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SUBJECT: **SIMULATED EMISSION RATINGS FOR ROTOTILL AND SOIL CAPPING APPLICATIONS OF METAM PRODUCTS**

INTRODUCTION

California's Department of Pesticide Regulation (DPR) calculates an annual inventory of Volatile Organic Compound (VOC) emissions from agricultural and commercial structural pesticide applications. The VOC inventory is a database of pesticidal VOC emissions by location (Meridian, Township, Range, Section) and date. The inventory is calculated by merging DPR's pesticide use reports and a database of the VOC content in individual pesticide products. For fumigants in particular, an additional factor called the emission rating (ER) is included in the calculation of VOC emissions. The ER is the cumulative flux of applied VOC volatilized from soil expressed as a fraction of total applied fumigant VOC. ERs vary with both type of fumigant and application method. In most cases ERs are determined from cumulative flux estimates determined in fumigant field monitoring studies (e.g., Barry et al., 2007).

In addition to cumulative flux, time-average fumigant volatilization fluxes (i.e. "discrete" flux densities) are also estimated in field fumigant monitoring studies (e.g. Sanders et al., 2005). The averaging times for discrete fluxes correspond to the study air sampling periods, and are typically 6 or 12 hours. Maximum discrete fluxes are used in conjunction with air dispersion modeling to determine buffer zone distances around fumigant applications that are protective of human health.

The fumigants metam-sodium and metam-potassium are nonvolatile salts. These fumigants degrade shortly after application into the volatile breakdown product methyl isothiocyanate (MITC). Thus MITC is the actual VOC that is emitted from metam applications, and the ER for the metam products reflect the cumulative flux of MITC emitted from the soil expressed as a fraction of MITC formed in soil after their application. Similarly, metam buffer zones are designed to limit exposure to MITC.

Only certain field fumigation application methods are allowed for metam products in California ozone nonattainment areas. Three listed methods are currently assumed equivalent for regulatory purposes under Title 3, Division 6, section 6450.1 of the California Code of Regulations. These methods are rototill, power mulcher and soil capping. The three methods are assumed to have an ER of 14 percent. The ER of 14 percent for these application methods is based on a single study (Wofford et al., 2005). In that study the soil was unusually wet relative to typical pre-plant fumigation conditions, with reported volumetric moisture contents ranging from 26 to 38 percent. One portion of the field was so wet that fumigation could not be conducted (P. Wofford, personal communication). In addition the soil was a fine-textured clay loam with a high organic carbon content (OC) of 4.9 percent, an uncommon texture and OC for soils where California fumigant applications occur (Johnson and Spurlock, 2009; Spurlock, 2016). Consequently the Wofford et al. (2005) study results may not be representative of metam rototill applications generally in California. It is also uncertain whether emissions from surface rototill applications are representative of those expected from soil capping applications.

The objective of the HYDRUS modeling conducted here was to simulate post-application MITC volatilization from typical California rototill and soil capping metam application scenarios. The simulations used actual soil data recently collected in California fields immediately prior to actual fumigations. The results include means and standard deviations of metam ER and 6-hr discrete maximum flux for the two application methods as they would be performed in California.

MODELING PROCEDURES

Application Methods

Rototiller/power mulcher application Rototiller and power mulcher applications are assumed to be identical in this paper, hereafter referred to as rototiller applications. In this application method the fumigant solution is sprayed directly on the soil surface immediately ahead of the power tiller or mulcher. The tiller is set to cut at a depth of five to six inches and followed immediately with a roller/packer to smooth and seal the soil surface (AMVAC, 2015).

Spray blade application In 2015 DPR's Enforcement Branch provided suggested permit conditions to the County Agricultural Commissioners for metam product Spray blade applications (DPR, 2015). DPR describes spray blade applications: "An 8–14 inch horizontal "V"-shaped blade designed to operate under the soil surface with one or two backward -facing spray nozzles placed under the leading edge. The blade is placed 1–4 inches below the soil surface and the resulting subsurface band is further covered with disk-hillers immediately following to form a minimum 6-inch protective cap over the treated band

Based on the descriptions above, and discussion with several DPR regional Enforcement staff and Deputy County Agricultural Commissioners, typical modeling scenarios for rototill and spray blade applications were developed for the simulations here (Figure 1).

