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MEMORANDUM

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FROM: David C. Edwards, Ph.D., Chief Deputy Director
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DATE: June 11, 2024

SUBJECT: UPDATE TO THE HEALTH-BASED RECOMMENDATIONS TO MITIGATE CANCER RISK OF OCCUPATIONAL BYSTANDER EXPOSURE TO 1,3-DICHLOROPROPENE

The Office of Environmental Health Hazard Assessment (OEHHA) has prepared an update to the health-based recommendations for the Department of Pesticide Regulation (DPR) provided December 13, 2023, to address potential cancer risks to occupational bystanders from the use of 1,3-dichloropropene (1,3-D). This action by OEHHA is consistent with the joint and mutual provisions outlined in Food and Agricultural Code sections 12980 and 12981.

The updated recommendations reflect input during the consultation process (Food and Agricultural Code 11454.2, 14023 and 14024) and additional work by our department that resulted in a greater understanding of occupational bystander exposures and mitigation measures.

The updated recommendations include several options for mitigating cancer risks to occupational bystanders. We look forward to working in a joint and mutual fashion with DPR to implement these recommendations in the development of the occupational bystander regulations.

Mitigation of Occupational Bystander Risks from Working in Close Proximity to Fields where 1,3-D is Applied

OEHHA recommends the following methods, separately or in combination, to mitigate occupational bystander risks from working in close proximity to fields to which 1,3-D has been recently applied.

1. Changes to application methods

Several field fumigation methods (FFMs) are associated with occupational bystander exposures at acceptable levels of exposure (see Scientific Basis section). These include FFMs 1242 and 1243 that utilize totally impermeable film tarps or “TIF” tarps when used for crops other than trees and grapes. Any mitigation measures that result in similar near-field annual average air concentration levels are assumed to result in bystander exposures at acceptable levels and are consistent with OEHHA recommendations.

2. Restrictions on proximity of occupational bystanders to fields after 1,3-D application

Exposures to occupational bystanders in proximity to recently treated fields can be reduced by limiting the duration of exposure and timing after application when they work in close proximity to the treated area. For example, a buffer zone of 100 feet for 48 hours after all non-TIF tarp treatments would reduce cancer risk to occupational bystanders to an acceptable level, whereas TIF tarp treatments would not require any buffer zone when used for crops other than trees and grapes (see Scientific Basis section).

3. Controlled application conditions

For each treatment method, emissions can be reduced by controlling application rates (e.g., pounds per acre), month of application, frequency of application, soil water content and other factors. Any combination of controls that result in similar or lower near-field annual average air concentration levels as those for TIF tarp FFMs 1242 and 1243 for crops other than trees and grapes are assumed to result in bystander exposures associated with risks at acceptable levels (see Scientific Basis section). As noted above, these risk mitigation methods address the time occupational bystanders spend in close proximity to treated fields, and where 1,3-D concentrations are the most pronounced.

Mitigation of Occupational Bystander Risk from Working in the General Vicinity of 1,3-D Treated Fields

The above-recommended mitigation measures do not account for general background exposures (not attributable to close proximity to treated fields) contributing to the occupational bystander exposure to 1,3-D from working in the vicinity of treated fields during their workday. DPR has indicated to OEHHA that the current township cap will remain in place for the next two years until the occupational bystander regulations for 1,3-D become effective. While background exposures to occupational bystanders are expected to sufficiently decrease once DPR's non-occupational bystander regulations are in place, OEHHA recommends that during this period DPR confirm this is the case by monitoring how the new methods are being implemented, conducting air monitoring to the extent feasible, and further evaluating through modeling ambient 1,3-D concentrations to which occupational bystanders are exposed. If the resulting annual average ambient air concentrations experienced by occupational bystanders working in the general vicinity of treated fields in high 1,3-D use areas fall significantly above 0.21 ppb (see Scientific Basis section), DPR should develop and adopt additional mitigation measures to reduce localized exposure.

Scientific Basis

OEHHA developed the recommendations above to reduce the risk of developing cancer to occupational bystanders to 1 in 100,000 (target risk value). Multiple factors inform the risk of developing cancer. These include the potency of the chemical and the extent of the exposure, including both the duration of the exposure and the concentration of the chemical to which the individual is exposed (exposure concentration). OEHHA assumed a potency value of 0.057 ppm^{-1}, equivalent to an inhalation cancer slope factor of 0.19 $(mg/kg\text{-}day)^{-1}$.[1] Using this assumption, OEHHA estimated that an occupational bystander exposed five days a week, eight hours per day, for forty years to 0.21 ppb has a risk of cancer of 1 in 100,000. Exposures to higher concentrations with less frequency also can result in an average concentration of 0.21 ppb over the work life, and a risk of 1 in 100,000. OEHHA recommends the measures above to achieve this or a lower average concentration, which would reduce the cancer risk of occupational bystanders to 1 in 100,000 or below.

The updated analyses and further details on the assumptions underlying the risk calculations by OEHHA are provided in the attachment.

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[1] OEHHA (2021). Initial Statement of Reasons. Proposed amendment to Section 25705(b). Specific regulatory levels posing no significant risk. 1,3-Dichloropropene (oral and inhalation routes).

