UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF PREVENTION, PESTICIDES AND TOXIC SUBSTANCES

MEMORANDUM

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SUBJECT: **Propazine** New Chemical Review for Non-Food Greenhouse Uses, Environmental Fate Data sponsored by Griffin Corporation

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Attached is the EFGWB Science Chapter for the new chemical review of Propazine (080808), which is proposed for non-food greenhouse uses. The following environmental fate data was submitted by Griffin Corporation in support of the proposed registration:

Guideline	MRID	Acceptability
161-1 (Hydrolysis)	436898-02	Acceptable
162-1 (Aerobic Soil Metabolism)	001537-12 (obtained from Ciba-Geigy)	Acceptable
163-1 (Leaching)	436898-03	Acceptable/ Partial
163-1 (Adsorption/Desorption)	436898-04	Acceptable/ Partial

The submitted studies, along with an additional leaching study submitted by Ciba-Geigy (MRID 001529-96) and reviewed by EPA in 1987, fulfill the data requirements for the use of propazine in non-food greenhouse weed control. The results of these studies suggest that propazine is stable to hydrolysis, moderately persistent under aerobic soil conditions (half-life of 12 to 24 weeks), and mobile (Fruendlich K_d values of 0.67 to 3.19; K_{oc} values of 65 to 268).

The following items are included in this Chapter: (1) Executive Summary; (2) Environmental Fate Assessment; (3) Recommendations; (4) Current Status of Data Requirements; and (5) Data Evaluation Records For the Supporting Environmental Fate Studies.

2048002

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CHEMICAL INFORMATION

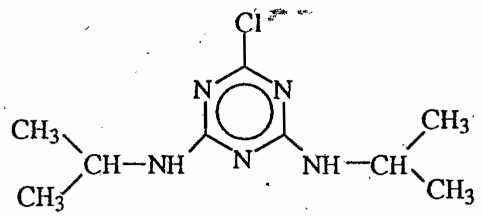
Common name: Propazine

Shaughnessy Number: 080808

Chemical name: 2-chloro-4,6-bis(isopropylamino)-s-triazine
6-chloro-N,N'-bis(1-methylethyl)-1,3,5-triazine-2,4-diamine

CAS Number: 139-40-2

Structure:



Formulations: Wettable Powder (WP), Flowable Concentrate (FlC), Soluble Concentrate/Liquid (SC/L) [taken from EFGWB One-Liner Data Base]

Physical/Chemical Properties:

Molecular formula:	$C_9H_{16}N_5Cl$
Molecular weight:	229.71
Vapor pressure:	2.9×10^{-8} Torr (20° C)
Water Solubility:	8.6 mg/L (ppm) at 20° C
pKa:	1.85 at 22° C [Ref: Montgomery, 1993; p. 356]
Octanol/Water Partition Coefficient:	Log K_{ow} = 2.91 [Ref: Montgomery, 1993; p. 356]
Henry's Law Constant:	1.02×10^{-9} atm m^3 mol^{-1} (calculated)

Test Materials

The active ingredient Propazine was used for all of the studies reviewed for this new chemical use evaluation.

USE PATTERN

At present, the registrant, Griffin Corporation, is proposing to use propazine for the control of greenhouse weeds (non-food greenhouse uses). Prior to voluntary cancellation in 1988, propazine was registered for use on sorghum (terrestrial non-food use).

EXECUTIVE SUMMARY

The registrant, Griffin Corporation, is seeking a new chemical registration to use propazine for the control of greenhouse weeds (non-food greenhouse uses). Prior to voluntary cancellation in 1988 by Ciba-Geigy, propazine was registered for use on sorghum (terrestrial non-food use). This EFGWB Science chapter examines the environmental fate data submitted by Griffin in support of the new chemical use. In addition, the status of the existing environmental fate database, including previous studies submitted by Ciba-Geigy and reviewed by EPA (Exposure Assessment Branch science chapter on propazine registration, dated June 15, 1987), is evaluated in the event that the registrant seeks additional uses in the future and desires to rely on these data.

