decreased from 6.83 to 5.22 ppm (67 to 51.2% of the applied) in anaerobic (flooded plus N_2 atmosphere) loam soil during 62 days of incubation in the dark at 25°C. The loam soil had been treated with [^{14}C]atrazine at 10.2 ppm and incubated for 32 days under aerobic conditions (in the dark at 25°C and 75% of 0.33 bar moisture) prior to flooding (40629393). Four degradates were isolated from the soil:water system: 2-amino-4-chloro-6-isopropylamino-s-triazine (G-30033) at ≤2.1% of the applied, 2-amino-4-chloro-6-ethylamino-s-triazine (G-28279) at ≤0.7% of the applied, 2,4-diamino-6-chloro-triazine (G-28273) at 0.3% (detected only on day 0 of anaerobic conditions), and 2-ethylamino-4-hydroxy-6-isopropylamino-s-triazine (G-34048) at ≤0.4. The degradates 2-amino-4-hydroxy-6-isopropylamino-s-triazine (GS-17794) and 2-amino-4-ethylamino-6-hydroxy-s-triazine (GS-17792) were not detected at any sampling interval. At 30 and 62 days postflooding (62 and 94 days post-treatment), 26.8 and 21.6% of the applied radioactivity was in the floodwater rather than the soil phase, respectively. Unextractable [^{14}C]residues in the soil increased from 26.7 to 40.9% of the applied during the 62 days of anaerobic incubation; no $^{14}CO_2$ evolution was detected (<34 dpm). The material balance ranged from 94.3 to 100.4% of the applied during the 62-day anaerobic study. The registrant-calculated half-life under anaerobic conditions was approximately 159 days. However, degradates comprising up to 6.8% of the applied (the water-soluble compounds in soil and water) were not identified.

Note that an acceptable anaerobic aquatic metabolism study (40431323) was submitted, which can be used to fulfill data requirements for the anaerobic soil metabolism study.

Mobility in Soil - Leaching and Adsorption/Desorption

In a study (00044017) in which TLC methods were used, radiolabeled atrazine (test substance uncharacterized) was determined to be intermediately mobile (Class 3) to mobile (Class 4) with R_f values of 0.34-0.74 in thirteen soils ranging in texture from sandy loam to clay (CECs ranging from 0.2-33.7 meq/100 g). However, portions of this study are unacceptable because it was impossible to confidently determine how the experiments had been conducted.

Based on batch equilibrium experiments (00027134), ring-labeled [^{14}C]atrazine (purity >97%), at 1 ppm, was very mobile in twenty-five soils ranging in texture from sandy loam to clay, with distribution coefficients (K_d = pesticide adsorbed to soil ÷ pesticide in solution) of 0.6-4.8. [^{14}C]Atrazine, at 5-70 ppm, was very mobile in silty clay loam soil with a Freundlich K_{ads} value of 4.32 and an n value of 0.87. At temperatures ranging from 3 to 50°C, atrazine was very mobile in silty

6

clay loam soil with distribution coefficients of ≈3.5-5.9; adsorption decreased with increasing temperature. The study was considered not to fulfill EPA Data Requirements because of several deficiencies noted.

Field Accumulation in Nontarget Organisms

This study (40431340), which was combined with the forestry dissipation study, indicated that the concentration of atrazine (applied aerially at a rate of 4 lb ai/A to 10 acres of an immature Douglas fir forest in Oregon) in stream water was <0.1 ppb after 88 days posttreatment, <0.05 ppm in stream sediment (90 days posttreatment), and <0.05 ppm in fish (29 days posttreatment). Because the accumulation of atrazine in fish is not considered to be high as to trigger a new study on accumulation in nontarget organisms, the study is no longer required.

RECOMMENDATIONS

Although the available data are insufficient to fully assess the environmental fate of atrazine, the following observations can be made: a) degradation in water is not an important degradation mechanism for atrazine; b) metabolic processes (aerobic) appear to be an important degradation mechanism for atrazine; c) the degradation product "hydroxy atrazine" (G-34048) is less mobile than parent atrazine or its dealkylated degradates G-28273, G-28279, and G-30033. The photochemical degradation of atrazine is still unclear. The submission of data required (new studies or additional, adequate information) for full registration of atrazine on terrestrial food crop, terrestrial nonfood, and forestry use sites is summarized below:

o The following data are required (new studies or additional information):

161-2, Photodegradation Studies in Water: One study, which was reviewed and accepted at the time of the 1983 Registration Standard (Burkhard and Guth, 00024328), was reevaluated and found to be unacceptable under current Subdivision N Guidelines because material balances were not provided (the majority of samples were analyzed only for atrazine) and it could not be determined whether the test solutions were sterile. In addition, this study would not fulfill data requirements because the artificial light source was incompletely characterized and was not compared to natural sunlight, degradates were analyzed only in the 6-hour sensitized solution sample, the test solutions were not buffered, the purity and specific activity of the test substance were not reported, and the test solutions were incubated at 15°C instead of 25°C. A new study is required.

161-3, Photodegradation Studies on Soil: One study (Spare, 40431320) was reviewed. The study, performed with sandy loam soil, was considered to be unacceptable for the following reasons: a) significant amounts (19-28%) of radioactivity were left unidentified at the origin of TLC plates (for both natural and artificial sunlight exposures); b) no other methodology was used to confirm the identity of the photodegradation products; and c) distribution of radioactivity in plates was not expressed as percent of applied dose. A new study is required.