We look forward to continuing to work with you, as part of the joint and mutual process, on regulatory development. If you need additional information or have any questions, please contact Dr. Ouahiba Laribi at Ouahiba.Laribi@oehha.ca.gov.

Attachment

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Attachment to OEHHA Memorandum: “Health-Based Recommendations to Mitigate Cancer Risk of Occupational Bystander Exposure to 1,3-Dichloropropene”

June 2024 Update

Pursuant to Food and Agricultural Code sections 12980 and 12981, the Office of Environmental Health Hazard Assessment (OEHHA) has developed health-based recommendations for reducing the cancer risk to occupational bystanders[1] from exposure to 1,3-dichloropropene (1,3-D or Telone) while at work. These recommendations are based on estimates of occupational bystanders’ exposures to 1,3-D that result from working adjacent to and in the vicinity of treated fields, and the reductions needed to reduce their cancer risk to an acceptable level.

This updates the recommendations presented in December 2023, and reflect input received during a cross agency consultative process[2] and further analyses. The Department of Pesticide Regulation (DPR) and OEHHA conducted the consultation process with the California Department of Food and Agriculture (CDFA), County Agricultural Commissioners, Air Resources Board and Air Districts. OEHHA and DPR had further internal discussions about the data and analyses.

Several options within DPR’s purview are available to mitigate occupational bystander risks due to exposure from working in close proximity to a field that has been treated. These include:

1. Changes to application methods, such as changing to a lower-emitting field fumigation method (FFM).
2. Restrictions on proximity of occupational bystanders to fields after 1,3-D application, such as instituting buffer zones to reduce the amount of time occupational bystanders spend in close vicinity to a treated field. Size and duration of buffer zone requirements are calculated taking into account application rate (pounds per acre), application size, exposure frequency, and fumigation method.
3. Controlling application conditions, for example, restricting application rates, month of application, frequency of application, soil water content, and other factors. For each FFM, the percent reduction in exposure that would reduce working lifetime cancer risk to acceptable levels was calculated.

In these evaluations, a cancer risk level of one per one hundred thousand (10^{-5}) was used by OEHHA as the acceptable risk level, as is done in other OEHHA programs.[3] As

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[1] For the purposes of this memorandum, an occupational bystander is an individual working in the vicinity of fields treated with 1,3-D, but is not directly handling, mixing or applying the pesticide.

[2] Pursuant to Food & Agr. Code §11454.2; 12980; 12981; 14023; 14024

[3] In Proposition 65, no significant cancer risk is 10^{-5}. See CA Code of Regs, Title 27, Section 25703(b). OEHHA (2012): “…a 1×10^{-5} level for notification is a common standard for the Air Districts,” as in ARB and CAPCOA (2015)

detailed below, OEHHA accordingly calculated that occupational bystander exposure to an average air concentration of 0.21 ppb or below over a working lifetime was associated with an acceptable risk.

Occupational bystanders can also be exposed to 1,3-D in ambient air when working in the general vicinity of 1,3-D applications. These kinds of ambient exposures have historically been controlled by maintaining a cap on the use of 1,3-D within each specified six-mile by six-mile area, also known as a township. DPR has indicated to OEHHA that the current township cap will remain in place for the next two years until the occupational bystander regulations for 1,3-D become effective. While background exposures to occupational bystanders are expected to sufficiently decrease once DPR's non-occupational bystander regulations are in place, OEHHA recommends that during this period DPR confirm this is the case by tracking how the new methods are being implemented, conducting air monitoring to the extent feasible, and further evaluating through modeling ambient 1,3-D concentrations to which occupational bystanders can be exposed (DPR, 2022b). If resulting annual ambient concentrations experienced by occupational bystanders working in the general vicinity of treated fields in high 1,3-D use areas fall significantly above 0.21 ppb, DPR should develop and adopt additional mitigation measures to reduce localized exposure. (See Section C for further discussion).

OEHHA conducted this analysis to estimate exposures and risks associated with different 1,3-D treatment methods utilizing modeling conducted by DPR and considered approaches for risk mitigation. As noted above, OEHHA made changes to some assumptions and further refined its analysis to incorporate feedback received during the consultation process. Input was received regarding:

- The assumption of treatment method that will be used on tree and grape crops;
- The combination of treatment methods that results in bystander exposure;
- The datasets analyzed for pesticide use statistics;
- Period over which the air modeling was done;
- Consideration of field size and application rate.

This input resulted in changes in assumptions related to exposure, which in turn resulted in some changes in our recommendations.

A. Assumptions and Methods

Below is an overview of the assumptions and methods used to develop the recommendations for mitigation measures to reduce risks to occupational bystanders.

Appendix G. OEHHA (2007) used target risk values for occupational exposures of 10^{-3} to 10^{-5}. OEHHA (2015) p. 8-18 referenced 10^{-5} as an acceptable risk level.

