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Addendum: Modeling for application factors of 1,3-Dichloropropene, Revised application factors

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1 Introduction

This document is an addendum to the initial modeling report for the determination of application factors of 1,3-Dichloropropene (1,3-D) (Luo and Brown, 2022). In this study, the application factors are revised for two field fumigation methods (FFMs) with broadcast-strip totally impermeable film (TIF): FFMs 1250 and 1264. The proposed methods in its original form assumed a minimum of 50% tarp coverage in the treated field (Brown, 2019, 2022). According to the comment from TriCal Inc. (letter from Mike Stanghellini dated January 18, 2023), DPR revised the proposed methods to allow for a minimum of 40% tarp coverage to accommodate greater row spacing. This report updates the application factors for the two methods (FFMs 1250 and 1264) to reflect the changes on the required minimum tarp coverage.

2 Methods and materials

2.1 Field fumigation methods and flux time series

In total 24 FFMs are considered in this study (Appendix I). Changes to the previous study (Luo and Brown, 2022) include:

- Change the 50% TIF methods to 40% TIF methods.
- Add the 24-in GPS method (FFM 1227) and group it with other 24-in methods (Group 4, Table 1)

The FFMs are categorized into 8 groups according to the injection depth, tarpaulin type, and emission ratio (Table 1). For each group, a representative FFM (highlighted in Table 1) is selected by considering the associated uses and emission ratios. For the representative FFMs, their flux time series with hourly flux rates ($\mu g/m^2/s$) were generated by HYDRUS model (Brown, 2022, 2023).

Table 1. Groups of field fumigation methods (FFMs) and the representative method

Group of FFMs	FFMs in the group
1-Standard nontarped and non-TIF tarp shallow (12 inch) methods	**1201**, 1202, 1203, 1204, 1205
2-Standard nontarped and non-TIF tarp deep (18 inch) methods	**1206**, 1207, 1208, 1210, 1211
3-Chemigation (drip)/non-TIF tarp method	**1209**
4-24-inch injection methods	**1224**, 1225, 1226, 1227
5-TIF methods – broadcast and strip	**1242**, 1247, 1249
6-TIF methods – bed and drip	**1243**, 1245, 1248, 1259
7-40% TIF with 18-inch injection depth method	**1250**
8-40% TIF with 24-inch injection depth method	**1264**

Notes: TIF = Totally Impermeable Film. Highlighted is the representative FFM for the group.

2.2 Air dispersion modeling

The application factors of 1,3-D are estimated by AERFUM, an integrated air dispersion modeling system for soil fumigants developed by DPR (Luo, 2019). The modeling approach and simulation design for predicting ambient concentrations and determining application factors have been documented in the previous study (Luo and Brown, 2022). This study only updates the application factors for FFMs 1250 and 1264 with their revised flux time series (Brown, 2023).

Modeling results are summarized for the two seasons of March to October and November to February. Specifically, the model predictions from Match to October are used to calculate application factors for the season of March to October. For the season of November to February, only the results in December and January are used in the calculation of application factors, representing a conservative estimation over the season (November to February).

In addition to the seasonal variation, application factors are separately developed for the inland and coastal regions in California. Inland and coastal county designations follow the definition used for the buffer zones of chloropicrin (DPR, 2017) (Table 2).

Table 2. County designations for inland and coastal regions in California

Inland	Coastal
Alameda, Amador, Alpine, Butte, Calaveras, Colusa, Contra Costa, El Dorado, Fresno, Glenn, Imperial, Inyo, Kern, Kings, Lake, Lassen, Madera, Mariposa, Merced, Modoc, Mono, Napa, Nevada, Placer, Plumas, Riverside, Sacramento, San Benito, San Bernardino, San Joaquin, Santa Clara, Shasta, Sierra, Siskiyou, Solano, Stanislaus, Sutter, Tehama, Trinity, Tulare, Tuolumne, Yolo, Yuba	Del Norte, Humboldt, Los Angeles, Marin, Mendocino, Monterey, Orange, San Diego, San Francisco, San Luis Obispo, San Mateo, Santa Barbara, Santa Cruz, Sonoma, Ventura

3 Modeling results

The estimated application factor for 1,3-D is presented as a function of FFM group, season, and region (Table 3).

