



## OFFICE OF CHEMICAL SAFETY AND POLLUTION PREVENTION

WASHINGTON, D.C. 20460

### MEMORANDUM

**DATE:** October 30, 2025

**Subject:** **PARAQUAT:** Review of the Volatilization Potential of Paraquat from Field Uses

**PC Code:** 061601

**CAS No.:** 190-42-5

**Petition No.:** N/A

**Risk Assessment Type:** Occupational/Residential  
Exposure

**TXR No.:** N/A

**MRID No.:** N/A

**Task Group No.:** 00651299

**Parent Case No.:** 00497925

**Registration No.:** N/A

**Regulatory Action:** Registration Review

**Case No.:** 0262

**40 CFR:** §180.205

**FROM:** Alexis Hardie, Occupational/Residential Exposure Assessor  
Risk Assessment Branch IV (RAB IV)  
Health Effects Division (HED, 7509T) 

**THRU:** Shalu Shelat, Branch Supervisor   
Risk Assessment Branch IV (RAB IV)  
Health Effects Division (HED, 7509T)

**TO:** Alexander Hazlehurst, Chemical Review Manager  
Marianne Walters, Team Leader  
Kelly Sherman, Branch Chief  
Risk Management and Implementation Branch III (RMIB III)  
Pesticide Re-evaluation Division (PRD; 7508T)

### **Introduction**

The Pesticide Re-evaluation Division (PRD) has requested that the Health Effects Division (HED) review potential post-application inhalation exposures to non-occupational bystanders resulting from volatilization of paraquat from previously treated fields.

The conclusions conveyed in this assessment were developed in full compliance with *EPA Scientific Integrity Policy for Transparent and Objective Science*, and EPA Scientific Integrity Program's

*Approaches for Expressing and Resolving Differing Scientific Opinions.* The full text of *EPA Scientific Integrity Policy for Transparent and Objective Science*, as updated and approved by the Scientific Integrity Committee and EPA Science Advisor can be found here: [EPA's Scientific Integrity Policy](#). The full text of the EPA Scientific Integrity Program's *Approaches for Expressing and Resolving Differing Scientific Opinions* can be found here: [Approaches for Expressing and Resolving Differing Scientific Opinions | US EPA](#).

## Table of Contents

1.0	Executive Summary .....	4
2.0	Use Pattern.....	4
3.0	Volatilization and Chemical Characteristics .....	4
3.1	Soil Organic Carbon-Water Partitioning Coefficient and Adsorption .....	5
3.2	Solubility .....	6
3.3	Vapor Pressure .....	6
4.0	Ambient Air Monitoring Studies.....	7
5.0	Volatilization Modeling.....	8
6.0	Conclusion.....	10

## 1.0 Executive Summary

In June 2019, HED completed the *Paraquat Dichloride: Draft Human Health Risk Assessment in Support of Registration Review* (DRA) (D430827, W. Britton, 2019-06-26) which included an evaluation of non-occupational bystander inhalation exposure resulting from volatilization.<sup>1</sup> Since the release of the DRA, Syngenta Crop Protection, LLC (a registrant for paraquat), submitted a new vapor pressure study<sup>2</sup> to the EPA under Section 6(a)(2) of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). Because vapor pressure is a key parameter influencing the extent of volatilization and resulting inhalation exposure, PRD has requested HED review the potential impact of the submitted vapor pressure study on the prior non-occupational bystander inhalation exposure assessment. Upon review of the new data, HED determined that there is greater uncertainty regarding the potential for paraquat to volatilize than previously considered. As a result, HED recommends additional data to refine the non-occupational inhalation bystander analysis, support a robust risk assessment, and resolve discrepancies among multiple lines of evidence (e.g., physicochemical properties, ambient air monitoring studies, and volatilization screens).

This memo summarizes the physicochemical properties of paraquat, the available data supporting the DRA review of non-occupational bystander inhalation exposure, and the additional data recommended to refine the assessment of non-occupational bystander inhalation exposure resulting from volatilization.