Population of focus in the analysis

OEHHA considered various types of occupational bystanders that might be exposed to 1,3-D, focusing on those most exposed. Fieldworkers directly hired by a grower, and who mainly perform manual work such as harvesting, weeding, and pruning, are likely to be the ones most chronically exposed to 1,3-D through working in fields adjacent to treated fields and/or by working in an area where 1,3-D is routinely applied. These fieldworkers also tend to live in an agricultural area close to where they work. California-specific data from the National Agricultural Worker Survey found that between 2015 – 2020, 92% of farmworkers were settled in an area and did not work far away from home (< 75 miles) (NAWS, 2022). And in that same period, almost 71% of California fieldworkers were employed directly by a grower, while 29% were employed by farm labor contractors. In this preliminary analysis, individual farmworkers were assumed to work in either Coastal or Inland Regions (as defined in DPR's regulations for non-occupational bystanders) and not to work in both regions over the year.

Farmworkers often perform physically demanding work that impacts their breathing rate, thereby modifying their intake and increasing their exposure to pesticides. A breathing rate of 10 cubic meters over the workday was assumed, consistent with moderately intensive work and assumptions for occupational exposure used in OEHHA guidelines for other programs (OEHHA, 2015).

Key variables on frequency and duration of exposure used to estimate lifetime 1,3-D exposure of occupational bystanders

Key to estimating lifetime exposure of occupational bystanders is a clear understanding of California-specific agricultural practices and fieldworker activity patterns. For example, when crops are harvested, fieldworkers may work more than the average 40 hours per week. It is also important to understand the distances between fieldworkers' working locations and 1,3-D application sites and how frequently fieldworkers may change locations. To gain further insight into fieldworker activity patterns, OEHHA performed an extensive search of available information in reports, databases, and publications, and contacted experts and stakeholders from various organizations.

Despite this effort, OEHHA was not able to identify references that would specifically indicate the frequency at which a farmworker might be present at the edge of a treated field, or within a certain distance of that field, during the time 1,3-D is being released into the air. Instead, OEHHA made assumptions about the frequency mainly based on an analysis of 1,3-D use data provided by DPR.

To estimate average working lifetime exposure for occupational bystanders from 1,3-D applications in close proximity to their work, OEHHA assumed they are directly exposed at the edge of the field:

(1) for 8 hours per day during the hours of 8:00 a.m. to 4:00 p.m. DPR used this assumption in their modeling to estimate average 8-hr air concentrations for the 8:00

a.m. to 4:00 p.m. period following treatment of fields with 1,3-D. There is evidence that occupational bystanders may be working an overall 10 hours per day during harvesting season (NAWS, 2022). However, only one study on activity patterns was available. This study of broccoli fieldworkers observed that these workers on average harvest for 6.6 hours with a maximum workday of 8.8 hours (UCANR, 2017). Assuming an 8-hour workday seemed a reasonable approach for these preliminary risk projections. This assumption may be modified during this regulatory process upon receipt of additional reliable and robust data.

(2) for 3 days per week. From conversations OEHHA had with University of California Cooperative Extension (UCCE) advisors, the most frequently a fieldworker may return to the same fields is during harvesting where, for example, they need to pick strawberries every 2 to 3 days. Therefore, OEHHA assumed 3 days per week a worker may be in the same field.

(3) for a 3-week emission period following an application. The data provided by DPR is an average over the 3 week-period, which includes both high and low levels. DPR has reported that their modeling shows that by 21 days, 1,3-D emissions are not significant (DPR, 2019), and OEHHA has adopted this assumption.

(4) with an updated frequency of 3.2 times per year in the Coastal Region or 1.6 times per year in the Inland Region. Coastal and Inland Regions are defined in DPR's proposed field fumigation requirements (DPR, 2023d). Using 1,3-D use data for the 2013-2023 period and revised parameters, OEHHA calculated:

   a. the number of applications per year from the average application counts per section (1-mile by 1-mile area);
   b. the average number of application counts per section with 1,3-D uses within townships (6-mile by 6-mile area) in each of the two regions;
   c. the percentiles of the average application counts of all inland and coastal townships with 1,3-D uses.

   For inland, OEHHA used the 99th percentile of the average application counts of the 462 townships with 1,3-D uses which is 1.6. For coastal, OEHHA used the 96.5th percentile of the 132 townships with 1,3-D uses which is 3.2. Using the high-end percentiles is needed here considering that this estimation does not account for aggregate exposure from other scenarios such as ambient air exposure to 1,3-D from working in the vicinity where 1,3-D is used during the other days of the year.

(5) over a 40-year working period in a 70-year lifetime. This is the default number of years worked over a lifetime used by both OEHHA, in calculating risk under Proposition 65,[4] and DPR, in its risk characterization documents. This is consistent with experts' testimony and with reports showing that the agricultural working community is aging (NAWS, 2022; UC Merced, 2023).

[4] California Code of Regulations, Title 27, Section 25721(d)(3)

With these updates, OEHHA believes it is using a more appropriate approach and parameters considering the data gap in estimating how frequently a fieldworker might be present at the edge of a treated field during the time 1,3-D is being released into the air. OEHHA is aware that some of its assumptions may overestimate exposure while others may underestimate it. For example, in the modeling described below, OEHHA obtained from DPR median concentration levels for large regions, which can underestimate concentrations for smaller localities. But OEHHA believes these parameters (i.e., edge of field, hours per day, not accounting for background, frequency of exposure) and other modeling assumptions overall balance each other out. Taken together they provide a realistic and health-protective exposure estimate that reflects occupational bystanders' lifetime exposure from working adjacent to treated fields.