Environmental fate studies reviewed for this new chemical registration suggest that propazine is moderately persistent and mobile. While apparently stable to hydrolysis in aqueous solutions, propazine may be susceptible to hydrolysis after adsorption onto the surface of soil particles (according to published scientific literature). Propazine is moderately persistent to degradation under aerobic soil conditions, degrading with a half-life of 12 to 24 weeks in a nonsterile loamy sand and 8 to 12 weeks in a sterile loamy sand soil. The major degradate in the metabolism study was hydroxy-propazine [2-hydroxy-4,6-bis(isopropylamino)-s-triazine], which comprised 14-16% of the applied radioactivity after 12 weeks and 31% after one year. Unextracted ("bound") residues comprised 35% after 12 weeks and 58% after one year.

Batch equilibrium experiments suggest that propazine is mobile, with Freundlich K_d values ranging from 0.67 to 3.19 in two separate studies involving 8 soil textures. The K_{oc} values ranged from 65 to 268 in these same studies. The major degradate, hydroxy-propazine was less mobile, with K_d values of 1.13 to 106 and K_{oc} values of 276 to 2163.

Volatility and air photolysis are not expected to be major routes of dissipation due to the low vapor pressure (2.9 x 10^{-8} Torr at 20°C).

The studies submitted by Griffin meet the minimum environmental fate data requirements for the proposed non-food greenhouse uses and additional data are not required at this point.

The environmental fate database is not sufficiently complete to adequately assess the fate of propazine in the terrestrial environment. The laboratory studies summarized above and supplemental studies on terrestrial dissipation (provided by Ciba-Geigy and reviewed in the 1987 EAB document) suggest that propazine has the potential to leach to ground water. Should propazine be reconsidered for terrestrial non-food and/or food crop uses, then additional environmental fate data would be necessary to fill the data gaps in support of outdoor usage.

The existing environmental fate studies on photolysis in water and terrestrial field dissipation are supplemental and would not fully satisfy EFGWB data requirements if required for additional uses. Field dissipation studies should include adequate information on water balance, potential leaching limits, the mapped soil series and soil properties with depth in order to interpret the results beyond the particular study plot and conditions during the time of the study.

The results of all submitted studies should be cohesive and consistent so that a fundamental understanding of the environmental fate of the chemical and its metabolites/degradates is possible.

ENVIRONMENTAL FATE ASSESSMENT

Environmental fate studies reviewed in this science chapter for a new chemical registration and in an earlier EAB (Exposure Assessment Branch) science chapter (dated June 15, 1987) suggest that propazine is moderately persistent and mobile. If applied in an outdoor environment, propazine has a high potential to leach into ground water or reach surface waters by runoff.

Existing laboratory studies indicate that propazine is stable to hydrolysis in sterile aqueous pH 5, 7, and 9 buffered solutions. However, published literature on propazine and related chloro-s-triazines indicate that the chemical may be susceptible to hydrolysis after adsorption onto the surface of soil colloids (a surface catalysis effect). Propazine is moderately persistent to degradation under aerobic soil conditions, degrading with a half-lives of 12 to 24 weeks (calculated 15 weeks) in a nonsterile loamy sand and 8 to 12 weeks in a sterile loamy sand soil. The shorter half-life in the sterile soil may have resulted from alterations in soil properties due to sterilization or may indicate that factors other than microorganisms, such as surface catalysis, affect the degradation of propazine. The major degradate in the metabolism study was hydroxy-propazine [2-hydroxy-4,6-bis(isopropylamino)-s-triazine], which comprised 14-16% of the applied radioactivity after 12 weeks and 31% after one year. Unextracted ("bound") residues comprised 35% after 12 weeks and 58% after one year.