162-1, Aerobic Soil Metabolism Studies: Four studies were reviewed. One study (Rustum, 40431321) is only a preliminary report (94-day study instead of the 12-month study required by Subdivision N Guidelines). The second study (Rustum, 40629303) is scientifically sound and provides supplemental information towards the registration of atrazine. This study does not fulfill data requirements because degradates comprising up to 7% of the applied (the water-soluble compounds and one degradate in the organosoluble fraction) were not identified. The third study (Obien and Green, 00040663) was previously included in the 1983 Registration Standard. This study is unacceptable because material balances were not provided (the soils were analyzed only for atrazine and total extractable triazine residues). In addition, this study would not fulfill data requirements because the pattern of formation and decline of degradates was not addressed; the soils were not completely characterized and may not be typical of those in the continental United States; and the purity and specific activity of the test substance was not reported. The fourth study (Klaine, 40431322) was unacceptable because of the following deficiencies: a) no complete data on soil characteristics were provided; b) low material balance for total accounted ^{14}C-radioactivity in the atrazine microcosms study; c) discrepancies between text and table for the material balance of ^{14}C-deisopropylatrazine microcosms. A new aerobic soil metabolism study is required.

162-2, Anaerobic Soil Metabolism Studies: One study (Rustum, 40629303) was reviewed and is scientifically sound and provides supplemental information towards the registration of atrazine. This study does not fulfill data requirements because degradates comprising up to 6.8% of the applied (the water-soluble compounds in soil and water) were not identified. However, an acceptable anaerobic aquatic metabolism study (Spare, 40431323) was submitted. According to Subdivision N Guidelines, an acceptable anaerobic aquatic metabolism study may be used to fulfill data requirements for anaerobic soil metabolism studies. Therefore, a new anaerobic soil metabolism study is not required.

163-1, Mobility in Soil - Leaching and Adsorption/Desorption Studies: Data requirements for mobility of atrazine in soil were satisfied by the batch equilibrium adsorption/desorption studies of atrazine and its four major degradates (Yu, 40431324, 40431327, 40431325, 40431328, and 40431326).

8

The soil TLC studies (Blair: unaged atrazine, 40431329; Saxena, aged atrazine: 40431330; degradates G-28273, G-28279, G-30033, and G-34048, Blair 40431333, 40431331, 40431334, and 40431332, respectively) may also satisfy data requirements if the actual "room temperature" at which the TLC plates were developed can be clarified.

The other reviewed studies were considered either supplemental or unacceptable. Unacceptable studies were Leake, et al. (00105942; 00114299), Hardies and Studer (00098254), Kinne, et al. (00116619), Froelich, et al. (00116620), Davidson et al. (00160292), Lavy (00027140), and Weidner (00027139). Supplemental studies were Helling (00044017), and Talbert and Fletchall (00027134). However, because acceptable batch equilibrium adsorption/desorption studies have been submitted, the Agency considers that no new mobility in soil studies are required.

164-1, Terrestrial field dissipation studies: Four studies (White, 40431336, 40431337, 40431338, 40431339) were reviewed and are unacceptable because the analytical method was inadequate to accurately assess the concentration of atrazine and its degradates in field soil (recovery of atrazine from fortified samples ranged from 87 to 147%, and recovery of its degradates ranged from 0 to 179%). However, these studies appear to have been conducted according to current guidelines. A fifth study (Klaine, 40431335) was reviewed and found unacceptable for the following reasons: a) information on the percentages of sand-clay-silt was not given; b) while the 1985 application was sampled through a 238-day period, the 1986 application was only sampled through a 43-day period, with no explanation given for this; c) not all of the results of the soil-depth samples said to have been analyzed were shown; and d) the 1986 application shows only analyses down to 20-30 cm depth.

Acceptable field dissipation studies are required to support registration on food crop and nonfood uses. Studies on turf are also required to support registration for uses on turf.

164-3, Forestry Dissipation Studies: One study (Schofield, 40431340) was reviewed. The study may be used to fulfill data requirements if acceptable information on freezer storage stability and an adequate description of the forest site are submitted.