Soil Data

Soil preparation prior to pre-plant soil fumigations typically entails tillage operations such as chiseling, ripping and discing, finishing with a packer/roller, and irrigation to bring the soil to fumigant label-required water contents. DPR recently conducted a study to measure representative soil bulk density, saturated water content and gravimetric water content in California fields after such preparation and immediately prior to broadcast fumigation (Johnson and Tuli, 2013). Those soil data have been subsequently used to evaluate within- and between-field variability in HYDRUS-modeled peak and cumulative fumigant fluxes for both bare-ground (Spurlock 2015a) and tarped broadcast fumigations (Spurlock, 2015b), and to evaluate various chloropicrin buffer zone credits using HYDRUS (Spurlock, 2016). One benefit of using actual California pre-fumigation soil data in modeling is that the HYDRUS modeling results are given in a statistical context. The actual soil data and further details on their use in modeling are discussed in Spurlock (2015a) and Spurlock (2016).

Because the fumigant label requirements for tilth and pre-fumigation soil water content are applicable to all soil fumigations – including the rototill and spray blade applications of interest here – these same soil data were used to evaluate expected cumulative MITC fluxes for the two application methods under California conditions.

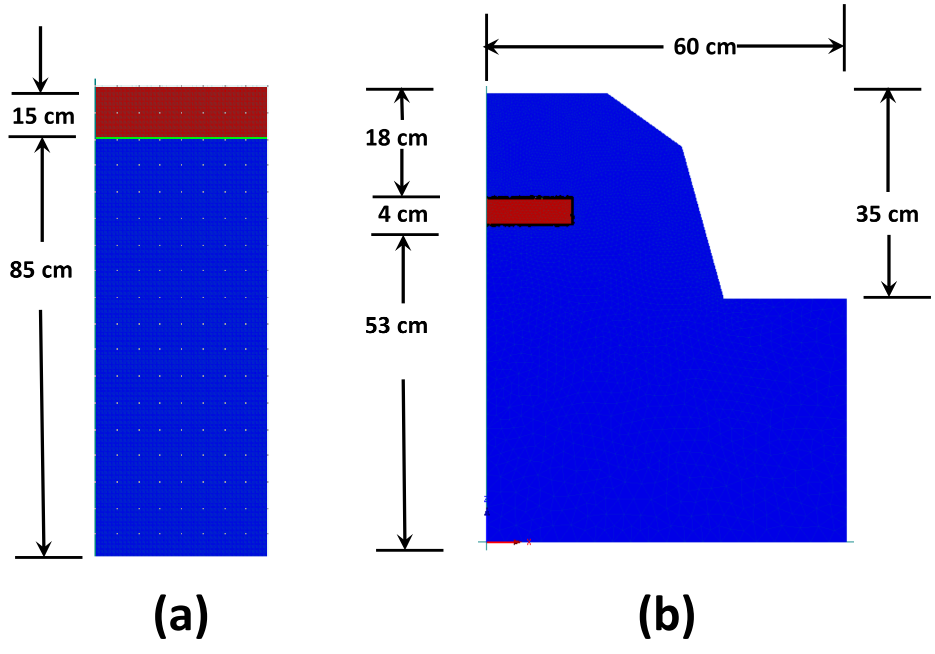

Figure 1. Modeling scenarios for (a) rototill/power mulcher application and (b) spray blade application showing initial metam sodium location in profile (red). Note different scale in drawings.

Application Timing

In all cases applications were assumed to occur at 0600 hrs. Simulations were conducted for 10.5 days at which time MITC volatilization was assumed essentially complete. All maximum 6 h discrete 6 h fluxes (ug $m^{-2}sec^{-1}$) were calculated on a 100 lb MITC broadcast equivalent applied basis, and the 6 h flux averaging periods were 00:00 – 06:00, 06:00-12:00, 12:00– 18:00, and 18:00 – 24:00 such as would be used in a typical field monitoring study.

Metam to MITC Conversion

Metam products convert rapidly to MITC in soil. The efficiency of metam conversion to MITC was assumed to be 100 per cent. Gerstl et al. (1977) reported metam conversion half-lives in 5 soils at moisture contents of 15 percent ranging from 7 to 174 minutes. In registrant technical data for metam degradation in 12 California soils after 60 minutes, the percent of metam degraded ranged from 28 percent to 100 percent, with a median of 93 percent (AMVAC, 2015). The registrant data correspond to a range in conversion half-lives of 2 hr down to minutes. To test the effect of conversion rate on simulated ER I conducted several preliminary spray blade application simulations (not shown) assuming metam-to-MITC conversion half-lives ranging from 5 minutes to 180 minutes. I found no effect of half-life on cumulative MITC flux. In the final spray blade and rototill simulations I therefore used an arbitrary metam-to-MITC conversion half-life of 60 minutes. Various other parameters used in the HYDRUS modeling are given in Table 1.