Batch equilibrium experiments suggest that propazine is mobile, with Freundlich K_{ads} values ranging from 0.67 to 3.19 in two separate studies involving 8 soil textures. The K_{oc} values ranged from 65 to 268 in these same studies. The major degradate, hydroxy-propazine was less mobile, with K_{ads} values of 1.13 to 106 and K_{oc} values of 276 to 2163.

Volatility and air photolysis are not expected to be major routes of dissipation due to the low vapor pressure (2.9×10^{-8} Torr at $20^{\circ}C$).

On the basis of these acceptable environmental fate studies, propazine is expected to be moderately persistent and mobile when used in the greenhouse to control weeds for non-food plants. These studies meet the minimum environmental fate data requirements for the proposed non-food greenhouse uses and additional data are not required at this point.

Prior to the voluntary cancellation of the registration in 1988, propazine was used for weed control on sorghum. While the current registration does not encompass non-food terrestrial uses, the existing environmental fate database is evaluated for completeness in the event that future uses are considered.

The environmental fate database is not sufficiently complete to adequately assess the fate of propazine in the terrestrial environment. The laboratory studies summarized above and supplemental studies on terrestrial dissipation suggest that propazine has the potential to leach to ground water. In areas where the soils are highly permeable, the water table is shallow, and sufficient precipitation and/or irrigation occur, the use of propazine may result in ground water contamination. If future uses, such as terrestrial non-food and/or food crop uses, are proposed, then additional environmental fate data would be necessary to support outdoor usage.

Detailed Information on Environmental Fate Studies Supporting New Chemical Registration

The registrant, Griffin Corp., submitted three environmental fate studies in support of non-food greenhouse uses for propazine: 161-1, hydrolysis (Perdue, 1994; MRID 436898-02); 163-1, aged column leaching (Perdue, 1995a; MRID 436898-03) and soil adsorption/desorption (Perdue, 1995b; MRID 436898-04). To address guideline 162-1 for aerobic soil metabolism, Griffin obtained a study (Keller, 1979; MRID 001537-12) from Ciba-Geigy. This study had already been reviewed and found to be acceptable in an earlier EAB (Exposure Assessment Branch) science chapter for the registration of propazine (dated June 15, 1987). Please refer to attached Data Evaluation Records (Appendix 2 and 3) for a detailed discussion of the individual studies.

With these studies, the environmental fate data requirements pertaining to the non-food greenhouse use of propazine for weed control have been satisfied. Environmental fate requirements for other uses, such as terrestrial non-food and/or food crop uses, are addressed in the following section.

A. Degradation

161-1 Hydrolysis

Perdue, D. 1994. Hydrolysis of [^{14}C] Propazine in Aqueous Buffered Solutions at pH 5, 7 and 9. Project No 850. Report No. 1640. Unpublished study performed by PTRL East, Inc., Richmond KY, and submitted by Griffin Corporation, Valdosta, GA. MRID 436898-02.

Propazine was hydrolytically stable, showing no significant degradation at concentrations of 5 ppm in sterile aqueous pH 5, 7 and 9 buffered solutions after 30 days. The plot of propazine concentration with time showed no pattern of decline and the slope was not significant.

B. Metabolism

162-1: Aerobic Soil Metabolism [obtained from Ciba-Geigy and reviewed in the 1987 EAB Science Chapter for Propazine Registration]

Keller, A. 1979b. Degradation of propazine (Gesamil) in aerobic soil. Project Report No. 15/79. Unpublished study prepared by Ciba-Geigy, Ltd., Basle, Switzerland. MRID 001537-12.

Propazine, applied to a nonsterile loamy sand soil (9% clay, 86% sand; 2.2% organic C; pH 5.6) at a rate of 10 ppm, degraded with a half-life of 12 to 24 weeks (calculated half-life was 15 weeks) under dark incubation at 25°C. The major degradate, hydroxy-propazine [2-hydroxy-4,6-bis(isopropylamino)-s-triazine], comprised 14% of the applied radioactivity after 12 weeks and 31% after 52 weeks. Unextractable residues accounted for an additional 35% at 12 weeks and 58% after 52 weeks.

