Department of Pesticide Regulation

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M E M O R A N D U M

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SUBJECT: RESULTS FROM AIR MONITORING WORKERS DURING TARPAULIN CUTTING ACTIVITY OF TOTALLY IMPERVIOUS FILM TARPAULIN ON FIELDS TREATED WITH CHLOROPICRIN AND 1,3-D

During the month of October, 2013, Worker Health and Safety (WHS) industrial hygienists and scientists traveled to Santa Cruz County to conduct an air monitoring of potential airborne exposure to workers involved in cutting tarpaulin on fumigated fields. These flat fields had been treated with a combination material containing 59 % chloropicrin and 39% 1,3-dichloropropene (Pic-Clor 60, EPA Reg. # 8536-8). A plastic laminate film was used to tarp the fields. This film was identified as VaporSafe™ brand, a "totally-impervious" film (TIF) manufactured by Raven Industries. The use of TIF tarpaulin potentially reduces fumigant escaping into the general air environment surrounding the treated field, relative to non-TIF films. However, this same retention property could also expose tarpaulin cutters to potentially higher levels of fumigant during their handling operations, fumigant that would have normally permeated non-TIF tarp at a faster rate. Greater concentration under TIF tarpaulins might be released by the initial cutting of the tarpaulin. To investigate this possibility, air monitoring was conducted of workers cutting these tarps.

A total of 6 distinct and physically separate sites were monitored, with one or two cutters working each site. Site characteristics are given in Table One.

Site Identifier	Application Rate (gallons per acre)	Shank Depth Shallow = 6" to 15" Deep = >20"	Days Post Application
Beach	33	Deep	9
Silliman I	33	Deep	10
Panabaker I	35	Shallow	9
Silliman II	33	Deep	9
Thompson	33	Shallow	10
Panabaker II	35	Shallow	10

Table One: Site characteristics

A cutter drives a 4-wheeled all-terrain vehicle (ATV) equipped with a cutter disc. This disc, located at the rear of the vehicle, presses down into the tarpaulin and makes a long slit in the film panel, exposing the soil and allowing free air exchange between the potentially fumigant-laden air below the film and the relatively uncontaminated air above the field. Photo One shows the ATV and disc, Photo Two shows the cutter performing the operation and Photo Three shows the resulting opening of the cut film. Note in Photo Three that not only does the disc slice open the tarpaulin film, but the tires driving over the film also contributes to the film's loss of integrity.