165-1, Confined accumulation studies on rotational crops: Four studies were reviewed. One study (Simoneaux, 40431342, 40431343) was unacceptable because the laboratory and greenhouse methods were incompletely described. In addition, this study would not fulfill data requirements because [^{14}C]residues in plants were inadequately characterized, [^{14}C]residues in soil were not characterized at most sampling intervals, and storage stability data were not provided. A second study (Fischer, et al., 00103163, 00103164, 00118936) was unacceptable because the analytical methods for extraction and analysis of plant and soil samples were not provided. In addition, this study would not fulfill data requirements because [^{14}C]residues in plants were inadequately characterized, [^{14}C]residues in soil were not characterized at most sampling intervals, the soil was not sampled until 17 weeks posttreatment (at which time only 20.3% of the [^{14}C]residues were atrazine) and was not sampled at all planting intervals, storage stability data were not provided, field test data were incomplete, and the test substance was not completely characterized. A third study (Hermes and Knaack, 00103167, 00103170) was unacceptable because the soil was not sampled until 22 weeks posttreatment (at which time only 12.4% of the [^{14}C]residues were atrazine); therefore, the application rate could not be confirmed. In addition, this study would not fulfill data requirements because [^{14}C]residues in plants were inadequately characterized, [^{14}C]residues in soils were not characterized at most sampling intervals, storage stability data were not provided, field test data were incomplete, and the test substance was not completely characterized. A fourth study (Cassidy, 00103153) was unacceptable because the analytical methods for extraction and analysis of plant and soil samples were not provided. In addition, this study would not fulfill data requirements because [^{14}C]residues in plants were not adequately characterized, [^{14}C]residues in soil were not characterized at most sampling intervals, the soil was not sampled until 52 weeks posttreatment (at which time only 19.0% of the [^{14}C]residues were atrazine) and was not sampled at all planting intervals, storage stability data were not provided, field test data were incomplete, and the test substance was not completely characterized.

The studies 40431342 and 40431343 would not support uses of atrazine for rotation crops at application rates higher than 2 lb ai/A. 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 <u>must</u> petition the Dietary Exposure Branch (DEB/HED) for suitable tolerances for all crops to be rotated.

o The following data requirements are fulfilled:

161-1, <u>Hydrolysis Study</u>: One study (Spare, 40431319) was reviewed and fulfills data requirements for the hydrolysis of atrazine at pH 5, 7, and 9.

162-3 and 162-2, <u>Anaerobic Aquatic Metabolism and Anaerobic Soil Metabolism Studies</u>: One anaerobic aquatic metabolism study (Spare, 40431323) was reviewed and found to be acceptable for fulfilling data requirements for the anaerobic aquatic metabolism of atrazine. This study may also be used to fulfill data requirements for anaerobic soil metabolism studies.

163-1, Mobility in Soil - Batch Equilibrium Adsorption/Desorption Studies: Five batch equilibrium adsorption/desorption studies with atrazine and its four major degradates G-28273, G-28279, G-30033, and G-34048 (Yu, 40431324, 40431327, 40431325, 40431328, and 40431326, respectively) were reviewed and found acceptable to fulfill data requirements for the adsorption/-desorption behavior of atrazine and its degradates on different soils.

165-4, Laboratory Studies of Pesticide Accumulation in Fish: One study (Forbis, 40431344) was reviewed and fulfills data requirements by providing information on the accumulation of [^{14}C]atrazine in laboratory fish.

o The following data requirements are deferred or are not required for presently registered uses:

161-4, Photodegradation in Air Studies: No studies were reviewed. This study is not required because of the low vapor pressure of atrazine (3.0×10^{-7} mm Hg at 20°C).

162-4, Aerobic Aquatic Metabolism Studies: No data were reviewed, but no data are required because atrazine has no aquatic use or any use involving direct discharges of treated water into outdoor aquatic sites at the present time.

163-2, Volatility Study (Laboratory): No data were reviewed. This study may be waived at the registrant's request based on the low vapor pressure of atrazine (3.0×10^{-7} mm Hg at 20°C) and the current use patterns.

163-3, Volatility Study (Field): No data were reviewed. This study is not required if the laboratory volatility study is waived.

164-2, Aquatic Field Dissipation Studies: No data were reviewed, but no data are 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.

164-4, Dissipation Studies for Combination Products and Tank Mix Uses: No data were reviewed; however, no data are required because data requirements for combination products and tank mix uses are currently not being imposed.

164-5, Long-Term Field Dissipation Studies: No data were reviewed, but all data 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.

165-2, Field Accumulation Studies on Rotational Crops: Data were reviewed for small plot studies. These studies were unacceptable (see Recommendations for confined rotational crop studies). No new field rotational crop studies are required because the registrant has been requested to restrict the rotation of crops for which rotational crop tolerances have been granted.

165-3, Accumulation Studies on Irrigated Crops: No data were reviewed; however, no data are required because the test substance is not intended for aquatic food crop or aquatic nonfood uses, for uses in and around holding ponds used for irrigation purposes, or for uses involving effluents or discharges to water used for crop irrigation.

165-5, Accumulation Studies in Aquatic Nontarget Organisms: The reviewed study (40431340), which was combined with a forestry dissipation study, was considered to provide supplemental information. However, based on the relatively low bioaccumulation factors in fish, no new study is required.

REFERENCES

o The following studies were reviewed:

Blair, J.E. 1986a. Determination of the mobility of atrazine in selected soils by soil thin-layer chromatography. Conducted by Hazleton Laboratories America, Inc., Madison, WI. Laboratory Study No. 6015-300. Completed March 7, 1986. Submitted by Ciba-Geigy Corporation, Greensboro, NC. (40431329)

Blair, J.E. 1986b. Determination of the mobility of G-28273 in selected soils by soil thin-layer chromatography. Conducted by Hazleton Laboratories America, Inc., Madison, WI. Laboratory Study No. 6015-305. Submitted by Ciba-Geigy Corporation, Greensboro, NC. (40431333)