In sterilized loamy sand soil (method of sterilization was not indicated), propazine degraded with a half-life of 8 to 12 weeks. Hydroxy-propazine comprised 16% of the applied radioactivity after 12 weeks while unextracted residues accounted for 31%.

The shorter half-life in the sterile soil may have resulted from alterations in soil properties due to sterilization or may indicate that factors other than microorganisms, such as surface catalysis, may play a role in the degradation of propazine (see discussion on published literature).

C. Mobility

163-1 Leaching and Adsorption/Desorption of Propazine

Perdue, D. 1995b. Soil Adsorption/Desorption of [^{14}C]Propazine by the Batch Equilibrium Method. Project No. 853. Report No. 1653. Unpublished study performed PTRL East, Inc., Richmond, KY, and submitted by Griffin Corporation, Valdosta, GA. MRID 436898-04.

Propazine was highly mobile, with Freundlich K_d values for adsorption/desorption of 0.67/86.4 for sand, 1.28/11.9 for sandy loam, 1.30/27.0 for silty clay, and 1.35/6.7 for loam. The adsorption K_{oc} values were 79 for loam, 96 for silty clay, 128 for sandy loam, and 268 for sand.

163-1 Aged Column Leaching

Perdue, D. 1995a. Column Leaching of [^{14}C]Propazine in Four Soil Types Following Aerobic Aging. Project No. 855. Report No. 1660. Unpublished study performed PTRL East, Inc., Richmond, KY, and submitted by Griffin Corporation, Valdosta, GA. MRID 436898-03.

The mobility of propazine and/or its degradates, applied at a rate of 5 ppm to four soils and aged for 30 days, varied with soil type and, possibly, column packing. An average of 2% (sandy loam) to 19% (sand) of the applied radioactivity was collected in the leachate. While the majority of the applied radioactivity remained in the 0-6 cm soil sections, ranging from 52% (loam) to 84% (sandy loam), radioactive residues were detected in each of the column sections, indicating a redistribution of the aged propazine residues during the leaching process. Propazine was the only ^{14}C-residue identified in the leachate fractions and was the dominant residue in the 0-6 cm column sections.

A supplemental study (MRID 001537-14) reviewed for the 1987 EAB Science Chapter also found that the aged propazine residues were mobile (33% leached in sand soil) to slightly mobile (4% leached in loam soil).

A second adsorption/desorption study (MRID 001529-97) that was found acceptable in the 1987 EAB document also found that propazine was highly mobile. The Freundlich K_d values for adsorption/desorption were 0.34/6.09 for loamy sand, 1.14/3.78 for sandy loam, 2.69/16.8 for loam, and 3.19/44.7 for clay loam. The adsorption K_{oc} values were 65 for clay loam, 83 for loamy sand, 123 for sandy loam, and 158 for loam.

In addition, that study found that the major degradate hydroxy-propazine [2-hydroxy-4,6-bis(isopropylamino)-s-triazine] was less mobile than propazine. The Freundlich K_d values for adsorption/desorption of 1.13/3.42 for loamy sand, 2.94/5.53 for sandy loam, 31.8/56.8 for loam, and 106/143 for clay loam. The adsorption K_{oc} values were 276 for loamy sand, 359 for sandy loam, 1871 for loam, and 2163 for clay loam.

Synopsis of Additional Environmental Fate Data Not Required For Non-Food Greenhouse Use

Only environmental fate data on hydrolysis (161-1), aerobic soil metabolism (162-1), and mobility (163-1) are required for the current proposed non-food greenhouse use. The comments in this section do not pertain to the current new chemical registration and are based on studies originally submitted by Ciba-Geigy and reviewed in the 1987 EAB science chapter. The data obtained from these studies are also available in the EFGWB One Line Summary Data Base. This brief synopsis is presented to paint a more complete picture of our understanding of the environmental fate of propazine and to identify potential data gaps in the event that future uses of propazine are considered.

