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MEMORANDUM

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TO: Randy Segawa, Environmental Program Manager I
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SUBJECT: CALCULATION OF EIGHT-HOUR MAXIMUM METHYL ISOTHIOCYANATE FLUX FROM DAZOMET APPLICATIONS

Summary

The maximum eight-hour emission ratios for day and night periods were determined for four dazomet (BasamidG) studies. The emission ratios were expressed as a percentage of the methyl isothiocyanate (MITC) equivalent application rate. The highest of these values amongst the four studies was 13.9 percent and 5.9 percent, day and night, respectively. The average over the four studies was 6.4 percent and 2.99 percent, day and night, respectively. The coefficients of variation were high at 99 percent and 73 percent, respectively. A factor of 0.99 was used to convert the Basamid application rate to a dazomet application rate and a factor of 0.45 was used to convert the dazomet application rate to an equivalent MITC application rate.

Background and Method

You requested maximum eight-hour flux estimates for dazomet applications segregated by night and day. Four flux studies are available for this purpose: Fan et al. (2008), Gurusinghe et al., (2008) and Rice and White (2004). The latter consisted of two separate studies. Three (Fan et al., 2008, Gurusinghe et al. 2008 and one application in the Rice and White 2004) were studies of surface applied dazomet. One study (the second application in Rice and White 2004) measured concentrations from an application incorporated to a depth of eight inches.

BasamidG is a 99 percent dazomet granular formulation. The granules are activated in moist soil to produce MITC gas, which has pesticidal properties. A degradation pathway proposed in Reinhard (2003, Figure 1) suggests a stoichiometric production ratio of 1:1 for conversion of dazomet to MITC. Using the molecular weights (162.3 g/mole and 73.1 g/mole, dazomet and MITC, respectively) gives a factor of 0.45 to convert dazomet mass to equivalent MITC mass. A factor of 0.112 was used to convert from pounds per acre to grams per meter squared.

The four studies were examined period-by-period to determine the largest nighttime and daytime eight-hour flux. Once these maximum fluxes were identified, they were converted to a fraction representing the mass loss per unit area divided by the equivalent applied MITC mass (emission ratio). These calculations can be represented by the following equation:

$$Fractional\,loss = \frac{F(\mu g m^{-2} s^{-1})(3600 s h^{-1})(8h)(10^{-6} g \mu g^{-1})}{ApprateMITC(g m^{-2})}$$

where F is the flux density (μg/m^{2}s), 3600 seconds per hour, 8 hours, conversion from μg to g all divided by the equivalent application rate of MITC.

Results

Table 1 lists the four applications and provides the application rates with equivalent dazomet and MITC application rates. Application rates varied about two-fold. The highest day and night time

Table 1. Application rates and equivalent dazomet and MITC application rates. Basamid is 99% dazomet. Assuming a 1:1 molar ratio between dazomet and MITC and assuming 100% stoichiometric conversion from dazomet to MITC gives a factor of 0.45 based on molar weights.

		Application Rate			
Study	**Application**	**Basamid (lbs/acre)**	**Basamid (g/m^2)**	**Dazomet (g/m^2)**	**MITC equivalent (g/m^2)**
Manteca Study #212 2005 (San Joaquin)	surface	235	26.32	26.06	11.73
Watsonville 2006 (Santa Cruz)	surface	444	49.75	49.26	22.17
Incorporated (8 ") Nov 2004 Dinuba (Tulare)	incorporated 8"	530	59.36	58.77	26.44
Surface Oct 2003 Dinuba (Tulare)	surface	265	29.68	29.38	13.22

fluxes ranged from 4.8 μg/m^{2}s to 79 μg/m^{2}s (Table 2). This range exceeds an order of magnitude. The Dinuba studies resulted in lower fluxes than the Watsonville and Manteca studies. No systematic problems were detected in any of the studies (Wofford and Fan 2006, Fan et al., 2008, Gurusinghe et al., 2008). Due to low wind speeds,

Table 2. Highest day time and night time MITC flux for four dazomet studies.

	Maximum Daytime Flux		Maximum Nighttime Flux	
Study	**Flux (ug/m^2s)**	**Length of Period (h)**	**Flux (ug/m^2s)**	**Length of Period (h)**
Manteca Study #212 2005 (San Joaquin)	53.8	6	23.8	12
Watsonville 2006 (Santa Cruz)	79.0	6	26.0	6
Incorporated (8 ") Nov 2004 Dinuba (Tulare)	8.5	8	14.1	8
Surface Oct 2003 Dinuba (Tulare)	4.8	10	5.6	8

initial regressions conducted to obtain the flux for the two applications in the Rice and White study (2004), were largely not significant. Consequently, the sorting procedure was utilized for most periods (Wofford and Fan 2006). Flux calculations for the Rice and White (2004) studies were reviewed and found to be reasonable (Wofford and Johnson 2006). The highest flux period for Study 212 (Fan et al. 2008) was analyzed independently by two different analysts using procedures which accounted for possible plot interference (Wofford and Johnson 2006). Both analysts obtained similar results. Sensitivity of the flux estimate to wind direction was analyzed during the same high flux period and the result was about 20 percent difference in flux with a ten degree shift in wind direction (Wofford and Johnson 2006). This difference is less than the order of magnitude differences between fluxes in the different studies. Rice and White (2004) was examined for potential wind direction problems and for analysis of the center-mast MITC concentration data using the aerodynamic method (Johnson 2008). The wind directions were correctly used in modeling. However, the low wind speeds probably introduced error into the reported wind directions. The aerodynamic calculations did not work properly because concentration gradients were not established within the internal boundary layer. This may have been due to low wind speed, overlapping applications of dazomet or the presence of orchards near the field (Johnson 2008).

The two Dinuba applications do not appear to show a systematic difference between the incorporated and surface applications. Therefore, I grouped all four studies together for calculation of the average maximum flux. The eight-hour flux calculations reflect the basic magnitude of differences between the two sets of studies (Table 3). When the high fluxes for eight hours were converted into a MITC emission ratio, the resulting average loss for daytime

Table 3. Highest day and night 8-hour flux expressed as a fraction of the applied MITC.

	Application Rate		Daytime		Nighttime	
Study	**Basamid (lbs/acre)**	**MITC equivalent (g/m^2)**	**Highest MITC Flux (ug/m^2s)**	**8 Hour Fraction of MITC applied**	**Highest MITC Flux (ug/m^2s)**	**8 Hour Fraction of MITC applied**
Manteca Study 212 2005	235	11.73	53.8	0.1321	23.8	0.0585
Watsonville 2006	444	22.17	79.0	0.1026	26.0	0.0338
Incorporated (8 ") Nov 2004 Dinuba (Tulare)	530	26.44	8.5	0.0093	14.1	0.0154
Surface Oct 2003 Dinuba (Tulare)	265	13.22	4.8	0.0105	5.6	0.0122
			Average	0.0636	**Average**	0.0299
			SD	0.0632	**SD**	0.0213

was 6.4 percent (0.064 as a fraction) and for nighttime was 2.99 percent (0.0299 as a fraction). The coefficients of variation were high at 99 percent and 71 percent, respectively.

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