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MEMORANDUM

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DATE: March 18, 2013

SUBJECT: COMMENTS ON THE DRAFT EXPOSURE ASSESSMENT DOCUMENT FOR SIMAZINE

The Office of Environmental Health Hazard Assessment (OEHHA) has reviewed the draft Exposure Assessment Document (EAD) for Simazine, prepared by the Department of Pesticide Regulation (DPR), dated October 27, 2011. Our comments are provided in the attachment. OEHHA recently reviewed the Risk Characterization Document for Simazine and sent comments on this document to DPR on March 6, 2013. OEHHA reviews risk assessments prepared by DPR under the authority of Food and Agriculture Code section 11454.1.

OEHHA has a number of comments on the assumptions and exposure assessment methodology of the draft EAD. These comments and our recommendations, as well as suggested clarifications, additions and corrections, are contained in the attachment.

Thank you for providing this draft document for our review. If you have any questions regarding OEHHA's comments, please contact Dr. Charles Salocks at (916) 323-2605 or you may contact me at (510) 622-3200.

Attachment

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OEHHA's Comments on the Draft (October, 2011)
Exposure Assessment Document for Simazine

The Office of Environmental Health Hazard Assessment (OEHHA) is responding to a request from the Department of Pesticide Regulation (DPR) to comment on the draft Exposure Assessment Document (EAD) for simazine [2-chloro-4, 6-bis (ethylamino)-s-triazine].

OEHHA reviews risk assessments prepared by DPR under the authority of Food and Agricultural Code Section 11454.1, which requires OEHHA to conduct scientific peer reviews of risk assessments conducted by DPR.

GENERAL COMMENTS

In general, the Exposure Assessment Document (EAD) for simazine was comprehensive, with assumptions sufficiently justified and calculations clearly described. Appropriate background information related to exposure scenarios for users (agricultural and non-agricultural related) and non-users (residents) was provided. Due to a lack of studies on exposure to simazine specifically, exposure estimates were calculated using data from the Pesticide Handler Exposure Database (PHED) or from studies on atrazine, a structurally similar chlorinated triazine herbicide.

OEHHA concurs with most of the approaches and parameter values used in the exposure calculations. However, OEHHA does not agree with the assumptions DPR used to exclude potential exposure from foliar residues upon reentry, and the assumptions that were adopted to estimate homeowners' exposures. OEHHA recommends that DPR: 1) consider estimating exposures from take-home residues in the homes of agricultural employees who work in simazine-treated fields; 2) consider exposure of swimmers to simazine residues in surface water; 3) increase the play time in grass for children from 1 hour to 2 hours per day; and 4) add the exposure of 6-18 month old toddlers to the nonuser resident groups.

SPECIFIC COMMENTS

Abstract

Although very concise, the abstract should note the routes of exposure (inhalation, dermal and ingestion) that were evaluated in the document. It should also include absorbed daily dose (ADD) estimates for chronic and lifetime exposure. In the last sentence dealing with non-user residents and children with normal mouthing behavior, the abstract should note that acute ADD estimates for children with pica behavior were greater than 0.14 mg/kg, as indicated in Table 19.

I. Introduction

The second paragraph discusses a purported common mechanism of neuroendocrine toxicity for simazine and other chlorinated triazine herbicides (atrazine and propazine), as well as their common degradation by-products and metabolites (diaminochlorotriazine and desisopropylatrazine). OEHHA recommends that this discussion be strengthened by emphasizing that a common mechanism of toxicity is an assumption that reflects in part a lack of comprehensive toxicity data for each of these compounds, and noting that these compounds may have other toxic effects in addition being neuroendocrine disruptors. This issue is also discussed in OEHHA's comments on DPR's Risk Characterization Document (RCD) for simazine.