Photolysis in water (161-2): In a 1972 study (MRID 001537-09), propazine was photolytically stable in aqueous solutions (2.5 ppm propazine; further characterization not provided) when exposed to natural sunlight for up to 17 days, less than the one-month time period specified for photolysis studies. In a second part of the study, propazine degraded under artificial light (source not specified) with a half life of 24 hr. However, greater than 50% of the applied radioactivity was not accounted for in the material balance. These studies were considered supplemental and do not completely satisfy the environmental fate requirements for the aqueous photolysis of propazine.

Anaerobic soil metabolism (162-2): In an acceptable 1979 study (001537-13), propazine degraded with a half-life of 8 weeks in a nonsterile loamy sand soil which was incubated anaerobically after 4 weeks of aerobic incubation. Propazine declined from 77% to 36% of the applied after 8 weeks while the major degradate, hydroxy-propazine increased to 12%. Unextracted residues comprised 50% of the applied after 8 weeks of anaerobic incubation.

Terrestrial field dissipation (164-1): The four submitted studies were either unacceptable or considered supplemental because of inadequate sampling depths (only the upper 12 inches were sampled), lack of freezer stability data (some samples were frozen for up to 3 years), and/or the presence of propazine in the control and treated plots prior to the start of the study. Supplemental data suggest that propazine, applied as a wettable powder at 2.4 to 4.8 lb a.i./A/yr, dissipated from the upper 6 inches with a half-life of <30 to 149 da in NY, <31 da in CA, and 60 to >357 da in NE. The degradates hydroxy-propazine, G-2873 [2-chloro-4,6-diamino-s-triazine], and G-30033 [2-chloro-4-amino-6-isopropylamino-s-triazine] were detected in one or more of the field studies (NY, CA, NE).

Comparison to Published Literature on the Environmental Fate of Propazine

The environmental fate of propazine in published scientific literature is sketchy. The published studies vary in quality and usually contain insufficient information on procedures or raw data to adequately assess the results in relation to EFGWB guidelines. However, these research findings can provide supplemental information on the environmental fate of propazine. The following discussion comes primarily from three published reviews -- Khan (1980), Montgomery (1993), and Wolfe et al (1990) -- which summarize several published studies.

Propazine, like the other triazine chemicals, is weakly basic, with a pKa value of approximately 1.85 at 22°C (Montgomery, 1993). The compound can be easily protonated at low soil pH values but is likely to exist as a neutral species at soil pH values more 2 pH units above the pKa (Koskinen and Harper, 1990). Adsorption of protonated propazine is pH-dependent, with a maximum adsorption at or near the pKa (Khan, 1980). Soil organic matter plays an important role in the adsorption of propazine and other s-triazines, affecting their movement in soil (Hayes, 1970).

The cited literature suggests that chemical hydrolysis of s-triazines, including propazine, is catalyzed by surface adsorption on soil colloids (Khan, 1980; Wolfe et al, 1991). Studies by Russell et al (1968), Brown and White (1969) and Nearpass (1972) found evidence that the chemical hydrolysis of propazine was catalyzed by adsorption onto organic matter and clay.

Montgomery (1993) summarized soil adsorption data from 4 studies (Burkhard and Guth, 1981; Harris, 1966; Talbert and Fletchall, 1965; Walker and Crawford, 1970) involving 38 soils. The reported adsorption K_d values averaged 3.4 mL/g, with a range from 0.1 to 20.5. In 35 of the 38 soils, the K_d values were less than 4.7. The K_{oc} values averaged 155 mL/g with a range of 29 to 363. These results suggest that propazine is similar in mobility to two other chloro-s-triazines: atrazine (p. 31-38 in Montgomery, 1993) and simazine (p. 371-377 in Montgomery, 1993). The results of the environmental fate studies on adsorption/desorption reviewed by EFGWB for this chemical registration are within the range of K_d and K_{oc} values found in the published literature.

