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Aquatic Exposure Assessment

SUBJECT: Drinking Water Assessment for Propazine Use on Sorghum and Green House Ornamentals
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The Environmental Fate and Effects Division has reviewed the proposed use of Propazine (Propazine 4L; 43% ai) to control weeds on container grown ornamentals in greenhouses and on sorghum. This memorandum reports the estimated drinking water concentrations (EDWCs) for human health assessment (**Table 1**). The surface water estimation was based on the Tier II PRZM/EXAMS (Pesticide Root Zone Model) and EXAMS (EXposure Analysis Modeling System) models, while the ground water was based on the Tier I SCI-GROW2 (Screening Concentration in Groundwater). Note that although the maximum allowed application rate for greenhouse use is higher than that of sorghum use, this assessment was performed on sorghum at one aerial application of 1.2 lb ai/A. EFED expects insignificant exposure to drinking water resources from propazine use on container grown greenhouse ornamentals.

The surface water EDWCs were estimated using the Texas and Kansas scenarios, as TX and KS are the two states with the most harvested acreage of sorghum. Note that this drinking water assessment was based on parent propazine only, as insufficient data exist to fully assess the persistence and mobility of propazine's major degradate, hydroxy-propazine [2-hydroxy-4,6,bis(isopropylamino)-s-triazine] in the environment. Furthermore, based on the risk assessment of the atrazine and simazine, this hydroxy-propazine [2-hydroxy-4,6,bis(isopropylamino)-s-triazine] was not considered to be of toxicological concern to human health. The minor degradates DEA and DACT, although of equal potency toxicologically compared to parent propazine, were also not included in this assessment mostly due to their low detection in the laboratory soil metabolism studies and in the terrestrial field studies (less than 5% of Total Applied Radioactivity (TAR)). For atrazine and simazine, these chlorinated degradates were formed at much higher percentage, and ample monitoring data were available to adequately estimate their concentrations versus those of the parents. For propazine, minimal monitoring data exist for an adequate quantitative assessment of the chlorinated degradates. Additionally, as mentioned above, laboratory and field studies indicate that DEA and DACT, if formed in the environment, would not be present nor would persist at any significant concentration compared to parent propazine to adversely impact the results of the drinking water assessment, as presented in this document.

Table 1 - Estimated Drinking Water Concentrations (EDWCs) of Propazine Ground and Surface Water (ppb).

	Upper 10th percentile *			
Sorghum 1.2 lb ai/A; 1 aerial app/yr	**Peak**	**Annual Mean**	**Yearly Average**	**Acute / Chronic**
Surface Water - Texas (0.87 PCA adj)	84	27	13	
Surface Water - Kansas (0.87 PCA adj)	38	14	10	
Ground Water				6.9

* Surface Water EECs were adjusted with National PCA value

Note that the surface water EDWCs reported above were adjusted with the EFED default national PCA value of 87%. Further refinement using the regional PCAs was also performed for the five states of high propazine use (Texas, Kansas, Oklahoma, Colorado, and New Mexico - see **figure 1**). In contrast to the national PCA, which is crop dependent, the regional PCAs incorporate regional considerations into the refined drinking water exposure assessments. The refined surface water EDWCs are summarized in **Table 2**. Further discussion on the limitations of regional PCAs are discussed in the "Uncertainties" section of Modeling Estimates.

Table 2 - Estimated Drinking Water Concentrations (EDWCs) of Propazine Surface Water (ppb), adjusted with Regional PCA values

	Upper 10th percentile		
Sorghum 1.2 lb ai/A; 1 aerial app/yr	**Peak**	**Annual Mean**	**Yearly Average**
Surface Water - Texas (0.67 Regional PCA adj)	65	21	10
Surface Water - Kansas (0.80 Regional PCA adj)	35	13	9
Surface Water - Oklahoma (0.80 Regional PCA adj)	77	25	12
Surface Water - Colorado (0.11 Regional PCA adj)	11	3	2
Surface Water - New Mexico (0.28 Regional PCA adj)	27	9	4

Monitoring data, although available, were not abundant in the areas of high propazine use and high run off potential, such as the coastal areas of Texas. Furthermore, the quality of the available monitoring data are not sufficiently reliable and at times could not be adequately or reasonably assessed. Therefore, EFED recommends modeling data, as presented in **Table 2,** for use in the human health risk assessment. The results from monitoring studies, as discussed in the following paragraph and in more details in the "Monitoring Data" section, are included in this assessment to solely corroborate the ability of propazine to contaminate surface and ground water and should not be used quantitatively.