Use of modeling to estimate average air concentrations near treated fields.

OEHHA calculated average air concentrations breathed by occupational bystanders from DPR's modeling results. An overview of the approach is provided here.

DPR modeled average air concentrations based on maximum allowed acreage and application rate (i.e., 80-acre treatments and 332 lbs. per acre) for groups of FFMs and regions (Inland and Coastal). DPR provided OEHHA with 1,3-D concentrations at the edge of the treated field, with or without a buffer zone of 100 feet for a duration of 48 hrs. after 1,3-D was applied. Further, DPR reported averaged 1,3-D air concentrations specific to workday hours of 8:00 a.m. to 4:00 p.m., since emissions and air concentrations also depend on the time of day. The DPR estimates of average exposure at the field edge with or without the 100 ft. buffer zone are provided in Appendix A.

DPR provided OEHHA with modeling data for 80 acres, which is the current maximum application block size of field for 1,3-D application. Similar to the summary of application counts, OEHHA used 2013 – 2023 1,3-D use data and calculated:

a. the average application acreage per section;
b. the average application acreage over all sections with 1,3-D uses within each township (6-mile by 6-mile area) of two regions;
c. the percentiles of the average application acreages of all inland and coastal townships with 1,3-D uses.

For inland, the 99^{th} percentile of the average application acreage of the 462 townships with 1,3-D uses is 140 acres. For coastal, the 96.5^{th} percentile of the average application acreage of the 132 townships with 1,3-D uses is 85 acres. Since both percentiles resulted in application sizes higher than the maximum acreage (i.e., 80 acres), OEHHA used 80 acres as the basis for the proposed mitigations.

While fieldworkers working for a single grower in a high use area (e.g., Salinas) are more likely working in small size farms with smaller field sizes (CDFA, 2020), Pest Control Operators tend to group applications from adjacent small fields. On the other hand, contract workers, who represent a third of fieldworkers in the state, are usually employed for the season and are mainly hired to do specific tasks such as harvesting, and maybe pruning and weeding. They travel from farm to farm and may be exposed to large field sizes (NAHWS, 2022, UC Merced, 2023), and with greater frequency than those workers employed on a farm.

Fumigation methods were grouped according to DPR's non-occupational regulations.[5] The FFM groupings considered are given in the table below, with the treatment method used as representative for the group given in bold:

Group of FFMs	FFM Codes
1: Standard nontarped and non-TIF tarp shallow (12 inch) methods	**1201**, 1202
2: Standard nontarped and non-TIF tarp deep (18 inch) methods	**1206**, 1207, 1210, 1211
3: Chemigation (drip)/non-TIF tarp method	**1209**
4: 24-inch injection methods	**1224**, 1225, 1226
5: TIF tarp methods – broadcast and drip	**1242**, 1247, 1249
6: TIF tarp methods – bed and strip	**1243**, 1245, 1259
7: 40% TIF tarp with 18-inch injection depth method	**1250**
8: 40% TIF tarp with 24-inch injection depth method	**1264**

TIF, totally impermeable film

To estimate lifetime exposure of occupational bystanders who routinely work near treated fields, OEHHA adjusted DPR modeling results for each FFM from the maximum application rate to the average application rate and to the relative frequency of use in each region. While application rates for tree and grape are close to the maximum allowable application rate, application rates for crops other than tree and grape are approximately 3-fold lower than the maximum allowable application rate of 332 pounds per acre. For example, in 2018, for FFM 1259, which is mostly used annually or semi-annually for crops other than tree and grape, the maximum application rate used was 130 pounds per acre and the average usage was 79 pounds per acre. In contrast, the maximum application rate in the same year for FFM 1210, which is mostly used once every 25-50 years for tree and grape, was 360 pounds per acre and the average was 324 pounds per acre. In addition, FFMs are not used with the same frequencies in the two regions. Consequently, the probability that an occupational bystander works at the edge of a field treated with a certain FFM varies between regions.

Application rates and frequencies were available in the 2013-2023 pesticide use data for FFM groups 1201, 1206, 1209, 1242, and 1243 but not for FFM groups 1224, 1250, and 1264. FFM 1201 and 1206 represent 99% of all 11-year tree and grape treatments.

[5] https://www.cdpr.ca.gov/docs/legbills/rulepkgs/22-005/dpr_22-005_oal_text_13-d.pdf

However, the non-occupational regulations do not allow FFM groups 1201, 1206, and 1209 for tree and grape applications. FFM 1224 is believed to become the dominant method used for tree and grape due to the high cost of TIF tarp required by other methods allowed for this type of treatment. Therefore, OEHHA excluded tree and grape data to calculate the average application rates and relative frequencies of use of these FFMs and assumed that all reported uses for tree and grape with FFM 1201 and 1206 would use FFM 1224. In addition, the modeled concentration of FFM 1224 is similar to the average of all five methods (FFM 1224, 1242, 1243, 1250, and 1264) available for tree and grape treatments. Although no data were available for FFM 1250 and 1264, any applications originally with higher emission method (such as FFM 1201, 1206, and 1209) changing to these methods would cause exposure similar to or lower than OEHHA's current estimation.