RECOMMENDATIONS

Non-food Greenhouse Uses

Environmental fate data requirements for the use of propazine as a herbicide in the greenhouse for non-food plants have been satisfied (see "Status of Environmental Fate Data Requirements"). The submitted studies on hydrolysis, aerobic soil metabolism, and leaching and adsorption/desorption meet the minimum requirements for assessing the fate of propazine for the proposed use covered by this new chemical registration.

Results of available environmental fate studies suggest that propazine is stable to hydrolysis, moderately persistent under aerobic soil conditions (half-life of 12-24 weeks) and mobile (Freundlich adsorption K_d values of 0.34-3.19; K_{oc} values of 65-268). Published research on the environmental fate of propazine suggest that while hydrolysis may not be significant in solution, surface-catalyzed hydrolysis may occur on soil organic matter and clay. Hydroxy-propazine was the major degradate in the metabolism studies. Volatility is not expected to be a major route of dissipation due to the low vapor pressure (2.9×10^{-8} Torr at 20°C).

No additional environmental fate studies are needed for the registration of propazine for non-food greenhouse uses.

Data Considerations For Future Additional Uses

Prior to voluntary cancellation of the registration by Ciba-Geigy in 1988, propazine was used for weed control in sorghum. If the current registrant, Griffin Corp., considers the reregistration of propazine for this use, additional environmental fate data would be needed to adequately assess the fate of the chemical in the terrestrial environment.

As indicated in the table on the status of environmental fate data requirements, the existing studies on photolysis in water and terrestrial field dissipation are supplemental and would not fully satisfy environmental fate data requirements if required for additional uses.

In field dissipation studies we are interested in assessing the mobility of propazine and its metabolites/degradates from all degradative pathways. The use of independent tracers to establish the limits of potential leaching or transport under actual field dissipation conditions would allow for a better interpretation of the results. Alternatively, a water balance based on sufficient information on soil hydraulic characteristics, antecedent moisture throughout the soil profile, amounts and distribution of rainfall and irrigation, and evapotranspiration rates should be provided. Without adequate information on water balance, potential leaching limits, the mapped soil series and soil properties with depth, the results of field studies may not be extractable beyond the particular study plot and conditions during the time of the study.

The results of all submitted studies should be cohesive and consistent so that a fundamental understanding of the environmental fate of the chemical and its metabolites/degradates is possible.

EFGWB One-Liner Database

The EFGWB One-Liner Database has been updated to reflect the results of the submitted studies.

Status of Environmental Fate Data Requirements for Propazine, Non-Food Greenhouse Uses

Guideline	Reference (MRID)[1]	Status[2]
161-1: Hydrolysis	436898-02	Satisfied
161-2: Photolysis in Water	001537-09	NR[3]; Partial[4]
161-3: Photolysis on Soil	---	NR; Not satisfied[5]
161-4: Photolysis in Air	---	NR; Waived, low vapor pressure
162-1: Aerobic Soil Metabolism	001537-12	Satisfied
162-2: Anaerobic Soil Metabolism	001537-13	NR; Satisfied
162-3: Anaerobic Aquatic Metabolism	---	NR
162-4: Aerobic Aquatic Metabolism	---	NR
163-1: Adsorption/Desorption	436898-03,-04 0015299-6,-7; 001537-14	Satisfied
163-2: Volatility - Lab	---	Waived; low vapor pressure
163-3: Volatility - Field	---	Waived; low vapor pressure
164-1: Terrestrial Field Dissipation	001537-15,-16,-17,-18	NR; Partial[4]
164-5: Long-Term Field Dissipation	---	NR; Reserved[6]
165-4: Bioaccumulation in Fish	---	NR; Not satisfied[5]

NOTES:

1 MRIDs 436898-02, -03, and -04 were submitted by Griffin Corporation. MRID 001537-12 was obtained by Griffin from Ciba-Geigy in support of propazine registration for non-food greenhouse uses. The remaining MRIDs were submitted by Ciba-Geigy.

