Department of Pesticide Regulation
Environmental Monitoring Branch
1001 I Street, P.O. Box 4015
Sacramento, CA 95812-4015

Modeling broadcast-strip TIF applications with 40% tarp coverage

Colin Brown, Research Scientist III

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DPR received comment from TriCal Inc. (letter from Mike Stanghellini dated 18 January 2023) recommending that the proposed broadcast-strip totally impermeable film (TIF) application methods (field fumigation methods [FFM] 1250 and 1264) be revised to accommodate typical tree row spacing in orchards. The broadcast-strip method uses an approach whereby a field is fumigated in its entirety (a broadcast treatment) and sealed with alternating rows (or strips) of TIF tarp to reduce whole-field emissions and possibly increase fumigant efficacy in the tarped rows. The proposed method in its original form (Brown 2019) assumed a minimum of 50% tarp coverage in the treated field. The comment from TriCal Inc. contends that 50% minimum coverage would be impractical for certain tree crops where typical tree spacing exceeds double that of the typical commercial strip application width of 11 feet, such as the 25-foot spacing typical of walnuts. Therefore, TriCal Inc. recommended that DPR consider revising the proposed method to allow for a minimum of 40% tarp coverage to accommodate greater row spacing.

I revised the HYDRUS simulations for FFM 1250 and 1264 to include 40% TIF coverage at the surface and 60% bare soil. Methods were otherwise those described in Brown (2019) in combination with the revisions described in Brown (2022).

Table 1. Summary of change in mean (21-soil) maximum 72-hour emissions and emission ratio (ER) with the drop from 50% to 40% TIF-covered surface area.

Method	FFM	Max 72-h flux – 50/50 (µg m^{-2} s^{-1})	ER – 50/50	Max 72-h flux – 40/60 (µg m^{-2} s^{-1})	ER – 40/60
TIF strip-broadcast 18"	1250	3.80	0.18	4.39	0.20
TIF strip-broadcast 24"	1264	2.03	0.13	2.31	0.14

The revision increased maximum 72-hour emissions by approximately 15% and cumulative 21-day emissions by approximately 10% for the 21-soil mean (Table 1) relative to the original estimates for FFM 1250 and 1264. Table 2 compares the revised estimates for FFM 1250 and 1264 to other TIF methods; emissions for the revised FFM 1250 are among the highest for TIF methods and similar to FFM 1243 (TIF/Shallow/Bed) whereas emissions for FFM 1264 remain comparatively low. Table 3 provides an expanded summary of results for each of the 21 soil types used in the HYDRUS simulations.

Table 2.Comparison the revised FFM 1250 and 1264 (bolded) to other TIF methods.

FFM code	Method Description	Max 72-h Flux (µg m^{-2} s^{-1})	EE
1242	1,3-D - TIF/Shallow/Broadcast	2.00	0.11
1243	1,3-D - TIF/Shallow/Bed	4.31	0.18
1245	1,3-D - TIF/Shallow/Bed w/ 3x Irrigation	3.52	0.15
1247	1,3-D - TIF/Deep/Broadcast	1.16	0.08
1248	1,3-D - TIF/Deep/Bed	3.73	0.17
1249	1,3-D - TIF/Deep/Strip	1.33	0.09
1250	**1,3-D - 40% TIF/Deep/Broadcast**	**4.39**	**0.20**
1259	1,3-D - TIF/Chemigation/Bed	4.07	0.16
1264	**1,3-D - 40% TIF/24-inch/Broadcast**	**2.31**	**0.14**

Table 3. Soil-by-soil summary of maximum 24-h flux, maximym 72-h flux, and emission ratio for revised FFM 1250 and 1264.

Soil no.	Max 24-h flux (µg m^{-2} s^{-1})	Max 72-h flux (µg m^{-2} s^{-1})	ER	FFM
1	3.01	2.76	0.15	1250
2	0.90	0.86	0.06	1250
3	1.22	1.16	0.08	1250
4	7.98	6.63	0.28	1250
5	11.56	8.95	0.38	1250
6	8.63	7.08	0.30	1250
7	4.51	4.01	0.19	1250
8	7.08	5.97	0.26	1250
9	9.55	7.57	0.31	1250
10	2.39	2.22	0.13	1250
11	5.85	5.01	0.23	1250
12	1.22	1.15	0.08	1250
13	5.37	4.73	0.22	1250
14	2.20	2.05	0.12	1250
15	4.13	3.74	0.18	1250
16	5.04	4.41	0.21	1250
17	3.45	3.14	0.16	1250
18	8.30	6.78	0.29	1250
19	5.09	4.42	0.22	1250
20	8.06	6.60	0.27	1250
21	3.28	3.01	0.17	1250
1	1.25	1.19	0.08	1264
2	0.43	0.32	0.03	1264
3	0.56	0.42	0.03	1264
4	3.71	3.39	0.19	1264

5	6.84	5.99	0.32	1264
6	4.90	4.46	0.24	1264
7	1.94	1.82	0.12	1264
8	3.48	3.19	0.19	1264
9	5.44	4.81	0.25	1264
10	0.94	0.77	0.06	1264
11	3.19	2.94	0.17	1264
12	0.15	0.12	0.01	1264
13	2.04	1.93	0.13	1264
14	0.77	0.60	0.05	1264
15	1.33	1.27	0.09	1264
16	2.31	2.16	0.13	1264
17	1.18	1.14	0.08	1264
18	3.99	3.65	0.21	1264
19	2.77	2.59	0.17	1264
20	4.81	4.35	0.22	1264
21	1.54	1.48	0.11	1264

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. Available online: https://www.cdpr.ca.gov/docs/emon/pubs/ehapreps/analysis_memos/2643-tif_strip_broadcast_ffm1250.pdf

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. Available online: https://www.cdpr.ca.gov/docs/emon/pubs/ehapreps/analysis_memos/1-3-d/1-updates_to_hydrus-simulated_flux_estimates_of_1-3-d.pdf