Table 1. Parameters Used in HYDRUS Modeling

Parameter	Value	Reference/comment
Metam to MITC conversion rate	16.6 d^{-1}	See discussion in text
MITC degradation rate	0.149 d^{-1}	mean of Smelt and Liestra (1974) and Gerstl et al. (1977) data
Metam dimensionless Henry's law constant	0	Nonvolatile salt
MITC dimensionless Henry's law constant	0.00424	mean of Worthington and Wade (2007)
MITC gas phase diffusion coefficient	8087 $cm^2\ d^{-1}$	See Table 4 and discussion, Spurlock (2010)
MITC aqueous diffusion coefficient	0.859	See Table 5 and discussion, Spurlock (2010)
MITC soil sorption coefficient 0-10cm	0.10	IUPAC PPDB[1] KOC = 13.5, assumed OC=0.75
MITC soil sorption coefficient 10-30cm	0.05	IUPAC PPDB[1] KOC = 13.5, assumed OC=0.37
MITC gas diffusion activation energy	4792 J mol^{-1}	See Table 4 and discussion, Spurlock (2010)
MITC Henry's law activation energy	37300 J mol^{-1}	See Table 9 and discussion, Spurlock (2010)
Soil surface temperature	22C ± 8C	HYDRUS sine wave default; assumed mean = 22C, amplitude=8C
Boundary layer depth	0.5 cm	Jury et al. (1986)
Potential evapotranspiration	0.5 cm d^{-1}	Typical San Joaquin Valley spring/early summer reference evapotranspiration

[1] International Union of Pure and Applied Chemistry Pesticide Properties Database, http://sitem.herts.ac.uk/aeru/iupac/

RESULTS

Emission Ratio

The HYDRUS-simulated metam ER for the rototill and soil cap scenarios of 0.66 ± 0.05 (SD) and 0.33 ± 0.08, respectively, were substantially greater than the ER currently assumed by DPR in their VOC calculations (DPR, 2008). That current assumed ER of 0.14 is among the lowest ER for any DPR-approved fumigant/application method combination, and is based on the air monitoring study of Wofford et al. (2005). The simulated ERs for the rototill scenario were greater than the soil cap scenario by a factor of approximately two (Figure 2).