2 The status of the environmental fate requirements applies only to non-food greenhouse uses. Additional uses, such as terrestrial food and non-food crops, may require additional environmental fate data.

3 NR = Data Not Required for non-food greenhouse uses. The data may be required for additional uses (refer to 40 CFR §158.290 to determine the environmental fate requirements of additional uses).

4 The study/studies reviewed for the 1987 EAB Science Chapter provided supplemental data only. Depending on future potential uses, additional data may be required.

5 No studies have been submitted in support of the environmental fate requirement. Depending on future potential uses, studies may be needed to satisfy this data requirement.

6 Depending on future potential uses, and the results of the terrestrial field dissipation studies, a longer term terrestrial field dissipation study may be required.

REFERENCES

Brown, C.B., and J.L. White. 1969. Reactions of 1,2-s-triazines with soil clays. Soil Sci. Soc. Am. Proc. 33:863-867.

Burkhard, N., and J.A. Guth. 1981. Chemical hydrolysis of 2-chloro-4,6-bis(alkyl-amino)-1,3,5-triazine herbicides and their breakdown under the influence of adsorption. Pestic. Sci. 12:45-52.

Harris, C.I. 1966. Adsorption, movement, and phytotoxicity of monuron and s-triazine herbicides in soils. Weeds 14:6-10.

Hayes, M.H.B. 1970. Adsorption of triazine herbicides on soil organic matter, including a short review of soil organic matter chemistry. Residue Rev. 31:131-174.

Khan, Shahamat U. 1980. Pesticides in the soil environment. Elsevier Scientific Publishing Company, Amsterdam. p. 90-97.

Koskinen, W.C., and S.S. Harper. 1990. The retention process: mechanisms. p. 51-77 *In* H.H. Cheng (ed.) Pesticides in the soil environment: processes, impacts, and modeling. SSSA Book Series No. 2. Soil Science Society of America, Madison, WI.

Montgomery, J.H. 1993. Agrochemicals desk reference: environmental data. Lewis Publishers, Chelsea, MI. p. 356-358.

Nearpass, D.C. 1972. Hydrolysis of propazine by the surface acidity of organic matter. Soil Sci. Soc. Am. Proc. 36:606-610.

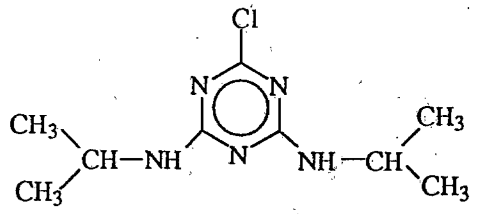
Russell, J.D., M. Curz, and J.L. White. 1968. Mode of chemical degradation of s-triazines by montmorillonite. Science 160:1340-1342.

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

Walker, A., and D.V. Crawford. 1970. Diffusion coefficients for two triazine herbicides in six soils. Weed Res. 10:126-132.

Wolfe, N.L., U. Mingelgrin, and G.C. Miller. 1990. Abiotic transformations in water, sediments, and soil. p. 103-168 *In* H.H. Cheng (ed.) Pesticides in the soil environment: processes, impacts, and modeling. SSSA Book Series No. 2. Soil Science Society of America, Madison, WI.

APPENDIX 1. Propazine



2-chloro-4,6-bis(isopropylamino)-s-triazine

(Propazine)

APPENDIX 2. Data Evaluation Records for Previously Unreviewed Studies

Comparison of Properties and Environmental Fate Data
Propazine vs. Other Triazine Herbicides