Average application rates and relative frequencies used to adjust DPR modeling results are provided in Tables 1 and 2.

Table 1. FFM Average Application Rates (pounds per acre) by Region and Season

FFM Group	Representative FFM	Inland		Coast	
		Nov-Feb	Mar-Oct	Nov-Feb	Mar-Oct
1201	Nontarp/shallow/broad-cast or bed	120	100	100	100
1206	Nontarp/18 inches deep/broadcast or bed	130	120	120	150
1209	Chemigation (drip system)/tarp	90	90	100	120
1242	Totally Impermeable Film (TIF) tarp/shallow/broadcast	130	190	140	110
1243	TIF tarp/shallow/bed	100	90	90	90
1224	Nontarp/24 inches deep/broadcast	320	320	330	330

Table 2. Relative Frequencies (%) of FFM Use by Region and Season

FFM Group	Representative FFM	Inland		Coast	
		Nov-Feb	Mar-Oct	Nov-Feb	Mar-Oct
1201	Nontarp/shallow/broad-cast or bed	0.21	4.14	2.17	8.85
1206	Nontarp/18 inches deep/broadcast or bed	8.73	19.15	1.49	8.71
1209	Chemigation (drip system)/tarp	1.10	0.97	0.35	5.76
1242	Totally Impermeable Film (TIF) tarp/shallow/broadcast	2.59	2.08	0.74	40.28

1243	TIF tarp/shallow/bed	0.18	0.39	1.98	27.47
1224	Nontarp/24 inches deep/broadcast	28.83	31.63	0.21	1.99
Total		100		100	

<u>Estimation of an acceptable air concentration for occupational bystanders</u>

OEHHA developed the recommendations above to reduce the risk of developing cancer to occupational bystanders to 1 in 100,000 (target risk value). Multiple factors inform the risk of developing cancer. These include the potency of the chemical and the extent of the exposure, including both the duration of the exposure and the concentration of the chemical to which the individual is exposed (exposure concentration). OEHHA assumed a potency value of 0.057 ppm^{-1}, equivalent to an inhalation cancer slope factor of 0.19 $(mg/kg\text{-}day)^{-1}$.[6] Using this assumption, OEHHA estimated that an occupational bystander exposed five days a week, eight hours per day, for forty years to 0.21 ppb has a risk of cancer of 1 in 100,000. Exposures to higher concentrations with less frequency also can result in an average concentration of 0.21 ppb over the work life, and a risk of 1 in 100,000. The calculation employed to attain this value is explained below.

The average air concentration experienced by occupational bystanders over their working lifetime that is associated with a given level of cancer risk can be calculated using the following equation:

$$\bar{C}_{lifetime-occ\ bystander} = CR \times \frac{BW}{BR \times CSF} \times \left(\frac{365\,\frac{days}{yr} \times 70\ yr}{5\,\frac{days}{wk} \times 50\,\frac{wks}{yr} \times 40\ yr} \right) \times \frac{1}{4.53\ \times 0.001}$$

The meaning of the variables and values assumed for them by OEHHA are as follows:

- CR = acceptable cancer risk: 10^{-5};
- BW = adult body weight: 70 kg;
- BR = breathing rate for 8 hours moderately intensive work per day: 10 m^3/day;[7]
- CSF = Inhalation Cancer Slope Factor[8] for Humans: 0.19 $(mg/kg - day)^{-1}$.

The equation also includes unit conversion values: 4.53 for ppb to $\mu g/m^3$, and 0.001 for $\mu g/m^3$ to mg/m^3.

[6] OEHHA (2021). Initial Statement of Reasons. Proposed amendment to Section 25705(b). Specific regulatory levels posing no significant risk. 1,3-Dichloropropene (oral and inhalation routes).

[7] OEHHA Air Toxic Hot Spots Guidance Manual, 2015; California Code of Regulations, Title 27, Section 25721(d)(3).

[8] The cancer potency assumed, 0.19 $(mg/kg\text{-}day)^{-1}$, is equivalent to the inhalation unit risk value of 0.057 ppm^{-1}. Cancer potency from OEHHA (2021). Initial Statement of Reasons. Proposed amendment to Section 25705(b). Specific regulatory levels posing no significant risk. 1,3-Dichloropropene (oral and inhalation routes).

The cancer potency assumed, 0.19 (mg/kg-day)$^{-1}$, is equivalent to 0.057 ppm^{-1}.

Using the above equation, an occupational bystander exposed during the workday to an average concentration of 0.21 ppb is estimated to experience a cancer risk of 10^{-5}.

Estimation of relative reduction of air concentrations

To protect occupational bystanders from the adverse effects of long-term exposure to 1,3-D, OEHHA calculated the relative reduction of air concentrations needed to reduce risks to acceptable levels in two regions. The mitigations to meet the reduction would ensure that lifetime cancer risk would be reduced to an acceptable cancer risk level of 10^{-5}, as discussed above.