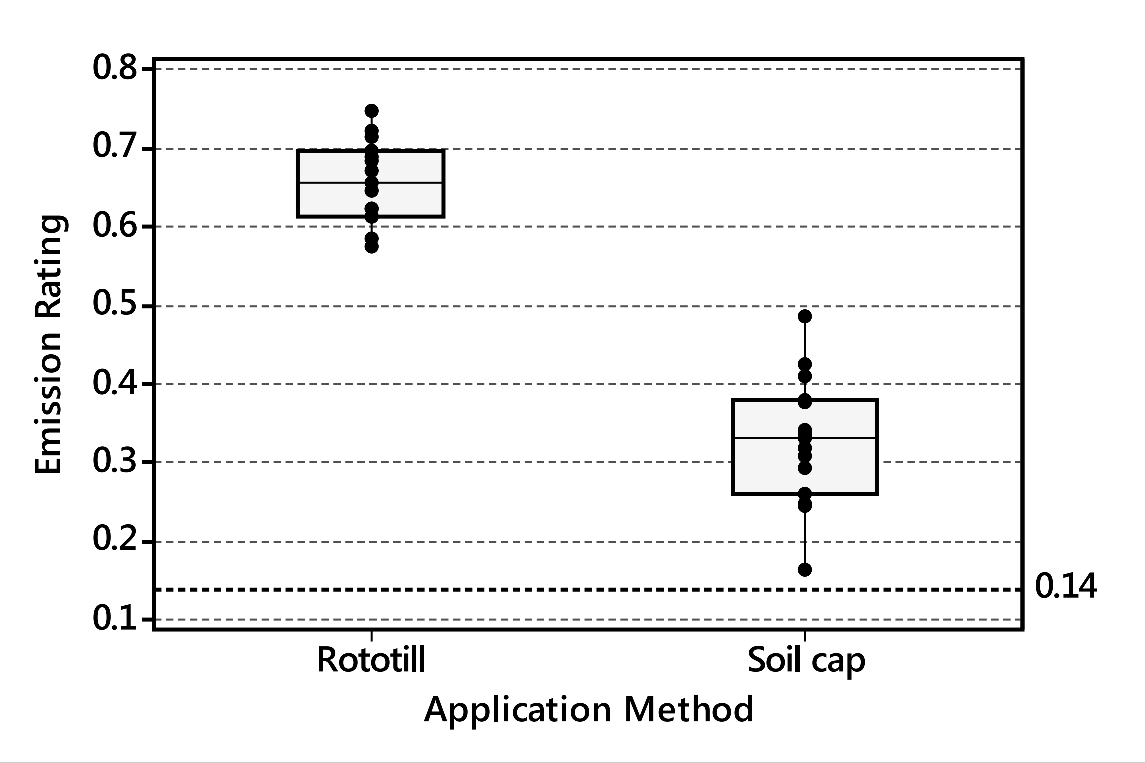

Figure 2. HYDRUS simulated MITC-based Emission Ratings for metam Rototill and Soil Capping Applications. The reference line at ER = 0.14 is the current assumed ER for both application methods. Simulated ERs are given in Appendix 1.

<u>Maximum 6 h discrete flux density</u>

The HYDRUS-simulated maximum discrete MITC flux density for the rototill and soil cap scenarios of 111.4 ± 17.6 (SD) and 13.3 ± 5.1 ug m^{-2} sec^{-1} (100 lb MITC equivalent applied basis), respectively, were substantially greater than that estimated by Wofford et al. (2005) in their rototill study. Their estimate based on inverse modeling was 28.2 ug m^{-2} sec^{-1} (100 lb MITC equivalent applied basis, 4 hr averaging period).

Similar to the ER results, maximum discrete 6 hr fluxes were much greater for the rototill than the soil cap applications (Figure 3). In the field study of Wofford et al. (2005), the maximum discrete flux was observed for the sampling period immediately after application. The same discrete flux timing was observed in the rototill simulations in all cases; maximum discrete flux occurred immediately after application followed by a rapid decline in flux thereafter (Appendix 2). In contrast, the simulated maximum discrete flux for the soil cap applications generally occurred on the afternoon of the second or third day after application (Appendix 3).