		------ Chloro-s-triazines ------			----- Other s-triazines ------		
Property	**Units**	**Propazine**	**Atrazine**	**Simazine**	**Prometone**	**Prometryn**	**Ametryn**
PC Code		80808	80803	80807	80804	80805	80801
R1		Cl	Cl	Cl	OCH_3	SCH_3	SCH_3
R2		iso-C_3H_7	iso-C_3H_7	C_2H_5	iso-C_3H_7	iso-C_3H_7	iso-C_3H_7
R3		iso-C_3H_7	C_2H_5	C_2H_5	iso-C_3H_7	iso-C_3H_7	C_2H_5
Emp. Form.		$C_9H_{16}N_5Cl$	$C_8H_{14}N_5Cl$	$C_7H_{12}N_5Cl$	$C_{10}H_{19}N_5O$	$C_{10}H_{19}N_5S$	$C_9H_{19}N_5S$
Chemical Properties							
Mol. Wt.	g/mol	229.71	215.69	201.66	225.29	241.35	227.30
Melt. Pt.	C	212	176	225-227	91-92	118-120	84-86
Vap. Pres	mmHg, 20C	2.9E-08	3.0E-07	6.1E-09	3.1E-06	1.0E-06	1.7E-06
Vap. Pres	mmHg, 30C	1.6E-07	1.6E-07	3.6E-08	7.6E-06	4.0E-06	
pKa		1.85	1.62	1.70	4.30	4.05	4.10
Log Kow		2.91	2.68	2.51	2.69	3.46	3.07
H (mea)	atm m3/mol			3.20E-10			
H (calc)	atm m3/mol	1.02E-09	2.58E-09	4.62E-10	1.48E-09	9.62E-09	2.75E-09
S-water	mg/L, 20C	8.6	33	3.5	620	33	185
S-acetone					3.00E+08	2.40E+08	5.00E+08
S-Benzene	ppm, 20C	6.20E+03			2.50E+08		
S-Chlorof.			5.20E+04	9.00E+02			
S-Methanol			1.80E+04	4.00E+02	6.00E+08	1.60E+08	4.50E+08
S-Toluene		6.20E+03			2.50E+08	1.70E+08	4.00E+08
Hydrolysis							
Ht1/2, pH	da	Stable	Stable	Stable	Stable	Stable	Stable
Ht1/2, pH	da	Stable	Stable	Stable	Stable	Stable	Stable
Ht1/2, pH	da	Stable	Stable	Stable	Stable	Stable	Stable
Ht1/2, pH	da	3	3.3			35	
Ht1/2, pH	da		14				
Ht1/2, pH	da		48				
Ht1/2, pH	da		240				
Ht1/2, pH	da		100				
Ht1/2, pH	da		12.5				
Ht1/2, pH	da	2	1.5			1440	
Photolysis							
Pw-t1/2	da	Stable	Stable	Stable	Stable	1-2	Stable
Ps-t1/2	da				~357		Stable
Metabolism							
AerS1/2	da	84-168	21-146	36-234	>365	83-360	41/84
AnaS1/2	da	56-84	159		>90	60-90	Stable
AnaAq1/2	da		608				
Mobility							
Kd/1-Lin		0.34-3.19	0.20-2.46	0.48-4.31	0.40-2.90	0.66-9.95	0.6-5.0
Koc/1-Lin							67-160
Kd/ADR	No.	38	67	174	33	47	38
	Mean	3.4					
	Range	0.1-20.5	0.23-12.6	0.21-11.2	0.5-55.2	0.62-139	0.88-18.2
Koc/ADR	Mean	155					
	Range	29-363	47-394	26-3559	53-3833	57-9586	120-959
Kd/Comp	No.	32/29	32	32	29	29	
	Mean	2.45	2.82	3.5	7.19	8.72	
	Range	0.1-11.9	0.6-7.1	0.9-7.9	0.5-55.2	0.9-43.4	
Koc/Comp	Mean	156	195	244	524	626	
	Range	29-363	53-394	47-486	53-3833	57-3014	
Terrestrial Dissipation							
TerrDis1/2	State/Da	NY/<30-149 CA/<64			NE, NY 200-400	CA/71-103 TX/14-30	NE/230-24 NY/39-114