Blair, J.E. 1986c. Determination of the mobility of G-28279 in selected soils by soil thin-layer chromatography. Conducted by Hazleton Laboratories America, Inc., Madison, WI. Laboratory Study No. 6015-304. Completed February 27, 1986. Submitted by Ciba-Geigy Corporation, Greensboro, NC. (40431331)

Blair, J.E. 1986d. Determination of the mobility of G-30033 in selected soils by soil thin-layer chromatography. Conducted by Hazleton Laboratories America, Inc., Madison, WI. Laboratory Study No. 6016-306. Completed February 27, 1986. Submitted by Ciba-Geigy Corporation, Greensboro, NC. (40431334)

Blair, J.E. 1986e. Determination of the mobility of G-34048 in selected soils by soil thin-layer chromatography. Conducted by Hazleton Laboratories America, Inc., Madison, WI. Laboratory Study No. 6015-302. Completed March 7, 1986. Submitted by Ciba-Geigy Corporation, Greensboro, NC. (40431332)

Burkhard, N. and Guth, J.A. 1976. Photodegradation of atrazine, atraton, and ametryne in aqueous solution with acetone as a photosensitizer. Pesti. Sci. 7(1):65-71. (00024328)

Cassidy, J. 1972. A rotational metabolism study of delta-^{14}C-atrazine in soil and soybeans 52 to 72 weeks after herbicide application to soil: M2-01-3P, M2-01-45: Report No. GAAC-72137. Unpublished study received June 10, 1982 under 100-631 and submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:070914-L. (00103153)

Fischer, W., N. Cargile, and J. Cassidy. 1979a. Degradation of delta-^{14}C-atrazine in field soil and uptake of the degradation products into rotation lettuce. Report No. ABR-79065. Unpublished study received June 10, 1982 under 100-631. Prepared and submitted by Ciba-Geigy Corporation, Greensboro, NC; CDL:070915-A. (00103164)

Fischer, W., N. Cargile, and J. Cassidy. 1979b. Degradation of delta-^{14}C-atrazine in field soil and uptake of the degradation products into rotation sugar beets. Report No. ABR-79064. Unpublished study received June 10, 1982 under 100-631. Prepared and submitted by Ciba-Geigy Corporation, Greensboro, NC; CDL:070914-X. (00103163)

Fischer, W., N. Cargile, and J. Cassidy. 1979c. Degradation of delta-^{14}C-atrazine in field soil and uptake of the degradation products into rotation winter wheat. Report No. ABR-79063. Unpublished study received June 10, 1982 under 100-631. Prepared and submitted by Ciba-Geigy Corporation, Greensboro, NC; CDL:070914-W. (00118936)

Forbis, A.D. 1986. Uptake, depuration, bioconcentration, and metabolite characterization of ^{14}C-atrazine by bluegill sunfish (Lepomis macrochirus). ABC Report No. 34737. Prepared by Analytical Bio-Chemistry Laboratories, Inc., Columbia, MO, and submitted by Ciba-Geigy Corporation, Greensboro, NC. (40431344)

Froelich, L., T. Bixler, C. Peake, et al. 1982. Soil adsorption/desorption characteristics of FMC 57020:M-4861. Unpublished study received Oct. 1, 1982 under 279-EX-93. Prepared and submitted by FMC Corp., Philadelphia, PA, CDL:248476-D. (00116620)

Hardies, D.E. and D.Y. Studer. 1982. Soil thin-layer chromatography of PPG-1292: BRC 22593. Unpublished study received April 5, 1982 under 2F2666; submitted by PPG Industries, Inc., Barberton, OH; CDL:070755-J. (00098254)

Helling, C.S. 1971a. Pesticide mobility in soils: II. Applications of soil thin-layer chromatography. Soil Sci. Soc. Amer. Proc. 35:737-743. (00044017)

Helling, C.S. 1971b. Pesticide mobility in soils: III. Influence of soil properties. Soil Sci. Soc. Amer. Proc. 35:743-747. (00044017)

Hermes, P. and J. Knaack. 1972a. The uptake of aged ^{14}C-atrazine and metabolites in rotation oats and the degradation of atrazine in soil: Report No. GAAC-72019. Unpublished study received June 10, 1982 under 100-631. Prepared and submitted by Ciba-Geigy Corporation, Greensboro, NC; CDL:070915-D. (00103167)

Hermes, P. and J. Knaack. 1972b. The uptake of aged ^{14}C-atrazine and metabolites in rotation soybeans and the degradation of atrazine in soil: Report No. GAAC-72032. Unpublished study received June 10, 1982 under 100-631. Prepared and submitted by Ciba-Geigy Corporation, Greensboro, NC; CDL:070915-G. (00103170)

Kinne, L., J. Reynolds, L. Froelich, et al. 1982. Soil mobility of FMC 57020. M-4862. Unpublished study prepared and submitted by FMC Company, Philadelphia, PA. (00116619)

Klaine, S.J. 1987. Biotic and abiotic degradation of atrazine and three of its metabolites in a Western Tennessee soil. Conducted by the Department of Biology, Memphis State University, Memphis. TN. Laboratory Study No. TX-431. Completed October 22, 1987. Submitted by Ciba-Geigy Corporation, Greensboro, NC. (40431322)