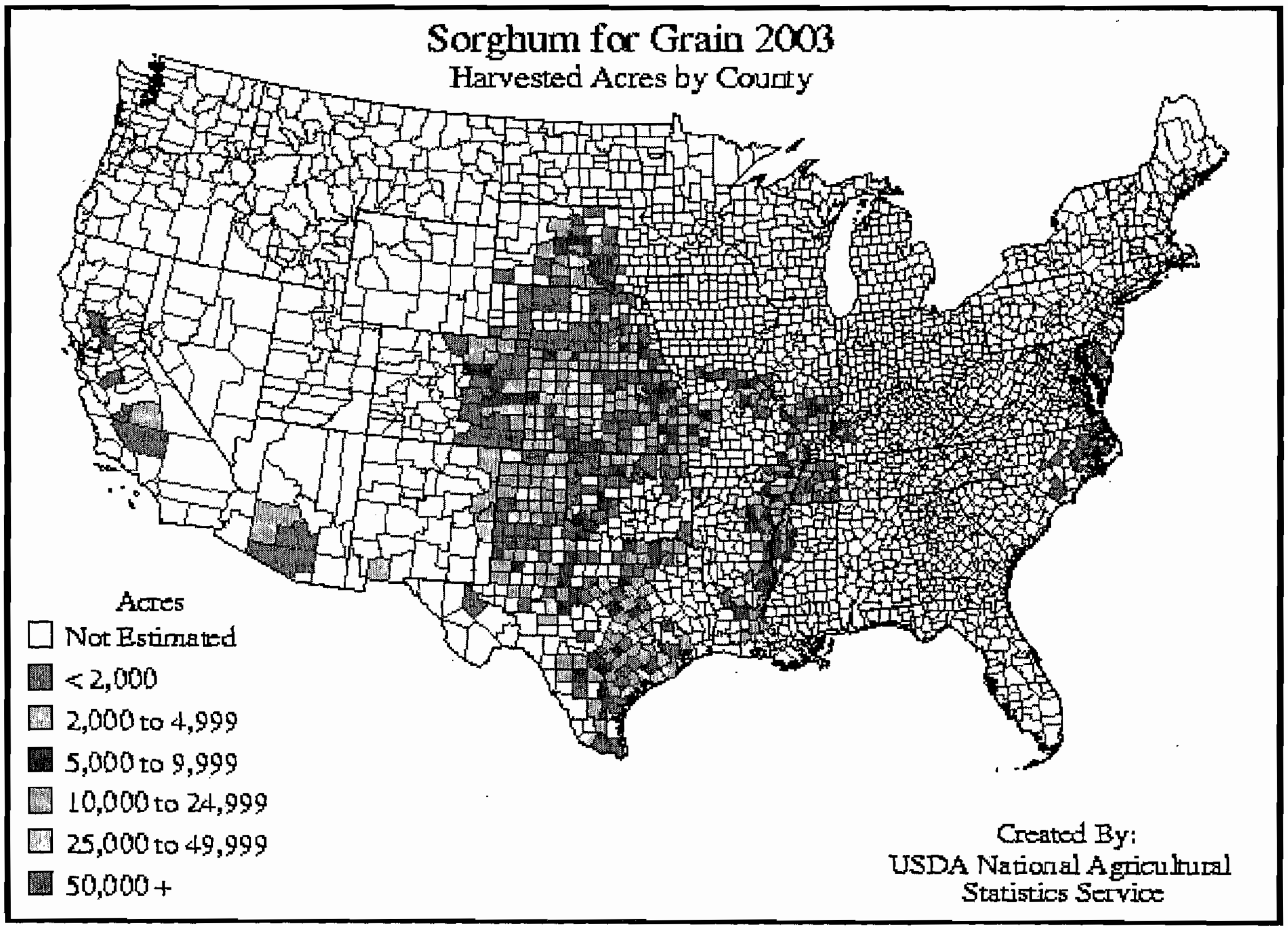
Readily available reports on surface and ground water monitoring data for propazine were also reviewed. For surface water, the US EPA's Office of Water STORET Database (1997) reports concentrations of propazine residues ranging from 9.1 to 105 ppb for Kansas (detection limits of 0.5 to 1.2 ppb), and from 0.4 to 2.1 ppb for Texas (detection limit of 0.1 ppb) (**Table 7**). For ground water, the US EPA Pesticides Ground Water Database (PGWDB; 1992) reports low detection of propazine in 12 states (less than 1 ppb) (**Table 8**). Other sources of data, including the National Research Council, Safe Drinking Water Committee and the US EPA (1977) and the Guidance for the Reregistration of Pesticide Products Containing Propazine (1988) also reported propazine in drinking water resources throughout the United States. Propazine was found in 33 out of 1,097 surface water samples reported in these references and in 15 out of 906 groundwater samples with maximum concentration of 13 ppb for surface water and 300 ppb for groundwater.

Proposed Uses

Propazine is part of the triazine herbicide family (including atrazine, cyanazine, and simazine) and is effective at stopping the photosynthetic process in susceptible plants by binding to specific sites within the plant's chloroplasts.

Propazine has been previously registered for use on sorghum and in greenhouse ornamentals. However, due to economic considerations, in 1990, the propazine registration was voluntarily cancelled by the Registrant (then Ciba-Geigy). For the 1993, 1994, 1995, 1996, and 1997 use seasons, at the request of sorghum growers, EPA granted section 18 emergency exemptions for the use of propazine to the five states of highest sorghum use: Colorado, Kansas, New Mexico, Oklahoma, and Texas. Presently there are no supported uses (agricultural and non-agricultural) of propazine in the United States.

Figure 1



Griffin L.L.C. is now seeking registration for propazine to be used as a selective herbicide in the control of annual grasses in sorghum (grain and sweet sorghum) and broadleaf weed in container grown ornamentals in greenhouses. End use formulations of propazine that are manufactured by Griffin L. L.C. include a 98% wettable powder technical product and a 43% flowable concentrate end use product (Propazine 4L; 43%ai).

Propazine 4L can be applied within four weeks before planting; or prior to weed or sorghum emergence; and or after removal of existing weeds. The proposed uses are listed in **Table 3.** Note that only one application is allowed during the planting cycle (ornamental uses) or per crop growing season (sorghum uses).