II. Exposure-Related Factors

The final EAD provides simazine usage data through 2007 (Table 3). This information should be updated to include commodity and site usages through 2011. The illness summary (Section II.6), which only includes data through 2007, should be updated as well. It would be informative to add details and descriptions of the circumstances of the three cases of illness that were described in this section. Were these exposures a result of accidental spills, approved uses, or other causes?

III. Acute Toxicity and Pharmacokinetics

The EAD identified three key studies as the basis for deriving a dermal absorption rate for simazine. In a study conducted by Hui et al. (1996), ^{14}C-atrazine was applied to the skin of human volunteers, and absorption was assessed after 24 hours. A dermal absorption rate of 6% was reported in this study. Murphy et al. (1988) evaluated the percutaneous absorption of ^{14}C-simazine in rats and concluded that an absorption rate of 18.7% would be appropriate for use in calculating dermal absorbed doses. In a similar study, Chengelis (1994) evaluated the dermal absorption efficiency of ^{14}C-atrazine in rats and found that approximately 20% of the applied dose was absorbed.

In arriving at an estimate of the percutaneous absorption efficiency for simazine humans, DPR noted that atrazine and simazine have similar physico-chemical properties and have similar dermal absorption efficiencies in rats. Therefore, insofar as dermal absorption is concerned, atrazine can be regarded as a reasonable surrogate for simazine, and it is reasonable to use the atrazine dermal absorption rate of 6% in humans to calculate absorbed dermal doses for simazine.

OEHHA concurs with the identification of Hui et al. (1996) as the key study for characterizing the dermal absorption of simazine, and agrees that a dermal absorption rate of 6% is scientifically justified. However, since the percutaneous absorption value is a critical parameter in estimating absorbed doses following dermal contact with simazine residues on plant leaf surfaces or in soil, additional support for his conclusion appears warranted. A table comparing the physical and chemical properties of simazine and atrazine would support the conclusion that these two compounds are indeed chemically and physically similar. Additional support would be provided if the estimated dermal permeability coefficients (K_P) of simazine and atrazine, derived using one or more empirically-derived equations (e.g.,Potts and Guy 1992), were shown to be comparable.

OEHHA also agrees with the use of a health-protective default value of 100% for inhalation intake and uptake since no data are available to characterize inhalation uptake (Frank 2008).

IV. Environmental Concentrations

<u>Ambient and onsite air</u>

A field study was conducted (Air Resources Board 1999) on ambient air levels at Fresno county school sites in close proximity to grape vineyards, and onsite air levels in a Tulare county orange orchard. The highest simazine concentration detected in air samples collected at the orange orchard was 190 nanograms per cubic meter (190 $\eta g/m^3$), which is more than ten times greater than the maximum concentration found in ambient air (18 $\eta g/m^3$). OEHHA concurs with the use of these values to estimate the inhalation exposure of bystanders.

<u>Dislodgeable foliar residues</u>

The EAD assumed dislodgeable foliar residues (DFR) to be negligible and did not assess quantitatively the reentry exposure of agricultural workers. To justify this assumption, DPR noted that pesticide labels recommend using sprinkler irrigation to wash residues from the foliage of treated crops if rainfall does not occur within 10 days of treatment. The EAD also assumed that reentry activities of agricultural workers would be minimal because "it is often a common as well as a good practice to remove pruning and trash in the field before any spraying is to take place" (page 6).

OEHHA believes that reentry exposure to foliar residue is reasonably likely to occur because studies have shown that farmworkers bring simazine residues home. (Additional discussion of this topic is provided below in OEHHA's comments under the "Nonuser Residents" heading.) In addition, workers could be exposed by dermal contact upon re-entering a field, particularly citrus groves where the leaves are low to the ground, during the period between the end of the restricted entry interval (REI, 12 hours) and occurrence of watering or rain. Furthermore, the label does not *require* fields to be pruned or cleaned up before application. For these reasons, OEHHA recommends that an assessment of fieldworker exposure to leaf and soil residues be included in the EAD.