B. Results and Recommendations

1. Occupation bystander exposure for FFMs

Occupational bystander exposure, in terms of an average concentration during work, was calculated as 0.221 ppb in the Inland Region and 0.229 ppb in the Coastal Region. This was done by combining modeled results received from DPR for air concentration at the edge of the field with the lifetime working period, which was adjusted to the average application rate for each FFM, and its relative frequency of use.

Any mitigation measures that reduce the near-field average annual concentration levels to the acceptable level of 0.21 ppb are consistent with OEHHA recommendations.

2. Restrictions on proximity of occupational bystanders to fields after 1,3-D application

OEHHA considered the average application rates and use frequencies of the different treatment methods and the frequency of exposure for the Inland and Coastal Regions where 1,3-D is used. OEHHA developed an example of buffer zone distances and durations that would mitigate risks to acceptable levels for occupational bystanders working in close proximity to where 1,3-D is being applied. Table 3 shows an example of a mitigation measure combination: buffer zone (BZ) of 100 feet for 48 hours post application would result in mitigation to acceptable risk levels of 10^{-5} for FFM groups 1201, 1206 and 1209 for crops other than trees and grapes and for any authorized method for trees and grapes. With OEHHA's updated analysis, FFM groups 1224, 1242, 1243, 1250, and 1264 would not require any buffer zone when used for crops other than trees and grapes.

Table 3. Example: Buffer Zones and Duration Periods for Different FFMs Estimated to Mitigate Risks to Occupational Bystanders *

Group of FFMs	FFMs in the group	Inland	Coastal
1: Standard nontarped and non-TIF tarp shallow (12 inch) methods	**1201**, 1202	100 feet for 48 hrs	100 feet for 48 hrs

Group of FFMs	FFMs in the group	Inland	Coastal
2: Standard nontarped and non-TIF tarp deep (18 inch) methods	**1206**, 1207, 1210, 1211	100 feet for 48 hrs	100 feet for 48 hrs
3: Chemigation (drip)/non-TIF tarp method	**1209**	100 feet for 48 hrs	100 feet for 48 hrs
4: 24-inch injection methods	**1224**, 1225, 1226	Tree & Grape: 100 feet for 48 hrs Other: None needed	Tree & Grape: 100 feet for 48 hrs Other: None needed
5: TIF methods – broadcast and drip	**1242**, 1247, 1249	Tree & Grape: 100 feet for 48 hrs Other: None needed	Tree & Grape: 100 feet for 48 hrs Other: None needed
6: TIF methods – bed and strip	**1243**, 1245, 1259	Tree & Grape: 100 feet for 48 hrs Other: None needed	Tree & Grape: 100 feet for 48 hrs Other: None needed
7: 40% TIF with 18-inch injection depth method	**1250**	Tree & Grape: 100 feet for 48 hrs Other: None needed	Tree & Grape: 100 feet for 48 hrs Other: None needed
8: 40% TIF with 24-inch injection depth method	**1264**	Tree & Grape: 100 feet for 48 hrs Other: None needed	Tree & Grape: 100 feet for 48 hrs Other: None needed

* The bolded FFM is the representative method. These were based on an 80-acre field using average application rates estimated by OEHHA (Table 1).

This analysis and the proposed mitigations are based on updated air dispersion modeling data (i.e., averages of concentration estimates from 2013 – 2017 and 2019 – 2023 periods) and 1,3-D use data (i.e., number of applications per year, average application rates, and use frequencies from 2013 – 2023 period). Under the non-occupational regulations, usage might change. It is anticipated that overall exposures would be lower under the new regulations, but this would need to be confirmed as discussed in the OEHHA recommendation below.

3. Controlled application conditions

Restricting application rates (e.g., pounds per acre), month of application, frequency of application, soil water content, and other factors can also mitigate risk. The degree of reduction in concentration to achieve acceptable levels for the different FFMs is 5% in Inland and 8% in Coastal Regions.

Limiting the daily exposure of occupational bystanders while working in close proximity to a recent application of 1,3-D to an annual average air concentration of 0.21 ppb or below will mitigate occupational bystanders' cancer risk to an acceptable level. This can be accomplished by achieving the percent reductions in nearby concentrations provided above.

C. Other Considerations: Occupational Bystanders Working in the Vicinity of Treated Fields

The risk mitigation measures recommended above by OEHHA aim to protect bystanders at the edge of the treated field, but they do not account for other potential exposures in the vicinity contributing to the occupational bystander's exposure to 1,3-D during their workday. To limit ambient air concentrations in high use areas, DPR historically instated a cap on the use of 1,3-D within each specified six-mile by six-mile area, also known as a township, to protect both occupational and residential bystanders. Currently, DPR has an annual limit of 136,000 adjusted total pounds of 1,3-D usage within each township. In its non-occupational regulations, DPR plans to phase out the capping of use as a means to control cumulative exposures (DPR, 2022b). DPR's regulations for non-occupational bystanders that aimed at mitigating risks from ambient exposures are in place since January 1, 2024.