## 2.0 Use Pattern

Paraquat dichloride (1,1'-dimethyl-4,4'-bipyridinium dichloride) is a non-selective herbicide currently registered for the control of broadleaf weeds and grasses in agricultural and non-agricultural areas. As a restricted use pesticide<sup>3</sup>, there are no paraquat products registered for homeowner use and no products registered for application to residential areas. The active ingredient, paraquat dichloride or paraquat, exists as a mixture of paraquat cations (dications) and chloride anions. Paraquat cation is the toxic moiety and, therefore, the form evaluated for purpose of exposure and risk assessment. Paraquat can be used pre-plant or pre-emergence, at planting, post-emergence, as a desiccant or harvest aid, as well as a post-harvest desiccant. It is a contact herbicide that desiccates and destroys plant cell membranes within hours of application. Paraquat is formulated as a soluble concentrate and may be applied to agricultural and non-agricultural areas (e.g., non-crop lands and pasture lands) with aerial, ground, and handheld spray equipment.

## 3.0 Volatilization and Chemical Characteristics

Volatilization is the process by which a chemical (e.g., pesticide) converts into a vapor and releases into the atmosphere. For risk assessment, pesticide volatilization refers to the post-application movement of pesticide vapors through the air and is considered differently than pesticide movement via spray drift, erosion, or windblown dust/soil particles.<sup>4</sup> Non-occupational bystander inhalation exposure from volatilization may occur from residues on foliage or soil from fields previously treated with a pesticide that transform into a vapor and move outside of the treated field.

---

<sup>1</sup> Available online: [Paraquat Dichloride: Draft Human Health Risk Assessment in Support of Registration Review](#)

<sup>2</sup> Available online: [Product Chemistry Review of the Vapor Pressure of Paraquat Dichloride](#)

<sup>3</sup> The "Restricted Use" classification restricts a product, or its uses, to use by a certified applicator or someone under the certified applicator's direct supervision, see 40 CFR 152.

<sup>4</sup> Additional information available: [EPA Pesticide Volatilization](#)

The air residue concentration of a pesticide in or near a previously treated field is determined by the rate of volatilization (i.e., flux) and affected by environmental and meteorological factors. Flux is the rate at which a chemical in liquid form volatilizes over a specified area and within a given timeframe, typically expressed as mass per square meter per second (e.g.,  $\mu\text{g}/\text{m}^2\text{-s}$ ). When assessing the potential of inhalation exposure due to volatilization, pesticide residues on plant surfaces are assumed to be volatilizing from a non-interactive surface in the period just after application.<sup>5</sup> This assumption reflects a conservative worst-case scenario in which the residue volatilizes immediately. While this may overestimate volatilization for some chemicals, it provides a health-protective basis for screening the potential volatility of pesticides. The physicochemical properties (i.e., vapor pressure, water solubility, and organic carbon absorption coefficient) are indicators of volatilization potential and can be used to estimate flux from soil and foliar surfaces.

### 3.1 Soil Organic Carbon-Water Partitioning Coefficient and Adsorption

The soil organic carbon-water partitioning coefficient ( $K_{oc}$ ) measures how strongly a chemical binds to organic matter in soil, providing insight into its availability at the soil surface for volatilization. A low  $K_{oc}$  value indicates the chemical does not strongly adhere to soil organic matter, allowing the chemical to remain mobile and increasing the likelihood of volatilization from soil surfaces. According to the Food & Agriculture Organization (FAO) mobility classification,  $K_{oc}$  values less than 10 mL/g are classified as highly mobile whereas greater than 100,000 mL/g are classified as immobile. For paraquat, the reported  $K_{oc}$  of 10,000 mL/g<sup>6</sup>, classifies paraquat as hardly mobile in soil. This suggests that paraquat is expected to primarily exist in the bound phase near the soil surface due to its strong sorption to soil and limited mobility and therefore has a lower potential to volatilize from soil.