<u>Turf residues</u>

The EAD described use of the California modified roller method, developed by the Outdoor Residential Exposure Task Force (ORETF), to collect and measure transferable turf residue (TTR) in the simulation study conducted by Novartis Crop Protection (Rosenheck 1999). The document also noted that this method is not standardized nor officially accepted (Welsh et al. 2005). Therefore, per interim DPR guidelines (Frank 2011), a default value of 6,000 micrograms/hour/kilogram body weight/pound (lb) of active ingredient (AI) applied was used to estimate reentry exposure to simazine residues on turf.

OEHHA notes that other EADs from DPR (e.g., carbaryl) utilized TTR values obtained using the ORETF methodology. Therefore there appears to be a discrepancy between the EAD for simazine and other EADs prepared by DPR, and a more complete explanation for the decision not to use TTR data from the Rosencheck (1999) study should be provided.

Offsite soil residues

This short section included discussion of both onsite and offsite soil residue concentrations, and the heading should be changed accordingly. It also presented a calculation of the theoretical maximum simazine concentration in onsite soil based on a maximum application rate of five pounds of active ingredient per acre (5 lb AI/acre). The theoretical maximum concentration of 22.5 milligrams per kilogram (mg/kg) was used to estimate exposure because actual field data on simazine levels in soil are extremely limited. The EAD noted that offsite soil residue levels are expected to be much lower than the onsite levels. OEHHA agrees that these are reasonable approaches given the lack of directly relevant data.

Ambient water

To assess simazine concentration in surface water, DPR identified a key study on the runoff potential of simazine that was conducted next to highway pavement in the northern Central Valley. Based on analysis of the results of this study, the EAD concluded, "Under normal circumstances, simazine residues in ambient water are expected to be much lower than the maximum level noted in the study. This expectation was based on the label specifications now advising users '...not to apply simazine where the water table (groundwater) is close to the surface and where the soils are very permeable'" (page 11). Even though this advice is provided on the label, it does not necessarily follow that it is common practice. It also presumes that the user knows the depth to the water table *and* the permeability of the soil. Furthermore, the Environmental Fate Document (EFD) concluded that simazine contamination of water is a potential public health concern because simazine and its degradation products have been found in both surface and ground waters. For this reason, OEHHA recommends that DPR re-assess the justification for concluding that maximum levels detected in ambient water samples in the Central Valley study are not reasonable for assessment purposes. OEHHA also recommends that DPR evaluate the exposure of swimmers to simazine residues in surface water.

Exposure Assessment

The EAD did not assess dietary exposure from food and drinking water even though these pathways were comprehensively evaluated in the RCD.

Handler Exposure from Agricultural Use

The EAD identified 28 occupational exposure scenarios defined by activity, pesticide formulation and application method. No simazine-specific studies were available for estimating exposures. Therefore, DPR used data from studies of the surrogate pesticide atrazine when available. Lacking such data, DPR used exposure parameter values from the PHED. The basis of and justification for each of these choices were described in the document. Atrazine was identified as a reasonably good surrogate because it has physical and chemical properties that are similar to those of simazine and has similar uses as an herbicide. However, DPR did not acknowledge that the use patterns, application methods, seasons and rates, and label recommendations for simazine and atrazine may differ. If DPR could provide information indicating that usage and applications of the two herbicides are indeed similar, the argument that atrazine is a good surrogate for simazine would be strengthened.

Appropriate personal protective equipment was assumed per label specifications for each scenario. Long pants, long sleeve shirts and gloves are not always required; therefore clothing was adjusted for each of the occupational groups.

OEHHA concurs with DPR's selection of data for daily application acreages, application rates and exposure rates. However, OEHHA is concerned that workers entering treated sites after the product is applied will be exposed to residues left on the ground, leaves and fruit, as discussed above.

There is a discrepancy between an application rate cited in Table 16 and page 17 of the text. In Table 16, an application rate of 40 lb AI/acre was indicated for the granular formulation. In contrast, page 17 of the text includes the following statement: "The maximum application rates are 5.0 lb AI per acre or lower for all simazine product labels." This discrepancy should be corrected or the ADDs need to be modified using an eight-fold higher application rate for the granular formulation.