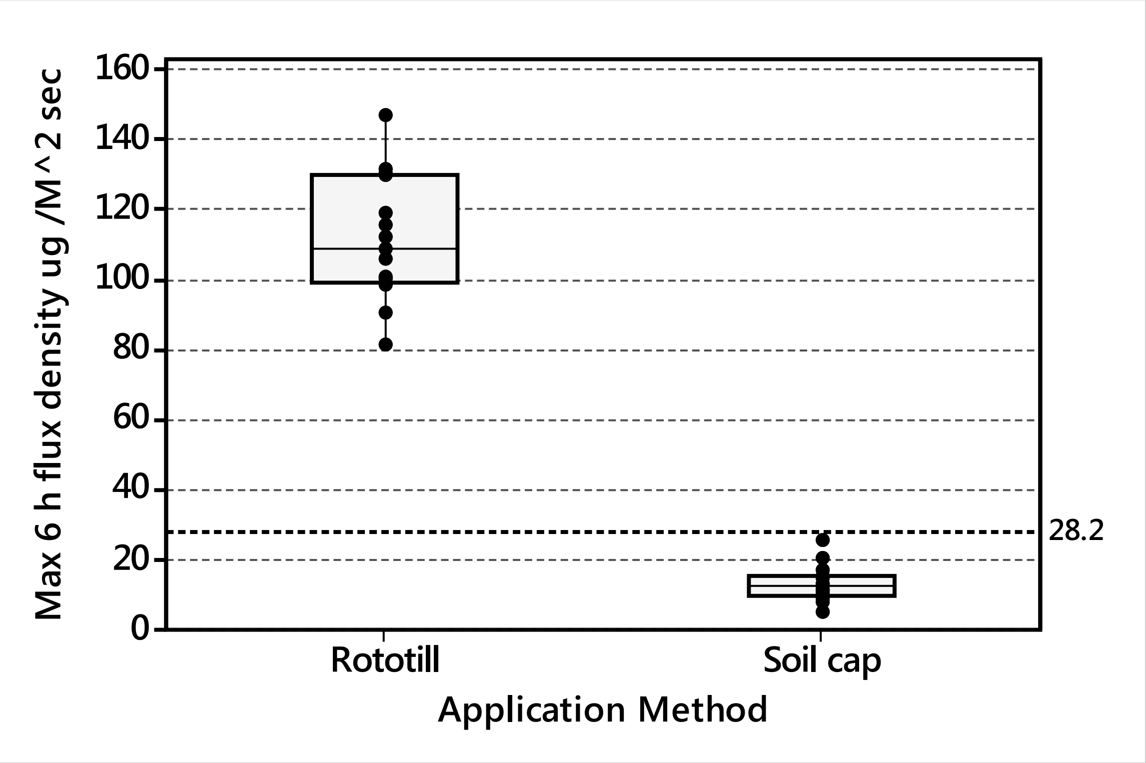

Figure 3. HYDRUS simulated MITC maximum discrete flux densities for metam rototill and soil capping applications (100 lb acre^{-1} MITC equivalent applied basis). The reference line flux = 28.2 is that estimated in the Wofford et al. study (2005).

DISCUSSION

Wofford et al. (2005) used MITC air concentration data collected in their study to estimate ER (cumulative flux) and discrete sampling period flux densities by inverse modeling with the Industrial Source Complex Short Term (ISCST) model. That procedure is often referred to as flux “back-calculation”. Back-calculated flux estimates are known to have substantial uncertainty (e.g., Spurlock et al., 2013; Johnson and Spurlock, 2013), potentially explaining part of the difference between the back-calculated and simulated ERs and discrete fluxes here. However, much of the difference between the back-calculated and HYDRUS-simulated results are likely attributable to the unusual soil conditions in Wofford et al. (2005). The surface soil moisture content was extremely high, with average 0-15 cm depth volumetric soil water content greater than 0.30. The soil organic carbon content of 4.9% reported by Wofford et al. (2005) is also much greater than typically observed in most California agricultural soils. Both factors contribute to lower fumigant emissions relative to the more typical California conditions that the HYDRUS modeling intended to reflect.

The difference in both ERs and maximum discrete fluxes between the rototill and soil-cap scenarios are attributable to the differences in depth of fumigant placement in the two application methods. The distance from the center of mass of initial fumigant applied and the nearest soil-atmosphere interface was 7.5 cm for the rototill scenario as compared to 20 cm for the soil cap scenario (Figure 1). Consequently the longer diffusive path length to the soil surface in the soil cap method yielded longer MITC transport times generally, allowing more time for MITC degradation, hence lower ER and smaller discrete fluxes. The ER variability as described by the coefficient of variation (CV, =SD/mean) was also greater for the deeper soil cap scenario than the rototill scenario, with CVs of 0.25 and 0.08, respectively, for the two application methods. The increased variability with depth of fumigant placement is typical of other fumigants/application methods (Spurlock, 2015a).

CONCLUSIONS

1. The HYDRUS-simulated MITC-based ER for metam products were 0.66 ± 0.05 (SD) and 0.33 ± 0.08 for the rototill and soil cap application methods, respectively. These are substantially greater than the current assumption of ER = 0.14 used in calculation of DPR’s VOC inventory.

2. The HYDRUS-simulated 6 hr maximum discrete MITC flux densities were 111.4 ± 17.6 (SD) and 13.3 ± 5.1 ug m^{-2} sec^{-1} (100 lb MITC broadcast equivalent applied basis) for the rototill and soil cap application methods, respectively. These compare to a discrete flux estimate based on inverse modeling of MITC air concentrations around a rototill application of 28.2 ug m^{-2} sec^{-1} (100 lb MITC equivalent applied basis).

3. The difference between the back-calculated and HYDRUS-modeled rototill ERs and discrete fluxes is likely at least partially attributable to the highly unusual soil conditions in the Wofford et al. (2005) field study that was the basis of the back-calculated flux. In contrast, the HYDRUS modeling relied on recent soil data collected from several fields where California pre-plant fumigations were conducted, so may be more representative of the range of conditions where fumigants are applied in California.

4. The HYDRUS modeling results indicate that soil-cap and rototill application methods display distinctly different ERs and maximum discrete 6 hr flux densities. The initial fumigant placement relative to the soil surface where volatilization actually occurs

explains these differences. The two methods should not be treated as equivalent for the purposes of calculating VOC emissions or estimating discrete flux.