The Environmental Fate and Effects Division (EFED) noted in the *Paraquat: Preliminary Ecological Risk Assessment for Registration Review*<sup>7</sup> that after applications, paraquat readily adsorbs to soils. Adsorption to soil is an important process that reduces volatilization.<sup>8</sup> The primary route of environmental dissipation of paraquat is adsorption to soil clay particles. Paraquat does not hydrolyze, does not photodegrade in aqueous solutions, and is resistant to microbial degradation under aerobic and anaerobic conditions. Paraquat was shown to be very immobile in soil with batch equilibrium studies conducted on four soils in the laboratory. High rates of paraquat were added because at realistic field application rates, paraquat was below detection in the batch equilibrium adsorption solution. There was no detectable desorption. In laboratory studies with radiolabeled paraquat, no radioactivity volatilized from the soil surface to adsorb to glass or to collect in volatile traps. In short- and long-term field dissipation studies, paraquat residues were extractable only by acid reflux and were shown to be persistent and to accumulate slightly with repeated applications. Paraquat is dissipated by rapid adsorption to clay particles. Due to the apparent adsorption strength of paraquat for soil clays, these adsorbed paraquat residues do not appear to be environmentally available in soils.<sup>9</sup>

---

<sup>5</sup> The assumption that pesticide residues on plant surfaces volatilize immediately from a non-interactive surface is based on the work of Woodrow et al. (1997). Additional details are found here: [Human Health Bystander Screening Level Analysis: Volatilization of Conventional Pesticides](#)

<sup>6</sup> The adsorption in the adsorption-desorption studies was extensive such that no paraquat could be detected in the water phase of these studies making it mathematically impossible to calculate reliable soil/water partition coefficients ( $K_d$ ) (D. Judkins, DP430829, 06/26/2019). The  $K_{oc}$  value was obtained from the ecological risk assessment.

<sup>7</sup> Available Online: [Paraquat: Preliminary Ecological Risk Assessment for Registration Review](#)

<sup>8</sup> Available Online: [Fate, Transport and Transformation Test Guidelines: OPPTS 835.6100 Terrestrial Field Dissipation](#)

<sup>9</sup> Available online: [Paraquat: Preliminary Ecological Risk Assessment for Registration Review](#)

### 3.2 Solubility

Water solubility and soil adsorption are closely related factors of a chemical that influence the movement, distribution, and rate of degradation of chemicals in the environment. Water solubility refers to the ability of a substance to dissolve in water. Higher soluble chemicals tend to stay dissolved in aqueous media (e.g., groundwater, surface water, wastewater) rather than partitioning into the air. As a result, the greater the water solubility, the lower the potential for volatilization from water surfaces. Paraquat is freely soluble in water (solubility 618 g/L at 20°C)<sup>10</sup> which indicates a lower potential to volatilize from water.

Generally, as mentioned above, the more soluble a chemical substance, the less likely it is to volatilize from water; additionally, higher solubility also decreases the likelihood the substance will sorb to soils and sediments.<sup>11</sup> However, paraquat was shown to be very immobile in soil studies. The strong sorption appears to limit its mobility and bioavailability. This property of paraquat, due to paraquat as a dicationic compound, was indicated during the environmental fate analysis; rather than stay in solution after application as might be expected, paraquat readily adsorbed to soil. The primary route of environmental dissipation of paraquat is reported as adsorption to soil clay particles.<sup>12</sup> Taken together, the combination of strong soil binding and higher water solubility indicates that volatilization from soil or water surfaces is not expected to be a significant exposure pathway for paraquat.