Klaine, S.J. 1987. Field dissipation study of atrazine in West Tennessee soil. Conducted by the Department of Biology, Memphis State University, Memphis. TN. Laboratory Study No. TX-431A. Completed October 22, 1987. Submitted by Ciba-Geigy Corporation, Greensboro, NC. (40431335)

Lavy, T.L. 1974. Mobility and deactivation of herbicides in soil-water systems. Project A-024-NEB. Nebraska Water Resources Research Institute. Available from: National Technical Information Service, Springfield, VA. (00027140)

Leake, C., D. Lines, and K. Tiffen. 1981. The leaching of NC 21314 in four soil types using soil TLC. METAB/81/40. Unpublished study prepared and submitted by FBC Chemicals, Inc., Wilmington, DE. (00105942)

Leake, C., L. Sommerville, D. Lines, et al. 1982. The leaching of Amitraz in four soil types using soil TLC. METAB/82/16. Unpublished study prepared by FBC Chemicals, Ltd., England, and submitted by FBC Chemicals, Inc., Wilmington, DE. (00114299)

Obien, S.R. and R.E. Green. 1969. Degradation of atrazine in four Hawaiian soils. Weed Sci. 17(4):509-514. (00040663)

Rustum, A.M. 1987. Aerobic, aerobic/anaerobic, and sterile soil metabolism of ^{14}C-atrazine. Conducted by Hazleton Laboratories America, Madison, WI. Laboratory Study No. HLA 6015-185. Completed November 6, 1987. Submitted by Ciba-Geigy Corporation, Greensboro, NC. (40431321)

Rustum, A.M. 1988. Aerobic, aerobic/anaerobic, and sterile soil metabolism of ^{14}C-atrazine. Laboratory Project Identification No. HLA 6015-185. Unpublished study performed by Hazleton Laboratories America, Inc. and submitted by Ciba-Geigy Corporation, Greensboro, NC. (40629303)

Saxena, A.M. 1987. Determination of the mobility of soil-aged ^{14}C-atrazine residues by soil thin-layer chromatography. Conducted by Hazleton Laboratories America, Madison, WI. Laboratory Study No. HLA 6015-186. Completed October 15, 1987. Submitted by Ciba-Geigy Corporation, Greensboro, NC. (40431330)

Schofield, M. 1986. Combined field dissipation and aquatic nontarget organism accumulation studies on Aatrex Nine-O for forestry use at Oregon City, Oregon. ABC Report No. 32989. Prepared by Analytical Bio-Chemistry Laboratories, Inc., Columbia, MO, and submitted by Ciba-Geigy Corporation, Greensboro, NC. (40431340)

Simoneaux, B. 1987a. Uptake and characterization of ^{14}C-atrazine metabolites in greenhouse grown corn. Laboratory Study No. ABR-87093. Prepared and submitted by Ciba-Geigy Corp., Greensboro, NC. (40431342)

Simoneaux, B. 1987b. Uptake and characterization of ^{14}C-atrazine metabolites in greenhouse grown rotational plants. Laboratory Study No. ABR-87103. Prepared and submitted by Ciba-Geigy Corp., Greensboro, NC. (40431343)

Spare, W.C. 1986. Determination of the hydrolysis rate constants of atrazine. Conducted by Agrisearch, Inc., Frederick, MD. Laboratory Study No. 1236. Completed December 31, 1986. Submitted by Ciba-Geigy Corporation, Greensboro, NC. (40431319)

Spare, W.C. 1987. Anaerobic aquatic metabolism of atrazine. Conducted by Agrisearch, Inc., Frederick, MD. Laboratory Study No. 1231. Completed October 1, 1987. Submitted by Ciba-Geigy Corporation, Greensboro, NC. (40431323)

Spare, W.C. 1987. Photodegradation of atrazine on soil surfaces exposed to artificial and natural sunlight. Conducted by Agrisearch, Inc., Frederick, MD. Laboratory Study No. 1237. Completed April 6, 1987. Submitted by Ciba-Geigy Corporation, Greensboro, NC. (40431320)

Talbert, R.E. and O.H. Fletchall. 1965. The adsorption of some s-triazines in soils. Weeds 13(?):46-52. (00027134)

Weidner, C.M. 1974. Degradation in groundwater and mobility of herbicides. Masters thesis: University of Nebraska, Lincoln, NE. (0027139)

White, S.M. 1987a. Field dissipation study on Aatrex Nine-O for terrestrial uses on bareground, Hollandale, MN. Laboratory Study No. 1641-86-71-01-21E-25. Prepared by Landis Associates, Inc., Valdosta, GA; Agri-Growth Research, Inc., Hollandale, MN; and Minnesota Valley Testing Labs., Inc., New Ulm, MN; and submitted by Ciba-Geigy Corporation, Greensboro, NC. (40431337)

White, S. 1987b. Field dissipation study on Aatrex Nine-O for terrestrial uses on bareground, Ripon, California. Laboratory Study No. 1641-86-71-01-21E-23. Prepared by Landis Associates, Inc., Valdosta, GA; Agri-Growth Research, Inc., Hollandale, MN; and Minnesota Valley Testing Labs., Inc., New Ulm, MN; and submitted by Ciba-Geigy Corporation, Greensboro, NC. (40431336)