Table 3. Proposed Use Information for Propazine 4L

Crop (Application type)	**Soil Texture**	**Rate**
Container-grown ornamentals in greenhouses (ground)	Sand, Loamy Sand, and Sandy Loam Loam, Silt, Silty Loam, Silty Clay Loam, and Sandy Clay Loam Sandy Clay, Clay Loam, Silty Clay Loam, and Peat-Lite Mixes	0.0117 lb ai/1000ft^2 0.0195 lb ai/1000ft^2 0.0352 lb ai/1000ft^2
Sorghum -Grain and Sweet (ground and aerial)	Sand, Loamy Sand, Heavy Clay, High OM Sandy Loam, Loam, Silt Loam, and Clay Loam	Do not use 1.2 lb ai/A

Chemical and Physical Properties

Common name:	Propazine
Chemical name:	2-chloro-4,6-bis(isopropylamino)-s-triazine
CAS number:	139-40-2
Molecular formula:	$C_9H_{16}ClN_5$
Molecular weight:	229.71
Melting point:	212-214°C
Vapor Pressure:	2.9×10^{-8} mm Hg at 20°C
Water solubility:	8.6 mg/L water at 20°C
Henry's Law Constant:	1.02×10^{-9} atm·m^3/mol (calculated)
Log K_{ow}:	2.91
pK_a:	1.85 at 22°C

Environmental Chemistry

Propazine is a colorless crystalline solid. It is stable in neutral, slightly acid, or alkaline media, but is hydrolyzed by stronger acids and alkalis. It is nonflammable and non corrosive under normal use conditions, however may burn if exposed to heat or flame. Thermal decomposition may produce toxic oxides of carbon and nitrogen, and toxic and corrosive fumes of chlorides.

Persistence: Existing laboratory studies indicate that propazine is resistant to breakdown by hydrolysis and photolysis (both aqueous and in soils). 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 persists to degradation under laboratory aerobic soil conditions with half-lives ranging from 15 weeks in loamy sand soil and to 41 weeks in sandy loam soil. The major soil metabolite is 2-hydroxy propazine (2-hydroxy-4,6-bis(isopropylamino)-s-triazine), which comprised of a maximum of 31% of the total applied radioactivity (TAR) after one year. Minor degradates consist of desethylatrazine (2-amino-4-chloro-6-isopropylamino-s-triazine or DEA) (less than 2% of TAR) and 2-hydroxy desethylatrazine (<5% of TAR). No studies were submitted on the persistence of the degradates (both major and minor) in the environment.

Propazine is not likely to volatilize from near surface soils or surface waters under normal environmental conditions, due to its low vapor pressure (2.9 x 10-8 Torr at 20C). If released to water, propazine will not be expected to bioconcentrate in aquatic organisms, adsorb to sediment and/or suspended particulate matter, or to volatilize. Slow biodegradation of propazine may occur in natural water based upon its biodegradation in soil.

Mobility: Propazine does not adsorb as strongly to soil particles as other triazine herbicides. In most soils used in batch equilibrium studies, especially sand and sandy loam soils, it binds weakly to soil particles ($K_{oc\text{-}ads}$ = 268 and 128 mL/g, respectively). Literature studies also showed that depending on soil temperature, moisture, and pH, it can become unbound ("Worthing, C.R., ed., 1983. The pesticide manual: A world compendium. Croydon, England: The British Crop Protection Council."). The major degradate, 2-hydroxy propazine is slightly less mobile, with $K_{oc\text{-}ads}$ values ranging from 78 (loam) to 342 (silty clay) mL/g. In sand and sandy loam soils, the $K_{oc\text{-}ads}$ values are 329 and145 mL/g, respectively.

Based on the information summarized above, propazine is expected to be moderately persistent and mobile in most soils, and it is resistant to breakdown by hydrolysis, photolysis, or biodegradation. The mobility of propazine is also noted in the fields, where supplemental terrestrial field dissipation studies suggest that propazine dissipates slowly from the upper 6 inches (half-lives of 51 days in TX, and 7 to 58 days in NC, <30 to 149 days in NY, <31 days in CA, and 60 to >357 days in NE) to leach to ground water. It has also been reported in the literature that if released to soil, propazine will persist longer in dry or cold conditions or other conditions which inhibit biological and chemical activity (Worthing). It is therefore very likely that in areas where soils are highly permeable, the water table is shallow, or where there is irrigation and/or high rainfall, the use of propazine may result in ground water contamination.

The major laboratory soil degradate, 2-hydroxy propazine was seen in the 0-3" and 3-6" soil layers of the terrestrial field studies at approximately 15% of parent at day 1, and decreased to less than 5% of parent by day 93. The other two minor degradates desethylatrazine (DEA) and 2,4-diamino-6 chloro-s-triazine (DACT), which are common to atrazine and simazine, were detected only in the 0-3" soil layer, each at less than 5% of parent at day 1, however decreasing to less than 1% by day 28.

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 the Subdivision N 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 (pKa ≈ 1.85 at 22C; Montgomery, 1993), can be easily protonated at low soil pH values, and is likely to exist as a neutral species at soil pH values more than two pH units above the pKa (Koshinen 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 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 four 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 of 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 (ranging from 29 to 363), which are within the range of the K_{oc} values reported in the above mentioned environmental fate studies.

Water Resources Assessment

Monitoring data, although available, were not abundant in the areas of high propazine use and high run off potential, such as the coastal areas of Texas. Furthermore, the quality of the available monitoring data are not sufficiently reliable and at times could not be adequately or reasonably assessed due to the following problems: (1) Information about the application dose or rate, areas of pesticide use, and farming practices involving application frequency and irrigation are insufficient or not available; (2) The monitoring database is a collection of isolated studies because the monitoring activities were not performed in a consistently uniform manner due to differences in study designs that radically affected the results; (3) Characterization of the sampling sites such as susceptibility of the watershed soils to runoff, soil index, monthly precipitation, and residence times of surface water bodies is inadequate; (4) The integrity of the sampling techniques, preservation procedures, and storage methods are questionable or sometimes not documented; (5) Analytical methods and limits of detections are different in several monitoring studies, thus contributing to difficulty in data interpretation.

For the aforementioned reasons, the results from monitoring studies are included in this assessment only as a corroboration of the ability of propazine to contaminate surface and ground water and should not be used quantitatively. Modeling estimates, presented in above **Tables 1 and 2**, are recommended for use in the human health risk assessment.