### 3.3 Vapor Pressure

The measured vapor pressure of a chemical compound is an indicator of its volatility and of the probability of its movement into the atmosphere. Chemicals with higher vapor pressures are more likely to transform to the gaseous stage and volatilize from treated fields. However, a volatility classification based solely on vapor pressure is best suited to dry, non-adsorbing surfaces. In general, pesticides with vapor pressures  $\leq 1.33 \times 10^{-4}$  pascals (Pa) are considered relatively non-volatile under field conditions, whereas pesticides with vapor pressures  $\geq 5.20 \times 10^{-3}$  Pa are of intermediate to high volatility under field conditions.<sup>13</sup> While vapor pressure is an important indicator within the framework of characterizing the potential for a chemical to volatilize, risk assessment conclusions related to volatility and subsequently inhalation exposure require a more comprehensive evaluation. Therefore, regardless of the volatility potential indicated by the vapor pressure, the entirety of a pesticide's profile (i.e., use pattern, toxicological profile, environmental fate, available air monitoring data etc.) is considered when evaluating the potential exposure from volatilization.

Previously, the vapor pressure for paraquat was reported as  $1.3 \times 10^{-7}$  Pa.<sup>14</sup> However, on January 18, 2024, EPA received a new vapor pressure study on paraquat dichloride, under Section 6(a)(2) of FIFRA. Section 6(a)(2) of FIFRA states: "If at any time after the registration of a pesticide the registrant has additional factual information regarding unreasonable adverse effects on the environment of the pesticide, the registrant shall submit such information to the Administrator."<sup>15</sup> Syngenta conducted the new vapor pressure study on the manufacturing-use product used to formulate the paraquat containing end-use product in the United States. The study concluded that paraquat has a vapor

<sup>10</sup> Available online: [Paraquat Dichloride: Draft Human Health Risk Assessment in Support of Registration Review](#)

<sup>11</sup> Available online: [Product Properties Test Guidelines: OPPTS 830.7860 Water Solubility, Generator Column Method](#)

<sup>12</sup> Available online: [Paraquat: Preliminary Ecological Risk Assessment for Registration Review](#)

<sup>13</sup> Available online: [Fate, Transport and Transformation Test Guidelines: OPPTS 835.6100 Terrestrial Field Dissipation](#)

<sup>14</sup> Available online: [Paraquat: Preliminary Ecological Risk Assessment for Registration Review](#)

<sup>15</sup> 7 U.S.C. 136d(a)(2); see also Agency guidelines regarding FIFRA 6(a)(2) submission available online: [PRN 98-3: Guidance on Final FIFRA 6\(a\)\(2\) Regulations for Pesticide Product Registrants](#)

pressure of  $5.3 \times 10^{-4}$  Pa at 25.0°C,<sup>16</sup> suggesting the potential for greater volatility under field conditions than previously assessed.<sup>17</sup> Although new vapor pressure data suggest an increased potential for volatilization, other physicochemical properties (i.e., high water solubility and strong soil sorption) point towards limited volatility under typical use conditions. Given these contrasting indicators, field measurements are likely to provide valuable context for evaluating bystander inhalation exposure risks.

Table 1 below summarizes the physicochemical properties of paraquat.

Table 1. Physicochemical Properties of Technical Grade Paraquat Dichloride		
Parameter	Value	Reference
Melting point/range	Decomposes at ca. 340 °C	Product Chemistry Registration Data Summary and Review MRID: 40479001 December 1987
pH	6.4 at 20 °C	
Density	1.5 g/cm <sup>3</sup> at 25 °C	
Octanol/water partition coefficient, Log (K <sub>ow</sub> )	log K <sub>ow</sub> = -4.5 at 20 °C	
Solvent solubility (20 °C)	<0.1 g/L in acetone, dichloromethane, toluene, ethyl acetate, and hexane, 143 g/L in methanol	
Water solubility (20 °C)	Freely soluble in water: 618 g/L at pH 5.2	
Organic carbon-water partition coefficient (K <sub>oc</sub> )	10,000 ml/g	K. Garber, DP382001, 2011-07-14

#### 4.0 Ambient Air Monitoring Studies

Monitoring studies of pesticide residues in the atmosphere may indicate whether a pesticide has volatilized from the field after application. Ambient air monitoring typically is focused on characterizing the airborne pesticide levels within a localized airshed or community structure of some definition (e.g., city, township, or municipality). This type of monitoring effort also can be focused on capturing chronic background levels or other temporal characteristics of interest such as focusing on seasonal pesticide use patterns.