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Appendix 1. Individual HYDRUS ER simulation results. For soil locations and texture class, see Table 1 in Spurlock (2015a).

soil	rototill	soil cap
cro1	0.697	0.377
din1	0.749	0.486
din2	0.715	0.380
LH1	0.684	0.336
LH2	0.613	0.260
LH3	0.615	0.248
mer1	0.723	0.426
san1	0.623	0.341
sto1	0.575	0.409
sto2	0.658	0.293
vis1	0.691	0.319
wat1	0.586	0.164
wat2	0.672	0.333
wat3	0.624	0.245
wat4	0.647	0.310

Appendix 2. Maximum 6 hr flux densities (ug m^{-2} sec^{-1} , 100 lb MITC equivalent applied basis) for rototill application. All periods are 6 hrs, period 1 is 0600 – 1200 hrs, day 1. Application at 0600 hours day 1.

period	cro1	din1	din2	LH1	LH2	LH3	mer1	san1	sto1	sto2	vis1	wat1	wat2	wat3	wat4
1	131.6	146.7	130.5	112.1	105.9	98.5	129.8	99.3	81.4	100.7	119.2	90.6	115.8	100.4	108.9
2	48.7	56.9	49.7	38.4	29.1	26.7	47.7	34.3	18.9	29.7	44.1	32.4	42.5	35.2	37.8
3	29.3	33.8	30.7	23.1	16.6	16.4	30.0	21.5	16.5	18.7	27.6	20.4	26.6	22.1	23.7
4	32.6	35.6	34.6	38.2	36.7	37.5	37.6	29.9	34.4	36.1	33.0	26.4	32.3	29.0	31.5
5	25.7	27.2	27.6	29.5	25.8	27.7	27.5	25.4	28.2	30.4	27.3	23.1	26.7	24.4	25.6
6	12.8	13.5	13.9	11.6	6.2	7.6	12.7	13.2	11.7	13.7	14.1	12.2	13.7	12.9	13.1
7	9.2	9.5	10.0	8.0	4.7	5.6	8.6	9.6	8.1	9.4	10.3	9.1	9.9	9.6	9.5
8	11.6	11.3	12.4	15.7	15.7	16.8	13.8	13.4	15.3	17.0	13.2	12.6	12.8	13.1	13.1
9	10.2	9.7	10.8	13.4	12.7	13.8	11.7	12.1	13.3	14.6	11.8	11.7	11.4	11.7	11.4
10	5.5	5.3	5.9	5.5	3.1	3.8	5.6	6.6	6.8	7.1	6.5	6.4	6.2	6.4	6.2
11	4.2	4.0	4.4	3.9	2.4	2.9	3.9	5.0	5.0	5.0	4.9	5.0	4.7	5.0	4.7
12	5.5	5.0	5.8	8.2	8.9	9.4	6.8	7.0	7.9	8.8	6.5	6.9	6.3	7.0	6.7
13	5.1	4.6	5.3	7.3	7.7	8.1	6.1	6.6	7.1	7.7	6.0	6.6	5.9	6.5	6.1
14	2.9	2.6	3.0	3.1	1.9	2.3	3.0	3.7	3.9	3.9	3.4	3.7	3.3	3.7	3.4
15	2.3	2.0	2.3	2.3	1.5	1.8	2.2	2.9	3.0	2.9	2.7	2.9	2.6	2.9	2.7
16	3.1	2.7	3.1	4.8	5.6	5.9	3.8	4.1	4.6	5.0	3.6	4.1	3.5	4.2	3.9
17	2.9	2.5	3.0	4.4	5.0	5.2	3.5	3.9	4.3	4.4	3.5	4.0	3.4	3.9	3.6
18	1.7	1.5	1.7	2.0	1.3	1.5	1.8	2.3	2.5	2.3	2.0	2.3	2.0	2.3	2.1
19	1.4	1.2	1.4	1.4	1.0	1.2	1.3	1.8	1.9	1.7	1.6	1.8	1.5	1.8	1.6
20	1.9	1.6	1.9	3.0	3.8	3.9	2.3	2.5	2.9	3.1	2.2	2.6	2.2	2.7	2.4
21	1.8	1.5	1.8	2.8	3.4	3.5	2.2	2.5	2.8	2.7	2.1	2.5	2.1	2.5	2.3
22	1.1	0.9	1.1	1.3	0.9	1.1	1.1	1.5	1.6	1.5	1.3	1.5	1.2	1.5	1.3
23	0.9	0.8	0.9	1.0	0.7	0.8	0.9	1.2	1.3	1.1	1.0	1.2	1.0	1.2	1.1
24	1.2	1.0	1.2	2.0	2.6	2.7	1.5	1.7	1.9	2.0	1.4	1.7	1.4	1.8	1.6
25	1.2	1.0	1.2	1.9	2.4	2.4	1.4	1.6	1.9	1.8	1.4	1.7	1.4	1.7	1.6
26	0.7	0.6	0.7	0.9	0.7	0.8	0.8	1.0	1.1	1.0	0.8	1.0	0.8	1.0	0.9
27	0.6	0.5	0.6	0.7	0.5	0.6	0.6	0.8	0.9	0.8	0.7	0.8	0.7	0.8	0.7
28	0.8	0.7	0.8	1.3	1.9	1.9	1.0	1.1	1.3	1.3	0.9	1.2	1.0	1.3	1.1
29	0.8	0.7	0.8	1.3	1.8	1.7	1.0	1.1	1.3	1.2	0.9	1.2	1.0	1.2	1.1
30	0.5	0.4	0.5	0.6	0.5	0.6	0.5	0.7	0.8	0.7	0.6	0.7	0.6	0.7	0.6
31	0.4	0.4	0.4	0.5	0.4	0.4	0.4	0.5	0.6	0.5	0.5	0.6	0.5	0.6	0.5
32	0.6	0.5	0.6	0.9	1.4	1.3	0.7	0.8	0.9	0.9	0.7	0.9	0.7	0.9	0.8
33	0.6	0.5	0.6	0.9	1.3	1.3	0.7	0.8	0.9	0.8	0.7	0.9	0.7	0.9	0.8
34	0.4	0.3	0.3	0.5	0.4	0.4	0.4	0.5	0.6	0.5	0.4	0.5	0.4	0.5	0.5