Modeling Estimates: As indicated in **Table 4**, the EDWC's for surface water bodies were determined using the Tier II screening-level simulation models PRZM and EXAMS (2.98.04), and the EDWCs for groundwater were derived using the Tier I screening level SCI-GROW2. Additional information on these models can be located at: http://www.epa.gov/oppefed1/models/water/.

Table 4 - Models Used in Drinking Water Assessment

Exposure Estimates	Model
Surface water (Tier II)	PRZM (Pesticide Root Zone Model) version 3.12 (Carsel *et al.*, 1997), May 24, 2001; simulates pesticide transport off the field EXAMS (Exposure Analysis Modeling System) version 2.98.04 (Burns, 2002), July 18, 2002; simulates the fate of chemicals in water body Linked with EFED PE4VO1.pl, August 8, 2003
Groundwater (Tier I)	SCI-GROW2 (Screening Concentration In Ground Water) version 2.3, August 8, 2003.

The surface water EDWCs were estimated using the standard index reservoir scenario in which a 172-ha field drains into a 5.3-ha reservoir. Typically if available, a national percent cropped area (PCA) adjustment factor is applied to PRZM/EXAMS outputs as an adjustment for the percent of crop in the watershed. For sorghum, the five states where propazine may be needed are: Colorado, New Mexico, Kansas, Oklahoma, and Texas. Currently, EFED has two sorghum scenarios (Texas and Kansas) that could be used as surrogates for these five states. Copies of PRZM/EXAMS input and output files are presented in Appendix I. Copies of the Metadata files for the TX Sorghum and KS Sorghum model scenarios are located at http://www.epa.gov/oppefed1/models/water/metadata.htm. Since no PCA value is available for sorghum, a default national adjustment factor of 0.87 was applied. With the national PCA factor, the **TX** sorghum scenario estimates the highest **peak EDWC of 84 ug/L** and the highest **annual average of 27 ug/L**. Further refinement using the regional PCAs was also performed for the five above mentioned high propazine use states. In contrast to the national PCA, which is crop dependent, the regional PCAs incorporate regional considerations into the refined drinking water exposure assessments. There are eighteen regions within the continental US, therefore eighteen regional PCAs representing the HUC-8-scale watershed that is most intensively cropped with the major basin of that region. The regional PCA values range from 7% for the upper Colorado to 87% for Missouri. For this assessment, based on a regional PCA value of 80%, **OK** has the highest **peak and annual average** concentration of **77 and 25 ug/L**, respectively. Using a regional PCA of 67%, **TX** EDWCs have been reduced to **65 ug/L for peak** and **21 ug/L for annual average**. Note that, as a default, since the TX scenario estimates higher EDWCs than the KS scenario, the refined estimates for OK, CO, and NM were based on the TX sorghum scenario. Therefore, although KS and OK share the same PCA value of 80%, the EDWCs for OK are higher than those of KS. However, based on the similarity in geographic location, soil hydrology and type, weather pattern, and hydrologic boundary of these two states, EFED believes that surface water runoff in OK could be comparable to that of KS.

The groundwater model SCI-GROW2 estimates likely groundwater concentrations if the pesticide is used at the maximum allowable rate in areas where groundwater is vulnerable to contamination. Characteristics of such vulnerable areas include high rainfall, rapidly permeable soil, and a shallow aquifer. In most cases, a large majority of the use area will have groundwater that is less vulnerable to contamination than the areas used to derive the SCI-GROW2 estimate. Using one aerial application of 1.2 lb ai/A of propazine on sorghum, the lowest lowest Koc of 65 mL/g and the average aerobic metabolism half-life of 197 days, SCI-GROW2 estimates a ground water EDWC of 6.9 ug/L. This value can be used for both acute and chronic (i.e., peak and mean) in determining potential risk to human health from drinking water contaminated with a pesticide.

Modeling relies on estimated fate parameters and assumes agricultural practices to predict concentrations of a pesticide to which humans may be exposed. For propazine, the fate database is essentially complete except for the terrestrial field dissipation studies, which were deemed supplemental, and repeating the studies may be necessary. Sufficient information was available to estimate all fate parameters required as model inputs for both PRZM/EXAMS and SCI-GROW2 for propazine. However, the environmental fate data are limited to only those studies submitted and therefore to insure that an EDWC is predicted which is protective of all populations, some of the model inputs used in this assessment (such as half lives for aerobic soil metabolism, aerobic and anaerobic aquatic metabolism studies) were estimated at the upper 10th percentile in accordance with EFED guidance (see EFED *"Guidance for Chemistry and Management Practice Input Parameters for Use in Modeling the Environmental Fate and Transport of Pesticides"* dated February 28, 2002). The general input values used in the model runs are presented in **Table 5**.

Table 5 - Propazine Input Parameters for PRZM/EXAMS and SCI-GROW2

Parameter	**Value**
Application Rate (lb a.i./A/application) One application per year	KS Sorghum: 1.2 TX Sorghum: 1.2
Application Type and Depth of Incorporation (cm)	Aerial application with no incorporation
Soil Partition Coefficient (K_{oc}; mL/g) r^2 of K_{oc} vs. OC = 0.9382	125 (average of 65, 83, 123, 158, 78, 96, 128, and 268 - PRZM/EXAMS) 65 (lowest K_{oc} - SCI-GROW2)
Aerobic Soil Metabolism Half-life (days)	480 days (upper 90th percentile confidence bound on mean half-life of 289 and 105 days - PRZM/EXAMS) 197 days (average - SCI-GROW2)
Anaerobic Soil Metabolism Half-Life (days)	56 days
Spray Drift Fraction (ground spray / aerial)	0.64 / 0.16 0.01/ 0.05
Application Efficiency (ground spray / aerial)	0.99 / 0.95 0.99/0.95
Molecular Weight	230 g/mole
Vapor Pressure	2.9×10^{-8} torr
Henry's Law Constant	1.02×10^{-10} Pa m^3 / mole
Solubility in Water at 20°C	2.9 ppm
Aerobic Aquatic Metabolism Half-life (days)	$t_{1/2}$ = 2 x 480 = 960 days (No data, use 2x aerobic soil metab. $t_{1/2}$)
Anaerobic Aquatic Metabolism Half-life (days)	$t_{1/2}$ = 2 x 56 =112 days (No data, use 2x anaerobic soil metab. $t_{1/2}$)
Hydrolysis Half-life @ pH 7 (days)	stable
Aquatic Photolysis Half-life @ pH 7 (days)	stable