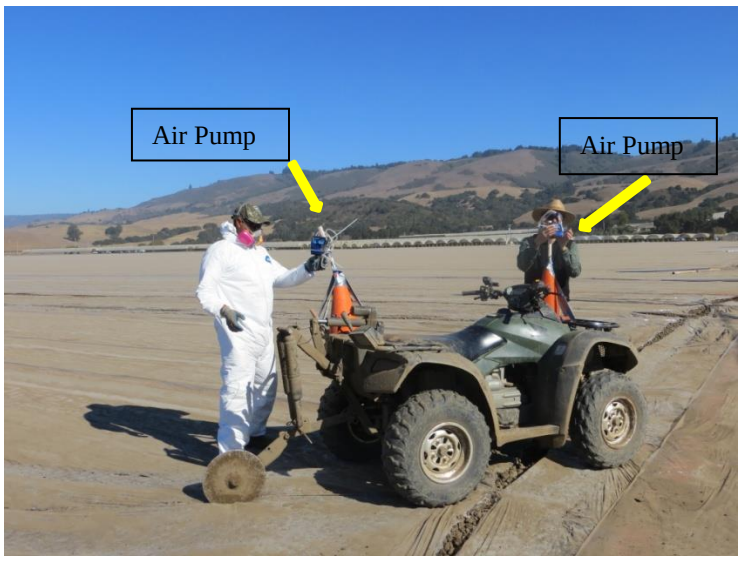

Photo One: ATV and cutter disc

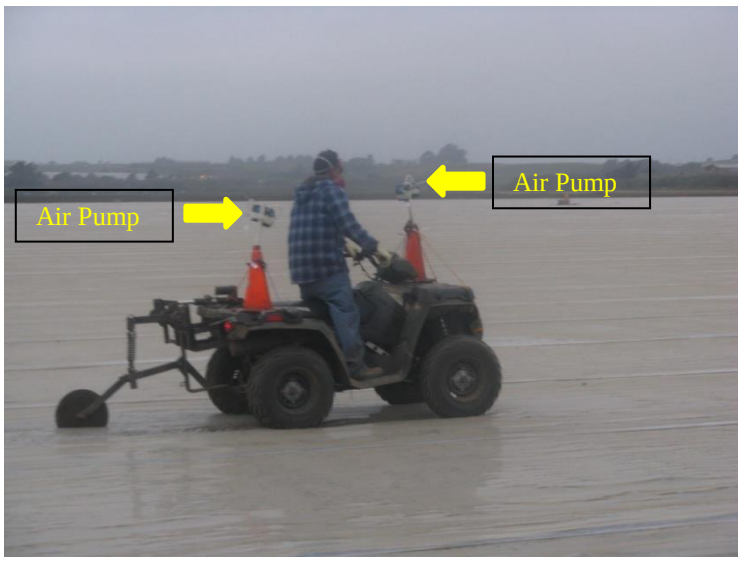

Photo Two: Cutting operation

Photo Three: Cutter slit and tire disruption

Air monitoring pumps were attached to the ATV to collect air samples of the worker's breathing zone during the cutting operation. Buck LIBRA PLUS™ air pumps were used to draw air through the appropriate sampling media: XAD-4 (SKC-West, Catalog #226-175) for chloropicrin; Anasorb CSC Coconut Charcoal (SKC-West, Catalog #226.09) for 1, 3-dichloropropene. The XAD tube consisted of two absorbent sections within the tube, a 400 mg primary section and a 200 mg secondary (backup) section. The Anasorb tubes had the same quantity configuration for their absorbents. Sampling tubes were connected to the air pumps via TYGON™ plastic tubing. The pumps sampling for chloropicrin were calibrated to run at 1.5 liters per minute, those for 1,3-dichloropropene for 1.0 liter per minute. Calibration was done previous to field deployment of the pumps using a Dry-Cal® DC-Lite Primary Flow Meter.

Pairs of pumps, one for 1,3-dichloropropene and one for chloropicrin, were attached to both the front and rear of the ATV. These can be seen in Photos One and Two. A close-up of the set-up can be seen on Photo Four. Just before the worker entered the field, the pumps were turned on and remained on for the duration of the worker's activity. Cutters were identified alphabetically, "A" through "F". In one, the same pair of workers (D and E) worked two different fields on the same day (Thompson/Silliman II). Sampling time ranged from 22 minutes (Thompson) to 45 minutes (Silliman) and was dependent on the amount of tarpaulin acreage requiring cutting. In the case of the Cutter B at Beach, two of those samples were invalidated, one because the pump had not been properly cleared and provided an erroneous volume reading (CTB-DC-001) and the

other was physically damaged (shattered) during sampling (CTB-CP-002). Fortunately the duplicate samples for those tubes were unaffected.

Photo Four: Pump mounting

Cutter E had the rear sampling assembly come loose during his activity. An attempt was made to remount the assembly, but was not successful and the pumps were turned off early. However, there was sufficient sampling time for them to be considered valid (CTE-DC-004 and CTE-CP-004) though they had sampled air approximately 2 feet lower from the breathing zone height.

The highest 1,3-dichloropropene concentration was 0.141 ppm (Silliman). The highest chloropicrin value was 0.024 ppm (Beach). However, these are not time-weighted averages (TWA) .These unmodified results all compare favorably to the Cal/OSHA Permissible Exposure Limits (PEL) for these materials: 1ppm for 1,3-dichloropropene and 0.1 ppm for chloropicrin.

Inasmuch as the PEL is a TWA value, the daily TWA values for these worker during the cutting activities monitored can be calculated. TWAs are calculated as follows:

$TWA_e = ([C_a \times T_a] + [C_b \times T_b] + . . C_n \times T_n]) \div 480$

Where:
TWAe is the equivalent time weighted average exposure for the 8-hour working shift.

C is the concentration during any period of time "T" where the concentration remains constant.
T is the duration in minutes of the exposure at the concentration "C".

ID number	Location	Date	Elapsed time	ug/sample	liters	ug/liter	ppm
CTA-DC-001	**Beach**	**10/2/2013**	**34**	**11.6**	**34.0**	**0.341**	**0.075**
CTA-DC-002	**Beach**	**10/2/2013**	**33**	**11.2**	**33.5**	**0.334**	**0.074**
CTA-DC-003	**Silliman**	**10/3/2013**	**44**	**28.5**	**44.5**	**0.640**	**0.141**
CTA-DC-004	**Silliman**	**10/3/2013**	**44**	**28.2**	**44.2**	**0.638**	**0.141**
CTB-DC-001	**Beach**	**10/2/2013**	**VOID/ Volume Error**				
CTB-DC-002	**Beach**	**10/2/2013**	**34**	**22**	**34.6**	**0.636**	**0.140**
CTB-DC-003	**Silliman**	**10/3/2013**	**45**	**24.7**	**45.8**	**0.539**	**0.119**
CTB-DC-004	**Silliman**	**10/3/2013**	**44**	**28.9**	**47.2**	**0.612**	**0.135**
CTC-DC-001	**Panabaker**	**10/10/2013**	**43**	**9.65**	**43.7**	**0.221**	**0.049**
CTC-DC-002	**Panabaker**	**10/10/2013**	**43**	**10.7**	**43.8**	**0.244**	**0.054**
CTD-DC-001	**Thompson**	**10/10/2013**	**25**	**4.19**	**25.2**	**0.166**	**0.037**
CTD-DC-002	**Thompson**	**10/10/2013**	**25**	**4.69**	**25.8**	**0.182**	**0.040**
CTD-DC-003	**Silliman II**	**10/10/2013**	**38**	**14.8**	**38.9**	**0.380**	**0.084**
CTD-DC-004	**Silliman II**	**10/10/2013**	**39**	**17.1**	**39.5**	**0.433**	**0.095**
CTE-DC-001	**Thompson**	**10/10/2013**	**22**	**3.64**	**22.4**	**0.163**	**0.036**
CTE-DC-002	**Thompson**	**10/10/2013**	**22**	**3.77**	**22.2**	**0.170**	**0.037**
CTE-DC-003	**Silliman II**	**10/10/2013**	**42**	**6.72**	**42.3**	**0.159**	**0.035**
CTE-DC-004	**Silliman II**	**10/10/2013**	**25**	**12.9**	**25.9**	**0.498**	**0.110**
CTF-DC-001	**Panabaker II**	**10/11/2013**	**32**	**3.28**	**32.3**	**0.102**	**0.022**
CTF-DC-002	**Panabaker II**	**10/11/2013**	**32**	**4.22**	**32.1**	**0.131**	**0.029**