DPR's decision to remove the township cap was based on modeling results of annual average air concentrations with new mitigations put in place in the non-occupational bystander regulations and warrants confirmation with air monitoring data to demonstrate efficacy. DPR has indicated to OEHHA that the current township cap will remain in place for the next two years until the occupational bystander regulations for 1,3-D become effective. While background exposures to occupational bystanders are expected to sufficiently decrease once the non-occupational bystander regulations are in place, OEHHA recommends that during this period DPR confirm this is the case by monitoring how the new methods are being implemented, conducting air monitoring to the extent feasible, and further evaluating through modeling ambient 1,3-D concentrations to which occupational bystanders are exposed. If resulting annual ambient concentrations experienced by occupational bystanders working in the general vicinity of treated fields in high 1,3-D use areas fall significantly above 0.21 ppb, DPR should develop and adopt additional mitigation measures to reduce localized exposure.

OEHHA also recommends ongoing assessment of 1,3-D concentrations through the evaluation of use, measurement, and modeling of concentrations to ensure occupational bystanders remain protected, once the joint and mutual regulations have been adopted. Effective January 1, 2024, DPR was required to provide on a regular basis in publicly released reports, data and analyses on the impacts of the non-occupational bystander regulations. The data collection and analysis for this exercise can be leveraged in the evaluations of occupational bystander exposures that OEHHA is recommending. Through the joint and mutual process, OEHHA may develop additional recommendations for modeling and monitoring pursuant to this recommendation.

There are historical observations (prior to implementation of the non-occupational bystander regulations) that support the recommendation for continued tracking of use and monitoring 1,3-D concentrations in high use areas. For example, during the 2013 – 2016 period when DPR granted waivers for the township cap, 1,3-D use was higher than the following period when waivers were generally not given.[9] Also, in the last six years, annual average air concentrations at monitoring stations in Shafter, Parlier, and Delhi have significantly exceeded the concentration of 0.21 ppb, as shown in Table 5. These sites can reflect the possible exposure an occupational bystander might currently experience while working in the vicinity of pesticide-treated areas in a high-use inland township, before the adoption of the non-occupational bystander regulations. However, based on expected use and modeling, under the DPR non-occupational bystander regulations that became effective January 2024, 1,3-D concentrations in ambient air for both residential and occupational bystanders are expected to be considerably lower than the levels for the Inland Region shown in Table 5 (DPR, 2022b). DPR's highest annual modeled level in any township in one year was 0.35 ppb (Santa Maria, S11N35W), and the 5-year period highest value was 0.25 ppb (Parlier, M15S22E), near the occupational bystander acceptable concentration level. These are modeled results during historically high use periods when banking was allowed. Monitoring of use and ambient concentrations will indicate whether additional mitigation is needed, as noted in the 2022 DPR memorandum by Segawa and Luo (DPR, 2022b).

Table 5. Annual average air concentration of 1,3-D in the six high-use communities monitored by DPR between 2017 and 2022*.

Region	Community	Annual Average for 2017-2022 (ppb)
Inland	Delhi	0.315
	Parlier	1.112
	Shafter	0.630
Coastal	Santa Maria	0.068
	Watsonville	0.068
	Oxnard	0.057

*The limit of detection varied between 0.01 and 0.1 ppb.

[9] DPR (2022), Initial Statement of Reasons and Public Report, Pertaining to health risk mitigation and volatile organic compound emission reduction for 1,3-dichloropropene. Available at: https://www.cdpr.ca.gov/docs/legbills/rulepkgs/22-005/dpr_22-005_oal_isor_1,3-d.pdf

Appendix A

DPR conducted modeling for an 80-acre treatment with 2013 – 2017 weather data and 2016 – 2023 weather data. For each of 8 FFM groups, results were summarized as 120-hr time weighted average (TWA) concentrations (or averages of 8-hr TWA concentrations over 15 working days of 3 weeks) at the edge of the application (Tables A1 and A3) and at 100 ft. buffer zone for 48 hours (Tables A2 and A4). The estimated concentrations provided to OEHHA are the median concentrations for each of two seasons, winter (November – February) and non-winter (March – October), over the 5-year weather data period. DPR used the maximum application rate of 332 lbs./acre in the modeling.

Table A1. DPR modeled 1,3-D concentrations for the 21-day emission period at the edge of field. Average 8-hr air concentrations (08:00-16:00), Mon-Fri, 80-acre application, 332 pounds per acre, receptor height of one meter, 2013-2017 weather data.

Field Fumigation Method	FFM Code	Avg Air Conc at Field Edge (ppb)			
		Inland	Inland	Coastal	Coastal
		Winter	Non-Winter	Winter	Non-Winter
Nontarp/shallow/broadcast or bed	1201	15.3	10.8	14.8	10.3
Nontarp/18 inches deep/broadcast or bed	1206	9.8	6.8	9.6	6.6
Chemigation (drip system)/tarp	1209	25.0	18.6	23.5	17.3
Nontarp/24 inches deep/broadcast	1224	5.6	3.9	5.5	3.8
Totally Impermeable Film (TIF) tarp/shallow/broadcast	1242	4.9	3.5	4.7	3.3
TIF tarp/shallow/bed	1243	6.2	4.3	6.1	4.2
40% TIF tarp/18 inches deep FFM 1250 w/ trees & grapes	1250	7.3	4.9	7.0	4.8
40% TIF tarp/24 inches deep FFM 1264 w/ trees & grapes	1264	4.2	2.9	4.3	2.9
40% TIF tarp/18 inches deep FFM 1250 no trees & grapes	1250	7.3	4.9	7.0	4.8
40% TIF tarp/24 inches deep FFM 1264 no trees & grapes	1264	4.2	2.9	4.3	2.9

Table A2. DPR modeled 1,3-D air concentrations for the 21-day emission period at the edge of field with 100 ft. buffer zone for the first 48 hours. Average 8-hr air concentrations (08:00-16:00), Mon-Fri, 80-acre application, 332 pounds per acre, receptor height of one meter, 2013-2017 weather data.