<u>Uncertainties in Modeling Estimates</u>:

- In addition to being conservative and estimating the modeling input parameters at the 90th percentile, a default national maximum PCA value of 87% was used, a value which EFED believes is high for sorghum. Since the sorghum production area where propazine may be needed the most is within the states of Colorado (East), New Mexico, Kansas, Oklahoma, and Texas, further refinement to the EDWCs were made using the regional PCA values: 67% for Texas, 80% for KS and OK, 7 -11% for CO, and 28% for NM. These refined EDWCs were listed above in **Table 2**. Since the TX scenario estimate higher EDWCs than the KS scenario, as a default, CO and NM values were based on TX sorghum. The same reasoning applies for OK, although OK and KS within the same region and share the same regional PCA value. However, based on the similarity in geographic location, soil hydrology and type, weather pattern, and hydrologic boundary of these two states, EFED believes that surface water runoff in OK may very comparable to that of KS.

- The BEAD division has reported that an average of less than 10% of sorghum was treated with propazine during the 1987 to 1989 time period, with about one-half of all sorghum treated with atrazine in this time period. Furthermore, BEAD noted that the use of propazine continued at much reduced levels until 2000, while atrazine use on sorghum remained relatively constant over the entire time period. When propazine was no longer available, less than one-half of the propazine market may have been replaced with atrazine. Based on these data, the BEAD predicts that if propazine became available again for use on sorghum, the total use of propazine would be less than 1,000,000 pounds applied to less than 1,000,000 acres of sorghum, which would result in a PCT (percent crop treated) value for sorghum at about 10%. With this prediction, the EDWCs could be lower than those reported in Table 2. However, at present, EFED does not have enough data to quantitatively include the PCT value into the EDWCs. The PCT is a state wide average; however, pesticide usage can be highly concentrated locally in only a few basins. Currently EFED does not have any reliable tools to estimate how high the PCT would be in each individual basin, and therefore could not incorporate the PCT value in the adequate estimation of pesticide residues in each individual basin.

Monitoring Data: Readily available reports on surface and ground water monitoring data for propazine were reviewed to get an idea of the levels of propazine actually detected in different environmental media. The results are presented here to corroborate the ability of propazine to contaminate surface and ground water and should be used qualitatively only.

Surface Water: Several sources of surface water monitoring data were reviewed, including data from the USGS reconnaissance studies and the US EPA's Office of Water STORET Database (1997).

1. USGS Reconnaissance Data: The post application monitoring data were performed on numerous streams within the 10 states comprising the Midwestern corn belt in 1989, 1990, 1994, and 1995. The maximum contamination was detected in Ohio at 3.8 ppb (see **Table 6**). Although these data provide useful information, Kansas and Southern Nebraska were the only areas in the primary propazine market area covered by these USGS studies. Furthermore, multiple pesticide residue studies not designed specifically for propazine may include many sampling stations outside of propazine use areas even within Kansas and Southern Nebraska.

Table 6 - USGS Reconnaissance Studies

State	1989 Post App Detects Samples	1990 Post App Detects Samples	1994 Post App Detects Samples	1995 Post App Detects Samples	3 Highest Propazine Dectects (ug/L)
IA	10 / 20	8 / 19	0 / 10	5 / 10	0.64, 0.51, 0.51
IL	6 / 28	5 / 10	3 / 9	6 / 8	1.4, 0.94, 0.75
IN	15 / 21	8 / 8	1 / 8	2 / 8	0.37, 0.27, 0.25
KS	3 / 4	1 / 1	1 / 2	2 / 2	0.17, 0.15, 0.14
MN	1 / 14	0 / 5	1 / 3	0 / 3	0.21, 0.13
MO	1 / 6	0 / 1	1 / 1	-	0.23, 0.07
NE	10 / 15	4 / 7	5 / 6	5 / 6	0.58, 0.47, 0.35
OH	8 / 13	10 / 10	2 / 9	4 / 9	3.8, 0.83, 0.57
SD	0 / 8	0 / 1	-	-	none
WI	1 / 9	0 / 4	0 / 4	0 / 4	0.37
Total	55 / 138 (39.9%)	36 / 66 (54.5%)	14 / 52 (26.9%)	24 / 50 (48.0%)	3.8, 1.4, 0.94

2. STORET Database: For the five states considered for the propazine market, the STORET Database (1997) reports residue concentrations ranging from 9.1 to 105 ppb for Kansas (detection limits of 0.5 to 1.2 ppb), from 0.4 to 2.1 ppb for Texas (detection limit of 0.1 ppb), and 0.1 to 0.3 ppb (detection limits of 0.1 ppb) in Oklahoma. There was no detection in surface water for Colorado and New Mexico (**Table 7**).