The California Air Resources Board (CARB) monitored for air concentrations of paraquat in communities near agricultural areas and did not find detectable levels of paraquat (limit of detection (LOD) = 0.022 µg/m<sup>3</sup>). CARB conducted ambient air monitoring to measure outdoor air concentrations of paraquat four days a week from August 31 through November 5, 1987, at four sites (Tranquility Fire Station, San Joaquin School, Five Points Field Station, and Huron Day Care Center) in Fresno County near agricultural areas expected to receive applications of paraquat and scheduled to coincide with applications to cotton. Based on the described study methods at the time, air monitoring was completed in high-use counties during peak season usage for the pesticide under evaluation.

CARB also monitored two background locations (Fresno and Bakersfield) in Fresno County where monitors were placed in areas not expected to detect residues from the monitored application sites. Based on the CARB study report, these sites were not paired with or used to interpret data from the monitored sites. Instead, CARB indicates that the background sites represent a low probability of

<sup>16</sup> Available online: [Product Chemistry Review of the Vapor Pressure of Paraquat Dichloride](#)

<sup>17</sup> Available Online: [Fate, Transport and Transformation Test Guidelines: OPPTS 835.6100 Terrestrial Field Dissipation](#)

detecting pesticide residues from the ambient monitoring. Therefore, the inclusion of the background sites does not imply a direct comparison to the monitored sites; rather detections at the background locations would be unexpected and could suggest possible off-target movement of residues from pesticide applications if residues were detected at these sites. For paraquat, these background locations were stationed away from the pesticide applications during the monitoring period and thus were unlikely to be impacted by the pesticide applications at the other four sites.<sup>18</sup>

All 318 samples (including the background monitoring sites) analyzed for paraquat were less than the LOD of 0.022 µg/m<sup>3</sup> for a 24-hour sample.<sup>19</sup> These results indicate that airborne residues were not detected during the monitoring period, and the absence of detectable residues suggests that off-target movement of paraquat under the tested conditions was minimal.

Ambient air monitoring studies are not without limitations as some studies may not be reflective of current agricultural practices or limited to a single geographic area and crop. The EPA noted in the DRA: *“Based on the results of the study which were all below the [minimal level of detection] MDL, no bystander post-application inhalation exposures would be expected from volatilization following applications of paraquat to cotton in CA. It should be noted these ambient air monitoring data have several uncertainties; the older study may not be reflective of current agricultural practices and is limited to a single geographic area and crop. Additional air monitoring studies would be necessary to make a more definitive risk finding relating to paraquat volatilization exposures.”*<sup>20</sup> While important to acknowledge, the uncertainties within ambient air monitoring do not invalidate or limit its usage for risk assessment.

## 5.0 Volatilization Modeling

In addition to considering air monitoring studies, HED may conduct bystander inhalation exposure assessments from volatilization with the use of the Probabilistic Exposure and Risk Model for Fumigants (PERFUM).<sup>21</sup> Atmospheric models, such as PERFUM, assist with predicting deposition patterns of pesticides released into the atmosphere and estimating buffer zones following applications to protect bystanders. PERFUM accounts for the hourly variability in the rate at which a pesticide may volatilize from a treated field (flux) over a 24-hour period. Based on the flux, the model estimates air concentrations of pesticide residue and based on those concentrations, calculates buffer zones that can help to avoid residue air concentrations above a level of concern. Use of PERFUM requires the input of hourly flux rates, gathered from field volatility studies, that are typically available for fumigant pesticides but not for conventional pesticides (e.g., paraquat).