35	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.5	0.4	0.3	0.4	0.3	0.4	0.4
36	0.4	0.4	0.4	0.6	1.0	1.0	0.5	0.6	0.7	0.6	0.5	0.6	0.5	0.7	0.6
37	0.4	0.4	0.4	0.6	1.0	0.9	0.5	0.6	0.7	0.6	0.5	0.6	0.5	0.6	0.6
38	0.3	0.2	0.2	0.3	0.3	0.3	0.3	0.4	0.4	0.3	0.3	0.4	0.3	0.4	0.3
39	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.2	0.3	0.2	0.3	0.3
40	0.3	0.3	0.3	0.4	0.5	0.5	0.3	0.4	0.5	0.4	0.3	0.5	0.4	0.5	0.4

Appendix 3. Maximum 6 hr flux densities (ug m^{-2} sec^{-1} , 100 lb MITC broadcast equivalent applied basis) for soil cap application. All periods are 6 hrs, period 1 is 0600 – 1200 hrs, day 1. Application at 0600 hours day 1.

period	cro1	din1	din2	LH1	LH2	LH3	mer1	san1	sto1	sto2	vis1	wat1	wat2	wat3	wat4
1	0.0	0.1	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.8	3.0	0.5	0.3	0.9	0.1	2.1	0.1	0.3	0.0	0.1	0.0	0.2	0.0	0.1
3	3.3	8.9	2.5	1.3	1.7	0.6	6.2	0.7	1.7	0.1	0.7	0.0	1.3	0.1	0.7
4	10.3	20.6	8.6	6.7	8.3	4.5	16.8	4.2	9.0	1.2	3.5	0.3	5.6	1.2	3.9
5	15.4	25.5	13.7	11.0	10.0	7.3	20.7	8.8	15.4	4.3	7.1	1.1	10.2	3.4	7.8
6	11.1	17.0	10.4	6.1	2.8	2.6	12.1	7.5	10.2	3.8	6.1	1.3	8.1	3.4	6.6
7	9.7	14.2	9.4	5.0	2.2	2.2	9.2	7.0	8.5	3.7	6.0	1.6	7.4	3.6	6.2
8	14.6	19.7	14.3	12.7	9.9	9.0	17.1	12.0	16.7	9.3	10.1	3.3	11.8	6.8	10.7
9	15.1	19.2	15.0	13.3	9.7	9.3	16.7	13.2	17.3	10.9	11.4	4.4	12.7	7.9	11.4
10	9.1	11.5	9.3	5.9	2.4	2.7	8.3	8.4	10.3	6.2	7.4	3.1	7.9	5.2	7.2
11	7.4	9.2	7.6	4.5	1.9	2.2	6.2	6.9	8.1	4.8	6.2	2.8	6.5	4.5	5.9
12	10.5	12.5	10.9	10.9	8.4	8.4	11.9	10.4	12.8	9.9	9.4	4.6	9.6	7.4	9.4
13	10.5	12.1	11.0	10.9	8.1	8.3	11.6	10.7	12.4	10.2	9.8	5.1	9.8	7.6	9.3
14	6.2	7.2	6.6	4.7	2.1	2.4	5.6	6.5	7.4	5.6	6.1	3.2	5.9	4.7	5.6