Table 7 - USEPA STORET Data for Propazine in Surface Waters (1997)

State	Propazine Detects / Sample		Propazine Detection Limits (ug/L)	Maximum Propazine Detections (ug/L)
Arkansas	0 / 243	(0.0%)	0.01	None
California	2 / 153	(1.3%)	0.10	0.1, 0.1
Colorado	0 / 42	(0.0%)	0.10	None
Connecticut	0 / 64	(0.0%)	0.05, 0.10	None
Delaware	2 / 47	(4.3%)	0.05	0.22, 0.11
Georgia	0 / 8	(0.0%)	0.05, 0.10	None
Hawaii	0 / 3	(0.0%)	0.10	None
Iowa	0 / 32	(0.0%)	0.05, 20, 25	None

Idaho	0 / 5	(0.0%)	0.00	None
Illinois	26 / 228	(11.4%)	0.05, 0.10	0.29, 0.2, 0.2
Indiana	6 / 43	(13.9%)	0.05, 0.10	0.11, 0.1, 0.1
Kansas (1) [1]	70 / 3505	(2.0%)	0.05, 0.1, 0.3, 1.2	5.6, 4.9, 2.6, 1.8, 1.3, 1.1
Kansas (2) [2]	201 / 3505	(5.7%)	0.05, 0.1, 0.3, 1.2	105, 27, 20, 15, 13, 13, 13, 12, 11, 9.7, 9.2, 9.1
Kentucky	0 / 63	(0.0%)	0.10	None
Louisiana	0 / 243	(0.0%)	0.05, 0.10	None
Maryland	5 / 188	(2.7%)	0.05, 0.10	0.1, 0.09
Missouri	9 / 160	(5.6%)	0.05, 0.10, 0.30, 1.20	1.9, 0.8, 0.3
Mississippi	2 / 98	(2.0%)	0.10	0.1, 0.1
Montana	0 / 3	(0.0%)	0.10	None
North Carolina	0 / 60	(0.0%)	0.05, 0.10	None
North Dakota	0 / 38	(0.0%)	0.10	None
Nebraska	129 / 853	(15.1%)	0.05, 0.1, 0.3, 3.4, 20	3.9, 3.4, 1.1, 0.65, 0.63
New Mexico	0 / 21	(0.0%)	0.10	None
Ohio	13 / 50	(26.0%)	0.05	0.57, 0.42, 0.23
Oklahoma	3 / 111	(2.7%)	0.05, 0.1, 0.3	0.1, 0.1, 0.1
Oregon	0 / 42	(0.0%)	0.10	None
Pennsylvania	68 / 1114	(6.1%)	0.05, 0.1, 0.2, 1	13, 2.6, 2.4, 2.3, 2.3, 2.0
South Carolina	0 / 5	(0.0%)	0.05	None
South Dakota	0 / 131	(0.0%)	0.10	None
Tennessee	0 / 6	(0.0%)	0.10	None
Texas	12 / 633	(1.9%)	0.10	2.1, 1.3, 0.4
Utah	0 / 6	(0.0%)	0.10	None
Virginia	0 / 67	(0.0%)	0.10	None
Washington	0 / 82	(0.0%)	0.1, 0.2, 0.25	None
Wisconsin	1 / 171	(0.6%)	0.05, 0.1	0.1
TOTAL [3]	479 / 8518	(5.6%)		

[1] - KS (1) - Excluding all "K" designations from detects- "K" means actual value is less than given value, which is usually the detection limit.

[2] - KS (2) - Including as detects all "K" designations that may be detection limits

[3] - TOTAL computed KS (2).

Ground water: No small-scale ground water monitoring study was performed for propazine. However, several studies conducted by counties, states, regulatory agencies, and USGS have been reported in the literature and compiled. The US EPA Pesticides Ground Water Database (PGWDB; 1992) reports low detection of propazine in 12 states (less than 1 ppb), including Texas, a state with high propazine market (**Table 8**).

Table 8 - Ground Water Monitoring Data for Propazine (USEPA PGWDB)

State	**Year**	**Propazine Detects / Sample**	**Concentration Range (ug/L)**
California	1984 - 89	0 / 313	None
Connecticut	1987 - 89	2 / 139	0.10
Hawaii	1984 - 85	0 / 42	None
Indiana	1987 - 88	0 / 161	None
Kansas	1984	1 / 27	0.10
Maryland	1983	0 / 30	None
Mississippi	1989 - 90	0 / 120	None
Nebraska	< 1989	10 / 173	0 - 0.11
New Jersey	1985 - 88	0 /188	None
Pennsylvania	1983 - 84	1 / 63	0.20
Texas	1988 - 90	1 / 91	unknown
Washington	1988	0 / 81	None
TOTAL		15 / 1428	0.10 - 0.20

APPENDIX I

PRZM environment: KSsorghumC.txt modified Satday, 12 October 2002 at 15:57:56
EXAMS environment: ir298.exv modified Thuday, 29 August 2002 at 15:34:12
Metfile: w13996.dvf modified Wedday, 3 July 2002 at 09:04:44
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	20.59	20.28	19.12	17.42	16.08	7.132
1962	38.58	37.98	36.09	31.79	28.81	13.67
1963	18.77	18.52	17.74	15.86	14.59	8.664
1964	20.29	20.11	19.2	17.22	15.92	8.248
1965	22.1	21.9	21.13	19.06	17.41	9.033
1966	22.27	22.02	20.75	18.34	16.7	8.95
1967	30.11	29.68	28.61	25.82	23.55	11.82
1968	16.79	16.54	15.9	14.52	13.61	8.286
1969	23.25	22.9	22.27	19.74	17.91	9.475
1970	26.94	26.69	26.15	24.17	22.1	11.16
1971	48.55	47.94	46.83	42.09	38.33	18.12
1972	14.56	14.35	13.69	13.36	13.12	9.01
1973	28.39	28.05	26.32	23.71	21.86	10.89
1974	23.93	23.57	22.14	20.65	19.05	10.14
1975	16.64	16.44	16.17	14.75	13.48	7.465
1976	20.12	19.82	18.62	16.65	15.38	7.836
1977	44.41	43.73	42.39	38.37	34.96	16.2
1978	42.49	41.83	39.76	36.22	33.02	16.99
1979	14.91	14.7	13.93	12.99	12.58	8.54
1980	28.75	28.31	26.53	23.52	21.45	10.47
1981	41.91	41.28	38.87	34.49	31.31	15.24
1982	43.98	43.55	41.53	36.6	33.25	16.63
1983	24.18	23.87	23.23	20.72	18.84	10.5
1984	35.77	35.23	33.26	30.08	27.42	13.23
1985	24.99	24.62	23.32	21.52	20.08	11.13
1986	40.96	40.35	38.1	34.04	31.21	15.11
1987	26.03	25.63	24.76	23.1	21.18	11.71
1988	25.71	25.35	24.01	21.58	21.04	11.56
1989	18.73	18.45	17.36	16.49	15.55	8.999
1990	43.1	42.46	39.88	35.26	32.05	15.14