Therefore, EPA developed the volatilization screen, based on PERFUM, for active ingredients without chemical-specific flux data to identify if additional data (e.g., flux or air monitoring data) are needed to quantify bystander inhalation exposure to inform the risk characterization. The screen and accompanying analysis of the results are an indicator of potential exposure from volatilization and not an indicator of risk to identify mitigations for risk assessment.

---

<sup>18</sup> Available online: [Community Pesticide Monitoring](#)

<sup>19</sup> State of California. Summary of Assembly Bill 1807/3219. Pesticide Air Monitoring Results Conducted by the California Air Resources Board 1986-1995.

<sup>20</sup> Available online: [Paraquat Dichloride: Draft Human Health Risk Assessment in Support of Registration Review](#)

<sup>21</sup> Available online: [Probabilistic Exposure and Risk Model for Fumigants \(PERFUM\)](#)

The volatilization screen is a predictive model used to determine whether additional data are needed to examine potential non-occupational bystander inhalation exposure from volatilization. The model estimates flux using the physicochemical properties of the active ingredient, but these properties may not fully represent the volatility of the formulated product, which is typically mixed or diluted in water, solvents, and inerts. Furthermore, field application and meteorological conditions such as temperature, rainfall, humidity, wind speeds, soil characteristics, application rate, application timing, crop target, product formulation, application type, and equipment can influence flux and therefore the air concentration of pesticide residues. The volatilization screen does not account for the variability in hourly flux over a 24-hour period. Instead, the volatilization screen<sup>22</sup> estimates flux as a constant 24-hour rate, the level at which residues of a pesticide may be concentrated in the air based on the flux, and the air concentration at different distances from the treated field. Since the volatilization screen is based on PERFUM, entering the estimated flux from the screen into PERFUM for each hour in a 24-hour period would yield similar results as the screen.

The modeled air concentrations from the volatilization screen are then compared to a threshold level or air concentration of concern (CoC) (i.e., the point of departure divided by the total uncertainty factors (UFs)) to determine the potential for bystander inhalation risk from volatilization. Although the screen may resemble a risk determination, its outcomes should not be interpreted as definitive for regulatory decision making. The screening approach is intentionally conservative, meaning a passing result supports low concern, but a failing result does not mean that the pesticide poses a risk of concern due to volatilization. Instead, it signals the need for further evaluation under more realistic conditions of use. In 2014, HED conducted and released the results of the volatilization screen for paraquat dichloride which indicated that additional data was needed to more accurately determine bystander inhalation risk from volatilization.<sup>23</sup> However, in a secondary review of the paraquat volatilization screen, it was discovered that the vapor pressure value<sup>24</sup> for paraquat was incorrectly entered into the model.<sup>25</sup> Since vapor pressure is a determining property to estimate flux and thus the amount of pesticide residue expected to be released in the air, a change in vapor pressure can greatly impact the results of the volatilization screen. After making this correction, the modeled air concentrations aligned with results from the CARB ambient air study, EFED environmental fate analysis, and reported physicochemical characteristics of paraquat suggesting a low potential for volatilization. According to the corrected screen, there are no air concentrations of concern at any distances from the treated field.

However, with the incorporation of the new vapor pressure study submitted by Syngenta in 2024, the outcome of the new volatilization screen is in contrast with the previously corrected screen, CARB ambient air study, and reported physicochemical characteristics of paraquat. **Notable, this inconsistency does not extend to bare soil, which remained unchanged between the original and updated screens and remains consistent with the EFED environmental fate analysis which suggests**

---

<sup>22</sup> Available online: [Human Health Bystander Screening Level Analysis: Volatilization of Conventional Pesticides](#)

<sup>23</sup> Available online: [Appendix C Data Entry Sheets for the Registration Review Chemical Volatilization Screening Analysis](#)