White, S.M. 1987c. Field dissipation study on Aatrex Nine-O for terrestrial uses on corn, Hollandale, MN. Laboratory Study No. 1641-86-71-01-06B-24. Prepared by Landis Associates, Inc., Valdosta, GA; Agri-Growth Research, Inc., Hollandale, MN; and Minnesota Valley Testing Labs., Inc., New Ulm, MN; and submitted by Ciba-Geigy Corporation, Greensboro, NC. (40431339)

White, S.M. 1987d. Field dissipation study on Aatrex Nine-O for terrestrial uses on corn, Ripon, CA. Laboratory Study No. 1641-86-71-01-06B-22. Prepared by Landis Associates, Inc., Valdosta, GA; Research for Hire, Porterville, CA; and Minnesota Valley Testing Labs., Inc., New Ulm, MN; and submitted by Ciba-Geigy Corporation, Greensboro, NC. (40431338)

Yu, W.C. 1986a. Determination of adsorption/desorption constants of atrazine. Conducted by Cambridge Analytical Associates, Inc., Boston, MA. Laboratory Study No. 59-1A. Completed February 14, 1986. Submitted by Ciba-Geigy Corporation, Greensboro, NC. (40431324)

Yu, W.C. 1986b. Determination of adsorption/desorption constants of G-28279. Conducted by Cambridge Analytical Associates, Inc., Boston, MA. Laboratory Study No. 59-4A. Completed February 17, 1986. Submitted by Ciba-Geigy Corporation, Greensboro, NC. (40431325)

Yu, W.C. 1986c. Determination of adsorption/desorption constants of G-30033. Conducted by Cambridge Analytical Associates, Inc., Boston, MA. Laboratory Study No. 59-6A. Completed February 26, 1986. Submitted by Ciba-Geigy Corporation, Greensboro, NC. (40431328)

Yu, W.C. 1986d. Determination of adsorption/desorption constants of G-28273. Conducted by Cambridge Analytical Associates, Inc., Boston, MA. Laboratory Study No. 59-5A. Completed February 18, 1986. Submitted by Ciba-Geigy Corporation, Greensboro, NC. (40431327)

Yu, W.C. 1986e. Determination of adsorption/desorption constants of G-34048. Conducted by Cambridge Analytical Associates, Inc., Boston, MA. Laboratory Study No. 59-7A. Completed February 26, 1986. Submitted by Ciba-Geigy Corporation, Greensboro, NC. (40431326)

- The following report was not reviewed because the study is considered to be too old:

Harris, C. and G. Warren. 1964. Adsorption and desorption of herbicides by soil. Weeds 12:120-126. Also In unpublished submission received Oct. 21, 1982 under 11683-EX-2; submitted by U.S. Dept. of the Interior, Washington, DC; CDL:248614-N. (00115755)

- The following report was rejected by the contract laboratory because of GLP violations and was, therefore, not reviewed. The new study was reviewed as MRID 40629303:

Obrist, J. 1987. Draft Report: Aerobic/anaerobic and sterile soil metabolism of atrazine: Laboratory Study No. HLA 6015-307A. Unpublished study prepared by Hazleton Laboratories America, Inc. 108 p. (40302101)

- The following report was not reviewed because it is a partial duplicate of 00160292:

Rao, P.S.C. and J.M. Davidson. 1979. Adsorption and movement of selected pesticides at high concentrations in soils. Water Research 13(4):375.380. (05008371)

- The following report was not reviewed because it is an administrative document (transmittal letter) only:

Ciba-Geigy Corp. 1987. Submission of data required under Atrazine Registration Standard. Transmittal of 86 studies. (40431300)

o The following report was not reviewed because it contains analytical methodology only. This method was not used in any of the environmental fate studies:

Jefferson, D. 1986. <u>Validation of methods for the analysis of hydroxyatrazine (G-34048) in Oregon silt loam soil</u>. Laboratory Study Number 32989. Unpublished study conducted by Analytical Bio-Chemistry Laboratories, Inc., Columbia, MO, and submitted Ciba-Geigy Corporation, Agricultural Division, Greensboro, NC. (40431341)

o The following reports were not reviewed because atrazine is used only as a reference compound and the data supplied were insufficient to fulfill data requirements:

Leake, C. and D. Lines. 1982. <u>The leaching of prochloraz and its major soil metabolites in four soil types using TLC</u>: METAB/81/35. Unpublished study prepared by FBC Ltd. 18 p. (00141365)

Weissler, M. and I. Hill. 1980. <u>PP009: Leaching on soil thick-layer chromatograms</u>: Report No. RJ 0138B. Unpublished study received Jan. 15, 1982 under 10182-EX-29; prepared by Imperial Chemical Industries, Ltd., submitted by ICI Americas, Inc., Wilmington, DE; CDL:070638-B. (00130228)

o The following reports were not reviewed because they contain protocols only:

Ciba-Geigy Corp. 1986. <u>Analysis of soil samples in the atrazine field dissipation - terrestrial crop use study</u>: [Protocol]. Unpublished study prepared by W.R. Landis Associates. 14 p. (00156570)

W.R. Landis Associates. 1986. <u>Field dissipation - terrestrial: Noncrop use</u>: Atrazine Protocol No. 1641-86-71-01-21E-02. Unpublished study. 19 p. (00156090)

o The following report was not reviewed because the experimental design was not pertinent to current environmental fate data requirements (artificial soils - Ca, Mg, Na-saturated; used to study effects on hysterisis):