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258064516129	48.55	47.94	46.83	42.09	38.33	18.12
0.0645161290322581	44.41	43.73	42.39	38.37	34.96	16.99
0.0967741935483871	43.98	43.55	41.53	36.6	33.25	16.63
0.129032258064516	43.1	42.46	39.88	36.22	33.02	16.2
0.161290322580645	42.49	41.83	39.76	35.26	32.05	15.24
0.193548387096774	41.91	41.28	38.87	34.49	31.31	15.14
0.225806451612903	40.96	40.35	38.1	34.04	31.21	15.11
0.258064516129032	38.58	37.98	36.09	31.79	28.81	13.67
0.290322580645161	35.77	35.23	33.26	30.08	27.42	13.23
0.32258064516129	30.11	29.68	28.61	25.82	23.55	11.82
0.354838709677419	28.75	28.31	26.53	24.17	22.1	11.71
0.387096774193548	28.39	28.05	26.32	23.71	21.86	11.56
0.419354838709677	26.94	26.69	26.15	23.52	21.45	11.16

```
0.451612903225806     26.03   25.63   24.76   23.1    21.18   11.13
0.483870967741936     25.71   25.35   24.01   21.58   21.04   10.89
0.516129032258065     24.99   24.62   23.32   21.52   20.08   10.5
0.548387096774194     24.18   23.87   23.23   20.72   19.05   10.47
0.580645161290323     23.93   23.57   22.27   20.65   18.84   10.14
0.612903225806452     23.25   22.9    22.14   19.74   17.91   9.475
0.645161290322581     22.27   22.02   21.13   19.06   17.41   9.033
0.67741935483871      22.1    21.9    20.75   18.34   16.7    9.01
0.709677419354839     20.59   20.28   19.2    17.42   16.08   8.999
0.741935483870968     20.29   20.11   19.12   17.22   15.92   8.95
0.774193548387097     20.12   19.82   18.62   16.65   15.55   8.664
0.806451612903226     18.77   18.52   17.74   16.49   15.38   8.54
0.838709677419355     18.73   18.45   17.36   15.86   14.59   8.286
0.870967741935484     16.79   16.54   16.17   14.75   13.61   8.248
0.903225806451613     16.64   16.44   15.9    14.52   13.48   7.836
0.935483870967742     14.91   14.7    13.93   13.36   13.12   7.465
0.967741935483871     14.56   14.35   13.69   12.99   12.58   7.132

0.1     43.892  43.441  41.365  36.562  33.227  16.587
                                        Average of yearly averages:     11.3782666666667
Inputs generated by pe4.pl - 8-August-2003

Data used for this run:
Output File: kssopi
Metfile:  w13996.dvf
PRZM scenario:  KSsorghumC.txt
EXAMS environment file:         ir298.exv
Chemical Name:  propazine
Description     Variable Name   Value   Units   Comments
Molecular weight        mwt     230     g/mol
Henry's Law Const.      henry   1.02E-9 atm-m^3/mol
Vapor Pressure  vapr    2.9E-8  torr
Solubility      sol     8.6     mg/L
Kd      Kd              mg/L
Koc     Koc     125     mg/L
Photolysis half-life    kdp     0       days    Half-life
Aerobic Aquatic Metabolism      kbacw   960     days    Halfife
Anaerobic Aquatic Metabolism    kbacs   112     days    Halfife
Aerobic Soil Metabolism asm     480     days    Halfife
Hydrolysis:     pH 7    0       days    Half-life
Method:         CAM     2       integer See PRZM manual
Incorporation Depth:    DEPI    0       cm
Application Rate:       TAPP    1.344   kg/ha
Application Efficiency: APPEFF          .95     fraction
Spray Drift     DRFT    .16     fraction of application rate applied to pond
Application Date Date   10-5    dd/mm or dd/mmm or dd-mm or dd-mmm
Record 17:      FILTRA
        IPSCND          1
        UPTKF
Record 18:      PLVKRT
        PLDKRT
        FEXTRC          0.5
Flag for Index Res. Run IR      IR
Flag for runoff calc.   RUNOFF          total   none, monthly or total(average of entire run)
```

```
PRZM environment: TXsorghumC.txt         modified Satday, 12 October 2002 at 17:29:44
EXAMS environment: ir298.exv     modified Thuday, 29 August 2002 at 15:34:12
Metfile: w13958.dvf         modified Wedday, 3 July 2002 at 09:06:24
Water segment concentrations (ppb)

Year     Peak     96 hr    21 Day   60 Day   90 Day   Yearly
1961     14.7     14.41    13.27    12.11    11       4.571
1962     23.42    22.96    21.39    18.11    16.06    7.152
1963     9.207    9.029    8.438    7.723    6.984    3.548
1964     13.5     13.23    12.19    10.62    9.6      4.116
1965     73.99    72.79    69.69    59.17    52.22    20.85
1966     39.49    38.77    36.02    30.74    27.22    12.76
1967     15.81    15.51    14.54    12.34    11.41    5.713
1968     58.75    57.71    53.67    46.29    41.23    16.8
1969     38.63    37.88    35.18    29.62    26.12    11.92
1970     66.85    65.55    60.78    51.13    45.06    18.73
1971     11.17    10.97    10.14    9.149    8.559    5.413
1972     182      179      168      142      125      49.32
1973     20.97    20.65    19.35    16.8     15.14    9.886
1974     72.08    70.67    65.09    55.46    49.58    20.29
1975     21.78    21.46    20.19    17.43    15.51    8.142