<sup>24</sup> Available online: [Paraquat: Preliminary Ecological Risk Assessment for Registration Review](#)

<sup>25</sup> At the time of the original screening-level assessment, the vapor pressure, which is a key input to calculating flux (i.e., rate of volatilization) in the volatilization screen, was reported as  $1.3 \times 10^{-7}$  Pa at 25°C. However, the vapor pressure of  $1.3 \times 10^{-7}$  Pa was incorrectly entered into the volatilization screen as  $1.3 \times 10^{-6}$  Pa – an order of magnitude higher. The input error resulted in modeled air concentrations above the CoC based on an inaccurate estimated flux value. Incorporating the 2014 reported vapor pressure of  $1.3 \times 10^{-7}$  Pa correctly, the tool estimated air concentrations below the CoC, indicating inhalation exposure to bystanders from volatilization near treated fields are not expected (i.e., the CoC was not exceeded for any crop scenario at any distance downwind from the field for any field size). All else equal, a lower vapor pressure will result in lower air concentrations.

limited volatilization from soil due to high solubility and extreme soil adsorption of paraquat. The updated screen modeled the air concentration of concern at various distances from the treated field. Table 2 and Table 3 present the results of the 2014 corrected screen and the updated volatilization screen following incorporation of the new 2024 Syngenta vapor study, respectively.

**Table 2: Corrected 2014 Volatilization Screen**

Screen Inputs		Screen Results	Field Size <sup>3</sup> (acres)					
Vapor Pressure	1.3x10 <sup>-7</sup> Pa at 25°C		10	20	40	60	80	120
Solubility	618,000 mg/L	<i>Crop Height</i> <sup>5</sup>	Distance to CoC (m) <sup>4</sup>					
K <sub>oc</sub>	10,000 ml/g	<i>Bare Soil</i>	0	0	0	0	0	N/A
Foliar Flux Rate <sup>1</sup>	9.93x10 <sup>-5</sup> µg/m <sup>2</sup> -s	<i>Cole crop</i>	0	0	0	0	0	N/A
Soil Flux Rate <sup>1</sup>	3.18x10 <sup>-9</sup> µg/m <sup>2</sup> -s	<i>Row crop</i>	0	0	0	0	0	0
CoC <sup>2</sup>	0.1 µg/m <sup>3</sup>	<i>Orchard</i>	0	0	0	0	0	N/A

<sup>1</sup> Flux equation and methodology found in: [Human Health Bystander Screening Level Analysis Volatilization of Conventional Pesticides](#).  
<sup>2</sup> CoC = Concentration of Concern: (NOAEC=10 µg/m<sup>3</sup>)/ (UF =100) = 0.1 µg/m<sup>3</sup>  
<sup>3</sup> 120 acres apply to row crop only; NA=Not Applicable  
<sup>4</sup> Distance to the CoC: distance from the edge of the field where air concentrations fall below the concentration of concern.  
<sup>5</sup> Crop height scenarios: Bare Soil (prior to or at planting), Cole (3 ft or less), Row (6-18 ft), and Orchards (greater than 18 ft)

**Table 3: Updated Volatilization Screen (2024 Vapor Pressure study)**

Screen Inputs		Screen Results	Field Size <sup>3</sup> (acres)					
Vapor Pressure	5.3x10 <sup>-4</sup> Pa at 25°C		10	20	40	60	80	120
Solubility	618,000 mg/L	<i>Crop Height</i> <sup>5</sup>	Distance to CoC (m) <sup>4</sup>					
K <sub>oc</sub>	10,000 ml/g	<i>Bare Soil</i>	0	0	0	0	0	N/A
Foliar Flux Rate <sup>1</sup>	9.59x10 <sup>-2</sup> µg/m <sup>2</sup> -s	<i>Cole crop</i>	>4500	>4500	>4500	>4500	>4500	N/A
Soil Flux Rate <sup>1</sup>	4.36x10 <sup>-6</sup> µg/m <sup>2</sup> -s	<i>Row crop</i>	>4500	>4500	>4500	>4500	>4500	>4500
CoC <sup>2</sup>	0.1 µg/m <sup>3</sup>	<i>Orchard</i>	>4500	>4500	>4500	>4500	>4500	N/A