15	5.0	5.8	5.4	3.6	1.7	1.9	4.2	5.2	5.9	4.2	5.0	2.7	4.8	3.8	4.5
16	7.2	7.9	7.7	8.4	6.8	7.0	8.2	7.7	8.7	8.0	7.4	4.2	7.0	6.3	7.1
17	7.2	7.7	7.7	8.3	6.6	6.8	8.1	7.8	8.5	7.9	7.6	4.4	7.1	6.2	7.0
18	4.3	4.6	4.6	3.7	1.8	2.1	4.0	4.7	5.1	4.3	4.6	2.7	4.2	3.7	4.1
19	3.5	3.7	3.8	2.8	1.4	1.6	3.0	3.8	4.0	3.3	3.7	2.3	3.4	3.0	3.3
20	5.0	5.1	5.4	6.2	5.5	5.7	5.8	5.6	5.9	6.0	5.5	3.5	5.1	4.9	5.3
21	5.0	5.0	5.4	6.2	5.3	5.5	5.7	5.6	5.8	5.8	5.6	3.6	5.2	4.8	5.2
22	3.0	3.0	3.2	2.9	1.5	1.8	2.9	3.4	3.5	3.2	3.4	2.2	3.1	2.8	3.0
23	2.4	2.4	2.6	2.1	1.2	1.4	2.2	2.7	2.8	2.5	2.8	1.8	2.5	2.3	2.4
24	3.5	3.4	3.8	4.6	4.4	4.5	4.1	4.0	4.0	4.5	4.1	2.8	3.8	3.8	4.0
25	3.5	3.3	3.8	4.6	4.3	4.4	4.1	4.0	4.0	4.3	4.2	2.8	3.8	3.7	3.9
26	2.1	2.0	2.3	2.2	1.3	1.5	2.1	2.4	2.4	2.4	2.5	1.7	2.3	2.2	2.3
27	1.7	1.6	1.9	1.7	1.0	1.1	1.6	2.0	1.9	1.9	2.1	1.4	1.9	1.7	1.8
28	2.5	2.3	2.7	3.4	3.5	3.6	2.9	2.9	2.8	3.3	3.0	2.3	2.8	2.9	3.0
29	2.5	2.2	2.7	3.4	3.4	3.5	2.9	2.9	2.8	3.2	3.1	2.3	2.9	2.8	2.9
30	1.5	1.4	1.6	1.7	1.1	1.3	1.6	1.8	1.7	1.8	1.9	1.4	1.7	1.7	1.7
31	1.2	1.1	1.3	1.3	0.9	1.0	1.2	1.4	1.4	1.4	1.5	1.1	1.4	1.3	1.4
32	1.8	1.6	1.9	2.5	2.8	2.8	2.1	2.1	2.0	2.5	2.2	1.9	2.1	2.3	2.3
33	1.8	1.5	2.0	2.5	2.8	2.8	2.1	2.1	2.0	2.4	2.3	1.8	2.2	2.2	2.2
34	1.1	1.0	1.2	1.4	1.0	1.1	1.1	1.3	1.2	1.4	1.4	1.1	1.3	1.3	1.3

35	0.9	0.8	1.0	1.0	0.7	0.8	0.9	1.1	1.0	1.1	1.1	0.9	1.0	1.0	1.0
36	1.3	1.1	1.4	1.9	2.2	2.2	1.6	1.5	1.4	1.9	1.7	1.5	1.6	1.7	1.7
37	1.3	1.1	1.4	1.9	2.2	2.2	1.5	1.6	1.4	1.8	1.7	1.5	1.6	1.7	1.7
38	0.8	0.7	0.9	1.0	0.8	0.9	0.8	1.0	0.9	1.0	1.0	0.9	1.0	1.0	1.0
39	0.7	0.6	0.7	0.8	0.6	0.7	0.7	0.8	0.7	0.8	0.8	0.7	0.8	0.8	0.8
40	1.0	0.8	1.0	1.2	1.2	1.3	1.0	1.1	1.0	1.3	1.2	1.1	1.2	1.3	1.2