Field Fumigation Method	**FFM Code**	**Avg Air Conc at 100 ft. buffer zone (ppb)**			
		Inland	**Inland**	**Coastal**	**Coastal**
		Winter	**Non-Winter**	**Winter**	**Non-Winter**
Nontarp/shallow/broadcast or bed	1201	11.1	7.7	10.7	7.6
Nontarp/18 inches deep/broadcast or bed	1206	8.9	6.1	8.8	6.0
Chemigation (drip system)/tarp	1209	12.8	9.1	12.2	9.1
Nontarp/24 inches deep/broadcast	1224	5.5	3.8	5.5	3.8
Totally Impermeable Film (TIF) tarp/shallow/broadcast	1242	4.5	3.2	4.4	3.1
TIF tarp/shallow/bed	1243	5.5	3.8	5.4	3.7
40% TIF tarp/18 inches deep FFM 1250 w/ trees & grapes	1250	6.5	4.5	6.5	4.4
40% TIF tarp/24 inches deep FFM 1264 w/ trees & grapes	1264	4.2	2.9	4.3	2.9
40% TIF tarp/18 inches deep FFM 1250 no trees & grapes	1250	6.5	4.5	6.5	4.4
40% TIF tarp/24 inches deep FFM 1264 no trees & grapes	1264	4.2	2.9	4.3	2.9

Table A3. DPR modeled 1,3-D concentrations for the 21-day emission period at the edge of field. Average 8-hr air concentrations (08:00-16:00), Mon-Fri, 80-acre application, 332 pounds per acre, receptor height of one meter, 2019-2023 weather data.

Field Fumigation Method	**FFM Code**	**Avg Air Conc at field edge (ppb)**			
		Inland	**Inland**	**Coastal**	**Coastal**
		Winter	**Non-Winter**	**Winter**	**Non-Winter**
Nontarp/shallow/broadcast or bed	1201	13.8	10.6	14.8	10.7
Nontarp/18 inches deep/broadcast or bed	1206	9.1	6.7	9.7	6.8
Chemigation (drip system)/tarp	1209	22.9	18.0	24.4	17.9
Nontarp/24 inches deep/broadcast	1224	5.3	3.8	5.5	3.9
Totally Impermeable Film (TIF) tarp/shallow/broadcast	1242	4.5	3.4	4.8	3.4
TIF tarp/shallow/bed	1243	6.3	4.5	6.1	4.3
40% TIF tarp/18 inches deep FFM 1250 w/ trees & grapes	1250	6.5	4.8	7.0	4.9
40% TIF tarp/24 inches deep FFM 1264 w/ trees & grapes	1264	4.0	2.9	4.3	3.0
40% TIF tarp/18 inches deep FFM 1250 no trees & grapes	1250	13.8	10.6	14.8	10.7
40% TIF tarp/24 inches deep FFM 1264 no trees & grapes	1264	9.1	6.7	9.7	6.8

Table A4. DPR modeled 1,3-D air concentrations for the 21-day emission period at the edge of field with 100 ft. buffer zone for the first 48 hours. Average 8-hr air concentrations (08:00-16:00), Mon-Fri, 80-acre application, 332 pounds per acre, receptor height of one meter, 2019-2023 weather data.

Field Fumigation Method	FFM Code	Avg Air Conc at 100 ft buffer zone (ppb)			
		Inland	Inland	Coastal	Coastal
		Winter	Non-Winter	Winter	Non-Winter
Nontarp/shallow/broadcast or bed	1201	10.2	7.5	10.9	7.8
Nontarp/18 inches deep/broadcast or bed	1206	8.2	6.1	8.7	6.2
Chemigation (drip system)/tarp	1209	11.9	8.9	12.7	9.3
Nontarp/24 inches deep/broadcast	1224	5.3	3.8	5.5	3.9
Totally Impermeable Film (TIF) tarp/shallow/broadcast	1242	4.2	3.2	4.4	3.2
TIF tarp/shallow/bed	1243	5.0	3.8	5.4	3.9
40% TIF tarp/18 inches deep FFM 1250 w/ trees & grapes	1250	6.0	4.4	6.5	4.6
40% TIF tarp/24 inches deep FFM 1264 w/ trees & grapes	1264	3.9	2.9	4.2	3.0
40% TIF tarp/18 inches deep FFM 1250 no trees & grapes	1250	10.2	7.5	10.9	7.8
40% TIF tarp/24 inches deep FFM 1264 no trees & grapes	1264	8.2	6.1	8.7	6.2

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