Handler Exposure from Non-Agricultural Use

Handler exposure from non-agricultural use includes exposure of commercial lawn care operators (LCOs) and homeowner users.

The ADDs for LCOs were calculated using the same parameter values as agricultural users with an estimated daily usage of 8 to 9 hours and the same frequency of exposure (60 days/year). As justification, DPR cited the same reasons that were given for agricultural users.

OEHHA suggests a re-examination of the assumption of 60 work-days per year for LCOs is appropriate because simazine can be used pre- and post-emergence on turfgrass. For this reason the pesticide could be used by commercial LCOs more frequently than agricultural handlers would use it. OEHHA is also concerned about potential post-application exposure. Following application to turfgrass, the label for simazine does not require or recommend irrigation although it does require re-entry restriction until the spray has dried (US EPA 2005). The determination of dryness is subjective, particularly on grass, and transfer of simazine residues by dermal contact may still occur after the turf has dried. Therefore post- application exposure of LCOs cannot be ruled out without additional justification.

The exposure of homeowners using simazine was assessed using PHED data for LCOs. Residential handler exposure scenarios were considered to be short-term only due to the infrequent use patterns associated with homeowner products. For this reason, DPR estimated that the exposure of homeowners would be five times less than the LCO exposure, and only acute exposure was assessed. DPR also assumed that homeowners would be wearing gloves, long pants and long sleeve shirts whereas U.S. EPA assumed as a "worse case but common scenario" that residential applicators would wear short pants, T-shirts and shoes (US EPA 1992, 2012). OEHHA concurs with the U.S. EPA's assumptions and suggests DPR revise their clothing assumptions for this scenario.

DPR concluded that reentry exposure for residents mowing treated lawns would be negligible because (1) all lawn mower operators are expected to wear shoes, long sleeve shirts and long pants, (2) the label recommends a re-entry restriction of several hours (i.e., until the sprays have dried), and (3) irrigation ("water drench") following application would wash simazine residues into the underlying thatch and soil (page 35).

As noted above, U.S. EPA assumed residential applicators would wear short pants, T-shirts and shoes as a "worse case but common scenario." U.S. EPA did not use a restricted-entry interval or other mitigation assumptions to limit post-application exposures in residential settings. Further, they noted that labels do not require or recommend irrigation following applications to turfgrass. OEHHA believes that U.S. EPA's assumptions are more reasonable, particularly in the heavily populated coastal regions of California where the weather is mild for most of the year.

Nonuser Residents

DPR chose two-year-old children as the sentinel nonuser resident population. The EAD assumed that two-year-olds spend on average one hour per day playing outside. U.S. EPA has used exposure duration of 2 hours/day for this age group (US EPA 2006) since a quarter of this population (a 75th percentile estimate) spends 2 hours or more per day playing on grass and 5 hours or more per day playing outdoors (US EPA 2008). DPR has used 2 hours/day for this population in other EADs (e.g., carbaryl), and OEHHA recommends increasing children's play time on grass from 1 hour to 2 hours in the EAD for simazine as well.