Swanson, R.A. and G.R. Dutt. 1973. <u>Chemical and physical processes the affect atrazine and distribution in soil systems</u>. Contribution from the Dept. of Soils, Water, and Engineering journal paper no. 1875 of the Arizona Agric. Exp. Sta., Univ. of Arizona, Tucson. 87521 as presented on Aug. 27, 1979 at the Annual ASA meetings in Tucson, Arizona in Session C of Division S-2. Received Feb. 5, 1973 and approved Aug. 28, 1973. (00027135)

- o The following reports were not reviewed because the experimental designs were not pertinent to current environmental fate data requirements (general survey of waters for atrazine--the data could not be correlated with field data such as application rate and date, formulation, soil type, and precipitation amounts):

Ross, R. and K. Balu. 1985. Summary of the metalaxyl surface water monitoring for 1983-1985: Report No. EIR-85020. Unpublished compilation prepared by Ciba-Geigy Corp. 163 p. (0015600)

Ross, R. and K. Balu. 1985. Summary of the simazine surface water monitoring for 1975--July, 1985 [including referenced residue reports]: Report No. EIR-85021. Unpublished study prepared by Ciba-Geigy Corp. and others. 309 p. (00155188)

- o The following reports were not reviewed because the studies were conducted using chemicals other than atrazine (although some of the studies used tank mixes with atrazine, the test substances were not primarily atrazine):

Dickson, G. 1983. Environmental impact of Technical CGA-112913 under specified EUP conditions: Report No. EIR-83006. Unpublished study received Apr. 4, 1983 under 100-EX-79; submitted by Ciba-Geigy Corp., Greensboro, NC; CDL:249870-A; 249871. (00126717)

McKay, J. 1987. Butylate: Iowa, 1985-1986, Sutazine + 6-ME: Field dissipation study for terrestrial food crop uses: Laboratory Project ID: RRC 87-69. Unpublished study prepared by Stauffer Chemical Co., Richmond Research Center. 62 p. (40389103)

McKay, J. 1987. Butylate: Florida, 1985-1986, Sutazine + 6-ME: Field dissipation study for terrestrial food crop uses: Laboratory Project ID: RRC 87-65. Unpublished study prepared by Stauffer Chemical Co., Richmond Research Center. 72 p. (40389104)

McKay, J. 1987. Butylate: Florida, 1985-1986, Sutazine + 18-6-G: Field dissipation study for terrestrial food crop uses: Laboratory Project ID: RRC 87-68. Unpublished study prepared by Stauffer Chemical Co., Richmond Research Center. 71 p. (40389105)

McKay, J. 1987. Butylate: Iowa, 1985-1986, Sutazine + 18-6-G: Field dissipation study for terrestrial food crop uses: Laboratory Project ID: RRC 87-71. Unpublished study prepared by Stauffer Chemical Co., Richmond Research Center. 62 p. (40389106)

McKay, J. 1987. Butylate: Iowa, 1985-1986, Sutazine + 6.7-E: Field dissipation study for terrestrial food crop uses: Laboratory Project ID: RRC 87-75. Unpublished study prepared by Stauffer Chemical Co., Richmond Research Center. 62 p. (40389107)

- The following reports were not reviewed because they contained data only (no analytical methodology or field test data for atrazine were provided):

  Danhaus, R. 1982. Dissipation of glyphosate in field soils following minimum till application of Roundup alone or in tank mix combinations with Lasso ME, atrazine, dyanap, or metribuzin: Report No. MSL-2422. Unpublished study prepared by Monsanto Co. and ABC Laboratories, Inc. 143 p. (00152205)

  Danhaus, R., E. Lenox, S. Dubelman, et al. 1982. Dissipation of alachlor in field soils following preemergent applications of Lasso ME alone or in tank mix combinations with Roundup, atrazine, Dyanap, Metribuzin, or cyanazine: MSL-2109. Unpublished study received May 10, 1982 under 524-344; prepared in cooperation with ABC Laboratories, Inc. and Craven Laboratories, Inc., submitted by Monsanto Co., Washington, DC; CDL:070841-D. (00101533)

- The following reports were not reviewed because they contained residue chemistry data only:

  American Cyanamid Company. 1981. Residues of Prowl. Includes undated method M-458.1; method M-465.1 dated May 9, 1974; method M-459.1 dated May 9, 1974; and others. Compilation; unpublished study, including published data, received Jan. 7, 1982 under 241-243; CDL:246583-A. (00093697)

  Beynon, K.I., G. Stoydin, and A.N. Wright. 1972. A comparison of the breakdown of the triazine herbicides cyanazine, atrazine, and simazine in soils and maize. Received Jan. 21, 1972; submitted by Shell Research, Ltd. (00040664)

  Shell Chemical Co. 1982. Multiple application use on field and sweet corn: Residue chemistry: Bladex. Compilation; unpublished study received Feb. 28, 1984 under 201-279; CDL:252506-A; 252507; 252508; 252509. (00139024)