<sup>1</sup> Flux equation and methodology found in: [Human Health Bystander Screening Level Analysis Volatilization of Conventional Pesticides](#).  
<sup>2</sup> CoC = Concentration of Concern: NOAEC (10 µg/m<sup>3</sup>)/ (UF =100) = 0.1 µg/m<sup>3</sup>  
<sup>3</sup> 120 acres apply to row crop only; NA=Not Applicable  
<sup>4</sup> Distance to the CoC: distance from the edge of the field where air concentrations fall below the concentration of concern.  
<sup>5</sup> Crop height scenarios: Bare Soil (prior to or at planting), Cole (3 ft or less), Row (6-18 ft), and Orchards (greater than 18 ft)

## 6.0 Conclusion

The 6(a)(2) vapor pressure study submitted by Syngenta increased uncertainty around the potential for paraquat to volatilize since vapor pressure is a key property used to estimate flux in the volatilization screen. While the volatilization screen is one tool to assess potential inhalation exposure from volatilization, the results are not an indicator of risk or the need to identify risk mitigations. HED considers several factors when conducting bystander inhalation risk assessments. These factors specific to paraquat have been outlined above and include the use pattern, toxicological profile, environmental fate, ambient air monitoring data, and physiochemical properties. In the case of paraquat, there is discrepancy among the multiple lines of evidence. The ambient air monitoring study from CARB found no detectable levels of paraquat in the air of communities near agricultural application sites,<sup>26</sup> and the

<sup>26</sup> State of California. Summary of Assembly Bill 1807/3219. Pesticide Air Monitoring Results Conducted by the California Air Resources Board 1986-1995.

EFED environmental fate analysis<sup>27</sup> indicated that paraquat is not expected to volatilize from water and soil; however, the HED volatilization screening analysis estimates an increased potential for volatilization from residues on foliage based on the new vapor pressure study. To resolve the discrepancy introduced by the new vapor pressure study and support a robust exposure and risk assessment addressing the potential volatilization of paraquat, additional data are necessary.

There are several additional types of data which may be used to either refine the volatilization screen (e.g., physical and chemical properties to *estimate* flux) or directly inform the non-occupational inhalation bystander analysis (e.g., studies to *measure* flux such as a field volatility study). A field study to measure flux specific to paraquat applications can directly inform the inhalation bystander analysis by providing flux measurements that take into account field application and meteorological conditions such as temperature, rainfall, humidity, wind speeds, soil characteristics, application rate, application timing, crop target, product formulation, application type, and equipment that can influence flux and therefore the air concentration of pesticide residues. These data can be incorporated into atmospheric models to determine deposition patterns of pesticides released into the atmosphere and estimate buffer zones following applications to protect bystanders. These data quantify the rate of pesticide vapor release into the atmosphere (i.e., volatilization) and the air residue concentration of the pesticide following volatilization from a surface (e.g., soil, foliage) over a specified area and within a given timeframe. Other data which can inform these exposure scenarios may also be considered. EPA recommends consultation or protocol review of any study prior to initiation to ensure that the data will satisfy the uncertainty identified in the current volatilization analysis.

---

<sup>27</sup> The newly submitted vapor pressure study will not change the reported environmental fate analysis in the Paraquat: Preliminary Ecological Risk Assessment for Registration Review for volatilization; because radiolabeled studies showed no volatilization from soil and combined with the high solubility and extreme adsorption of paraquat, volatilization from soil is not expected. Available online: [Paraquat: Preliminary Ecological Risk Assessment for Registration Review](#)