DPR assumed that toddlers (6-18 month old children) have a smaller body mass, are more likely to engage in hand-to-mouth and object-to-mouth behavior (oral exposure), and are more likely to be exposed to surface residues due to crawling on lawn (dermal exposure). DPR also assumed that toddlers' access to soil and foliar residues is limited since their outdoor activities are more restricted and more supervised. However, toddlers are more likely to be exposed through other routes, especially indoors (Firestone et al. 2007). There is sufficient evidence that pesticide residues, including simazine and other triazines, are taken home by agricultural workers via their clothing (Bradman et al. 2007, Curwin et al. 2007, Golla et al. 2012, Gunier et al. 2011) or are otherwise brought into homes located near agricultural fields (Gunier et al. 2011). The main routes of indoor exposure – dermal contact and ingestion – are more specific to main routes of indoor exposure – dermal contact and ingestion – are more specific to the 6-18 month old age group. Indoor exposure pathways may not represent a significant acute hazard but may be of concern for repeat and aggregate exposure scenarios. Based on these considerations, OEHHA recommends that the indoor exposure scenario be included as part of an aggregate exposure assessment. OEHHA also recommends that DPR evaluate other possible scenarios for this younger age group. In support of this recommendation, OEHHA notes that U.S. EPA assessed the exposure for 3 age groups (adults, children and toddlers) in the Reregistration Eligibility Decision (RED) document.

DPR also did not consider the exposure a swimmer might receive as a result of swimming in contaminated surface water. OEHHA believes this scenario should be addressed in the EAD since contamination of surface water was discussed in DPR's Environmental Fate Document for simazine.

EDITORIAL COMMENTS

OEHHA recommends that the document be carefully reviewed for typographical and editorial errors, some of which are noted at the end of these comments. Additionally, the readability of document would be improved if page numbers were added when within-text references are made. For example, the second paragraph on page 9 refers the reader to Section V-3, which is seven pages long, and the specific information referenced is at the bottom of page 40, which are 31 pages ahead in the document.

It would also be helpful to note on the title page that this EAD is limited to residential, bystander and occupational exposure scenarios.

One sentence in the Abstract briefly summarizes results of metabolism studies in rats, referring to a di-N-dealkylated metabolite as a "degradate." "Metabolite" is a more appropriate term. The sentence also refers to the "applied dose" suggesting that the route of exposure was dermal. Was this the case? It also indicates that the applied doses were 0.50 and 50 mg/ml. These are concentrations, not doses.

At the bottom of page 8 a sentence begins with the phrase, "As part of the same study, ARB later (December, 1988)..." The References section indicates that this study was conducted in1999.

Page 9: The 1999 Rosenheck study (*Determination of Transferable Turf Residues on Turf Treated with Atrazine Applied in a Granular Fertilizer Formulation*), was conducted on atrazine, not simazine as stated in the text.

Page 10: The last line in the first paragraph of section 4 included the value 5.1 cm^4. This should be 5.1×10^1 cm^3.

Page 11: The second paragraph indicated that the vapor pressure of simazine is 22.1 mm Hg. The correct value is 22.1×10^{-9} mm Hg. The next to last line included the phrase “two times less than.” This could be replaced with “half.”
Table 8, footnote (h) did not give the name of the compound used in the study (DCPA).

Table 9: It isn’t clear that the first two columns specifically referred to the “corn study” which evaluated exposure to atrazine, whereas the third column was based on data from the PHED. The PHED did not specifically assess atrazine exposure.

Table 11, footnote (a) indicated that volunteers were all wearing normal work clothes (usually assumed to be long pants and long sleeve shirts) plus gloves whereas footnote (b) indicated that dermal exposure of LCOs was measured assuming that workers wore T-shirts and shorts. DPR should justify these two contradictory assumptions.

On page 35, the following statement needs to be justified: “It is not unreasonable to expect that homeowners can afford to use this type of grass cutter (with grass catcher) if they can afford to have their lawn treated with herbicides”. OEHHA is not aware of any basis for the presumption that homeowners use grass catchers because they can afford to do so. For example, mulching lawn mowers do not use a grass catcher at all. Leaving grass cuttings on the lawn is frequently cited as a strategy for reducing green waste and enhancing the health of a lawn.

Appendices B-1 through B-11 referenced individual exposure scenarios by number. For example, the sub-title for Appendix B-1 was “Table 19-1. Description of PHED subsets for Scenario 19.” This is the only place in the document where the exposure scenarios were referred to by number. It would be very useful to add a table to the main body that provides scenario numbers and brief descriptions of each of the 28 scenarios evaluated in this report.

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