  Wright, A. 19??. The breakdown of [carbon-14]DW 3418 herbicide. Part II: Residues in maize and soils following soil application of [carbon-14]DW 3418, atrazine, or simazine: Group Research Report No. WKGR.0104.68. Unpublished study prepared by Woodstock Agricultural Research Centre, Shell Research Limited. 14 p. (00149428)

- The following reports were not reviewed because they contained summary data only:

  Ellgehausen, H., J. Guth, and H. Esser. 1980. Factors determining the bioaccumulation potential of pesticides in the individual compartments of aquatic food chains: [Addendum to the product chemistry data (octanol/water partition coefficient) submitted on May 16, 1984

by Ciba-Geigy Corp.]. Ecotoxicology and Environmental Safety 4:134-157. (00153235)

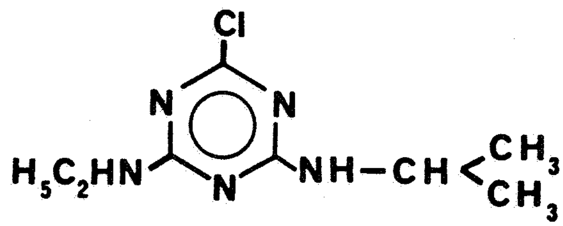
Huber, M. and K. Balu. 1987. Summary of environmental fate studies for the reregistration of atrazine. Laboratory Study Number EIR-87014. Volume 33 of 145 of submission atrazine. Unpublished study prepared by submitted by Ciba-Geigy Corporation, Agricultural Division, Greensboro, NC. (40431318)

- The following report was not reviewed because it contained summary data only and the original data pertain primarily to picloram and not atrazine:

Evans, J. and D. Duseja. 1973. Herbicide contamination of surface runoff waters. Prepared by Utah State Univ. for the Environmental Protection Agency: Project No. 13030 EDJ. Available from the National Technical Information Service. 107 p. (00141646)

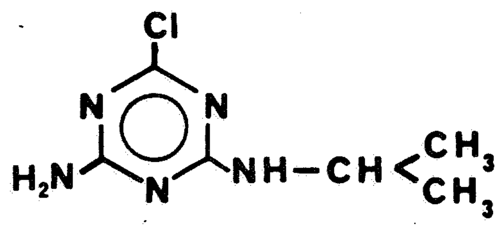
APPENDIX

ATRAZINE AND ITS DEGRADATES



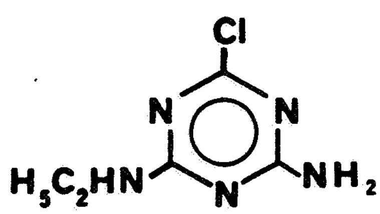
2-Chloro-4-ethylamino-6-isopropyl-
amino-s-triazine

Atrazine
G-30027



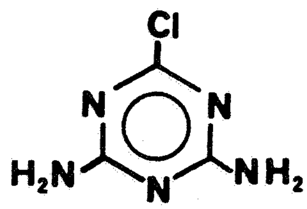
2-Amino-4-chloro-6-isopropylamino-
s-triazine

G-30033



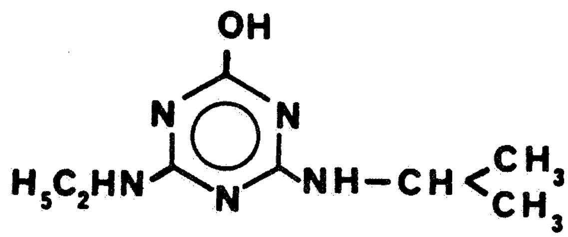
2-Amino-4-chloro-6-ethylamino-s-triazine

G-28279



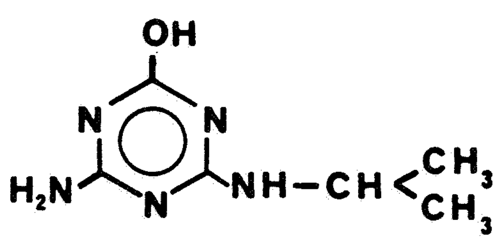
2,4-diamino-6-chloro-triazine

G-28273



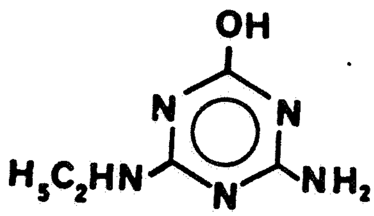
2-Hydroxy-4-ethylamino-6-isopropylamino-s-triazine ("Hydroxy atrazine")

G-34048

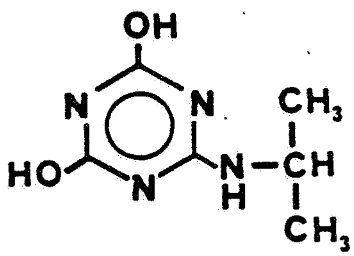


2-Amino-4-hydroxy-6-isopropylamino-s-triazine

GS-17794

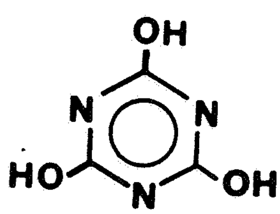


2-Amino-4-ethylamino-6-hydroxy-s-triazine
GS-17792



2,4-Hydroxy-6-isopropylamino-s-triazine

GS-11957



Cyanuric Acid