1976     57.27    56.16    53.01    44.72    39.47    16.22
1977     12.33    12.1     11.18    10.1     9.205    5.295
1978     88.67    86.92    82.54    70.22    61.99    24.67
1979     96.96    95.11    87.76    77.69    70.95    31.18
1980     37.2     36.49    34.73    29.37    25.93    13.16
1981     27.09    26.57    25.2     23.21    20.79    9.258
1982     52.69    51.66    47.66    39.96    35.69    15
1983     78.39    76.86    71.67    60.46    53.33    22.34
1984     11.98    11.76    10.95    10.29    9.297    5.822
1985     8.515    8.349    7.756    6.872    6.209    2.859
1986     179      175      163      143      127      50.31
1987     27.23    26.73    24.97    21.96    19.67    12.49
1988     15.25    14.96    13.96    12.1     10.99    5.267
1989     64.58    63.5     59.96    51.96    46.03    18.56
1990     94.25    92.4     85.16    71.51    63.01    26.38

Sorted results
Prob.    Peak     96 hr    21 Day   60 Day   90 Day   Yearly
0.032258064516129    182      179      168      143      127      50.31
0.0645161290322581   179      175      163      142      125      49.32
0.0967741935483871   96.96    95.11    87.76    77.69    70.95    31.18
0.129032258064516    94.25    92.4     85.16    71.51    63.01    26.38
0.161290322580645    88.67    86.92    82.54    70.22    61.99    24.67
0.193548387096774    78.39    76.86    71.67    60.46    53.33    22.34
0.225806451612903    73.99    72.79    69.69    59.17    52.22    20.85
0.258064516129032    72.08    70.67    65.09    55.46    49.58    20.29
0.290322580645161    66.85    65.55    60.78    51.96    46.03    18.73
0.32258064516129     64.58    63.5     59.96    51.13    45.06    18.56
0.354838709677419    58.75    57.71    53.67    46.29    41.23    16.8
0.387096774193548    57.27    56.16    53.01    44.72    39.47    16.22
0.419354838709677    52.69    51.66    47.66    39.96    35.69    15
0.451612903225806    39.49    38.77    36.02    30.74    27.22    13.16
0.483870967741936    38.63    37.88    35.18    29.62    26.12    12.76
```

```
0.516129032258065       37.2    36.49   34.73   29.37   25.93   12.49
0.548387096774194       27.23   26.73   25.2    23.21   20.79   11.92
0.580645161290323       27.09   26.57   24.97   21.96   19.67   9.886
0.612903225806452       23.42   22.96   21.39   18.11   16.06   9.258
0.645161290322581       21.78   21.46   20.19   17.43   15.51   8.142
0.67741935483871        20.97   20.65   19.35   16.8    15.14   7.152
0.709677419354839       15.81   15.51   14.54   12.34   11.41   5.822
0.741935483870968       15.25   14.96   13.96   12.11   11      5.713
0.774193548387097       14.7    14.41   13.27   12.1    10.99   5.413
0.806451612903226       13.5    13.23   12.19   10.62   9.6     5.295
0.838709677419355       12.33   12.1    11.18   10.29   9.297   5.267
0.870967741935484       11.98   11.76   10.95   10.1    9.205   4.571
0.903225806451613       11.17   10.97   10.14   9.149   8.559   4.116
0.935483870967742       9.207   9.029   8.438   7.723   6.984   3.548
0.967741935483871       8.515   8.349   7.756   6.872   6.209   2.859

0.1     96.689  94.839  87.5    77.072  70.156  30.7
                                Average of yearly averages:     15.2674
Inputs generated by pe4.pl - 8-August-2003

Data used for this run:
Output File: txsopi
Metfile: w13958.dvf
PRZM scenario:  TXsorghumC.txt
EXAMS environment file:         ir298.exv
Chemical Name:  propazine
Description     Variable Name   Value   Units   Comments
Molecular weight        mwt     230     g/mol
Henry's Law Const.      henry   1.02E-9 atm-m^3/mol
Vapor Pressure  vapr    2.9E-8  torr
Solubility      sol     8.6     mg/L
Kd      Kd              mg/L
Koc     Koc     125     mg/L
Photolysis half-life    kdp     0       days    Half-life
Aerobic Aquatic Metabolism      kbacw   960     days    Halfife
Anaerobic Aquatic Metabolism    kbacs   112     days    Halfife
Aerobic Soil Metabolism asm     480     days    Halfife
Hydrolysis:     pH 7    0       days    Half-life
Method:         CAM     2       integer See PRZM manual
Incorporation Depth:    DEPI    0       cm
Application Rate:       TAPP    1.344   kg/ha
Application Efficiency: APPEFF          .95     fraction
Spray Drift     DRFT    .16     fraction of application rate applied to pond
Application Date Date   01-05   dd/mm or dd/mmm or dd-mm or dd-mmm
Record 17:      FILTRA
        IPSCND          1
        UPTKF
Record 18:      PLVKRT
        PLDKRT
        FEXTRC          0.5
Flag for Index Res. Run IR      IR
Flag for runoff calc.   RUNOFF          total   none, monthly or total(average of entire run)
```