Table 3. Table of Application Factors for 1,3-dichloropropene

Field Fumigation Methods (FFMs) and FFM codes	Inland		Coastal	
	Nov-Feb	Mar-Oct	Nov-Feb	Mar-Oct
Standard nontarped and non-TIF tarp shallow (12 inch) methods (1201, 1202, 1203, 1204, 1205)	2.93	1.40	2.42	1.78
Standard nontarped and non-TIF tarp deep (18 inch) methods (1206, 1207, 1208, 1210, 1211)	1.73	0.83	1.42	1.04
Chemigation (drip)/non-TIF tarp method (1209)	2.15	1.02	1.74	1.21
24-inch injection methods (1224, 1225, 1226, 1227)	1.00	0.48	0.82	0.61
TIF methods – broadcast and strip (1242, 1247, 1249)	0.46	0.21	0.37	0.24
TIF methods – bed and drip (1243, 1245, 1248, 1259)	0.76	0.36	0.62	0.45
40% TIF with 18-inch injection depth method (1250)	1.16	0.56	0.95	0.70
40% TIF with 24-inch injection depth method (1264)	0.71	0.34	0.58	0.43

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References

Brown, C. (2019). Simulation of 1,3-dichloropropene emission from a broadcast application with partial low permeability film surface cover. California Department of Pesticide Regulation, Sacramento, CA.

Brown, C. (2022). Updates to HYDRUS-simulated flux estimates of 1,3-dichloropropene maximum period-averaged flux and emission ratios. California Department of Pesticide Regulation, Sacramento, CA.

Brown, C. (2023). Modeling broadcast-strip TIF applications with 40% tarp coverage. California Department of Pesticide Regulation.

DPR (2017). Additional Labeling Requirements for Use of All Products Containing Chloropicrin as an Active Ingredient in California. California Department of Pesticide Regulation, Sacramento, CA.

Luo, Y. (2019). AERFUM: an integrated air dispersion modeling system for soil fumigants. California Department of Pesticide Regulation, Sacramento, CA.

Luo, Y. and C. Brown (2022). Modeling for application factors of 1,3-Dichloropropene, modeling approach #2. California Department of Pesticide Regulation, Sacramento, CA.

Appendix I. 1,3-Dichloropropene field fumigation methods

Table 4. 1,3-Dichloropropene field fumigation methods in California

Method Group	Method Name	Field Fumigation Method (FFM) Code
1	Nontarp/shallow/broadcast or bed	1201
1	Tarp/shallow/broadcast	1202
1	Tarp/shallow/bed	1203
1	Nontarp/shallow/broadcast or bed/3 water treatments	1204
1	Tarp/shallow/bed/3 water treatments	1205
2	Nontarp/18 inches deep/broadcast or bed	1206
2	Tarp/18 inches deep/broadcast	1207
2	Tarp/18 inches deep/bed	1208
3	Chemigation (drip system)/tarp	1209
2	Nontarp/18 inches deep/strip	1210
2	Nontarp/18 inches deep/GPS targeted	1211
4	Nontarp/24 inches deep/broadcast	1224
4	Tarp/24 inches deep/broadcast	1225
4	Nontarp/24 inches deep/strip	1226
4	Nontarp/24 inches deep/GPS targeted	1227
5	Totally Impermeable Film (TIF) tarp/shallow/broadcast	1242
6	TIF tarp/shallow/bed	1243
6	TIF tarp/shallow/bed/3 water treatments	1245
5	TIF tarp/deep/broadcast	1247
6	TIF tarp/deep/bed	1248
5	TIF tarp/deep/strip	1249
7	40% TIF tarp/18 inches deep/broadcast	1250
6	Chemigation (drip)/ TIF tarp	1259
8	40% TIF tarp/24 inches deep/broadcast	1264