Table Two: 1,3-dichloropropene air monitoring results

In calculating TWAs for workers, it is assumed that after completing their activities at the field, the workers would have no further detectable exposure and thus zero values for the time they were not actively working at this site (equipment set up, take-down and transit to next work site).

In all calculated time-weighted cases, the TWA exposure values were well below the Cal/OSHA PELs. The highest TWA chloropicrin value was 0.002 ppm (PEL 0.1 ppm); the highest 1,3-dichloropropene value was 0.015 ppm (PEL 1 ppm). Using worst-case, non-weighted results (i.e. sample is assumed to represent exposure for entire work period engaged in cutting) and assuming a cutting period of 6 hours (in an 8 hour day), the TWA for chloropicrin (highest value 0.024 ppm) is 0.018ppm; for 1,3-dichloropropene (highest value 0.141 ppm) it is 0.106 ppm. If there is no time-weighting, the highest values would be the default maximum exposure for the 8- hour day.

ID number	Location	Date	Elapsed time	ug/sample	liters	ug/liter	ppm
CTA-CP-001	**Beach**	**10/2/2013**	**34**	**4.46**	**50.3**	**0.089**	**0.020**
CTA-CP-002	**Beach**	**10/2/2013**	**33**	**3.87**	**52.6**	**0.074**	**0.016**
CTA-CP-003	**Silliman**	**10/3/2013**	**31**	**2.2**	**47.7**	**0.046**	**0.010**
CTA-CP-004	**Silliman**	**10/3/2013**	**44**	**2.77**	**68.8**	**0.040**	**0.009**
CTB-CP-001	**Beach**	**10/2/2013**	**33**	**5.4**	**49.5**	**0.109**	**0.024**
CTB-CP-002	**Beach**	**10/2/2013**	**VOID/ Tube broken**				
CTB-CP-003	**Silliman**	**10/3/2013**	**45**	**2.23**	**68.7**	**0.032**	**0.007**
CTB-CP-004	**Silliman**	**10/3/2013**	**46**	**2.64**	**70.4**	**0.038**	**0.008**
CTC-CP-001	**Panabaker**	**10/10/2013**	**43**	**1.55**	**65.5**	**0.024**	**0.005**
CTC-CP-002	**Panabaker**	**10/10/2013**	**44**	**2.27**	**66.9**	**0.034**	**0.007**
CTD-CP-001	**Thompson**	**10/10/2013**	**25**	**0.29**	**37.5**	**0.008**	**0.002**
CTD-CP-002	**Thompson**	**10/10/2013**	**25**	**0.367**	**38.5**	**0.010**	**0.002**
CTD-CP-003	**Silliman II**	**10/10/2013**	**39**	**3.41**	**58.7**	**0.058**	**0.013**
CTD-CP-004	**Silliman II**	**10/10/2013**	**39**	**4.17**	**58.7**	**0.071**	**0.016**
CTE-CP-001	**Thompson**	**10/10/2013**	**22**	**0.421**	**33.7**	**0.012**	**0.003**
CTE-CP-002	**Thompson**	**10/10/2013**	**22**	**0.44**	**33.8**	**0.013**	**0.003**
CTE-CP-003	**Silliman II**	**10/10/2013**	**42**	**1.33**	**64.0**	**0.021**	**0.005**
CTE-CP-004	**Silliman II**	**10/10/2013**	**27**	**2.35**	**41.2**	**0.057**	**0.013**
CTF-CP-001	**Panabaker II**	**10/11/2013**	**32**	**0.569**	**48.3**	**0.012**	**0.003**
CTF-CP-002	**Panabaker II**	**10/11/2013**	**32**	**1.5**	**48.8**	**0.031**	**0.007**

Table Three: Chloropicrin air monitoring results

Given the fairly low levels of TWA exposure, further monitoring of TIF tarp cutters may not be necessary, unless application-to-cutting intervals less than 9 days are proposed.