Department of Pesticide Regulation

Paul E. Helliker
Director

Gray Davis
Governor

Winston H. Hickox
Secretary, California Environmental Protection Agency

M E M O R A N D U M

TO: Sue Edmiston **HSM-01020**
Senior Environmental Research Scientist
Worker Health and Safety Branch
Sacramento

FROM: Frank Schneider **[original signed by F. Schneider]**
Associate Environmental Research Scientist
445-4201

DATE: November 16, 2001

SUBJECT: Hand Residue Sampling Methods Validation: Project 9901

This memo summarizes the preliminary work and the reasons for discontinuing this approach to validation of hand sampling methods. This project was undertaken because dermal monitoring techniques for the hands are a standard part of pesticide exposure monitoring and required by the U.S. EPA to establish reentry intervals[1]. Dermal exposure is most often the major exposure route for field workers[2]. The hands of fieldworkers harvesting pesticide treated crops can contact more pesticide treated foliage and produce than any other body part. Hand exposure is measured in one of three ways: washing the hands, wearing gloves or wiping the hands to remove residues. The efficiency of handwash removal has been questioned[2,3]. Measurements using gloves seem to overestimate exposure[4]. Wipe procedures have been shown to be reproducible but potential penetration into skin is unknown[5]. Since workers harvesting crops do not usually wear gloves this study was going to evaluate the differences in handwipes verse handwashes.

The preliminary work involved spraying sheets of floral tissue wax paper (purchased from Floral Supply Syndicate) measuring 18" x 24". The treatments used malathion at the rate of 1 pound active ingredient per acre in 10 gallons of water and were applied using a linear spray table. Using this application rate, the expected result would be 31,238 µgs for the 18" x 24" area being treated. All spray suspensions were weighed out prior to use in the spray table. Sheets were placed inside the spray table and taped to a plastic sheet. This was necessary because the lightweight of the paper would be sucked up into the ventilation system of the table. Two sheets were placed in line with each other with a backup sheet underneath. There were two top sheets and two bottom sheets for each pass. The bottom sheet was used to check if material was soaking through the top sheet. Top sheets were observed to be very wet after treatment. After each pass, the sheets were pulled out and were allowed to set only a short time before the top and bottom sheets were separated, folded, put in quart jars, sealed and frozen. The spray was not allowed to dry before being placed into the jars due to limited space in the room and the odor from the material being used. This spray procedure was repeated ten times for twenty treated 18" x 24" sheets and a corresponding backup sheet for each treated sheet.

Initially, twelve treated sheets along with their corresponding backup sheets were analyzed. For analysis, it was necessary to cut the sheets along the folds to allow the solvent to flow as freely as possible around all sides of the paper. Sheets were extracted on a roller for 30 minutes with 400 mL ethyl acetate almost covering the paper. A sample was removed for analysis and an additional 200 mL ethyl acetate were added and re-rolled. Results of the two analyses were nearly identical to show quantitative extraction. Analysis of the samples was performed on an HP 5890 gas chromatograph with flame photo detector using a HP-1 megabore column. The limit of detection was 2 µgs per sample.

Results for the first twelve treated sheets averaged 31,808 ± 1710 µgs (cv 5%) per sheet. The backup sheets averaged 848 ± 361 µgs (cv 43%). There was noticeable over spray on the plastic sheeting used to hold the floral sheets in place. The results of the backup sheets are likely due to the over spray coming in contact with the edges of the plastic sheeting and handling of the paper. The accuracy of the spray table is only within the width of two feet.

The eight treated sheets set aside were used in a small exposure scenario where two subjects rubbed their hands on one treated sheet each to find out how much material would be removed from the waxed floral papers. One subject washed his hands first followed by a wipe. A second subject wiped his hands first followed by a wash. For the wipe samples two cloth wipes were used that had been soaked in a 10:1 solution of water and 0.02% sodium dioctyl sulfosuccinate. The handwash solution used 500 mL of this same solution. The wipes and washes were then analyzed along with the eight sheets that included the two used in the exposure scenario. The results for the eight sheets averaged 29,176 ± 1053 µgs (cv 4%) per sheet. The handwash levels were 126 µgs and 33.5 µgs for subjects performing wash first and wash second, respectively. For the wipes, the level was less than 2 µgs for the subject performing the wipe first and 8.7 µgs for the subject performing the wipe second. Only a very small amount of material was removed from the floral papers during the two exposure scenarios. The two treated sheets used still had residues with the range of the other six sheets analyzed at the same time, over 28,000 µgs.

It appears the pesticide is bound up in the wax once it is dry and when performing the exposure scenario very little residue comes off the paper, while the ethyl acetate is efficient at removing the residues in the extraction procedure. This outcome was not considered in the protocol accounting for the much lower transfer rate of the pesticide residues. An approximate transfer factor of 10 can be obtained by using the first handwash measurement of 126 µgs divided by the 11.4 µgs/cm^2 obtained from the surface area of the floral papers. While this transfer factor is not on a per hour of activity basis it does have the known amount of surface area contacted along with a known amount of material uniformly applied over the surface. In terms of surface area required to get a handwash residue of a tree harvester (about 2 mg) it would take about twenty treated sheets. This requires an area 120 sq ft per subject just to dry the papers before exposure. If you have the same variability by subject this amount of space would have to be increased, considering one subject showed very little residue on the hands. While the spraying of the floral

papers is very accurate when compared to the expected levels, there is still enough variability found on the individual floral papers to account for one subjects residue that would be recovered from the hands. It was expected that an obvious difference would be noted on the floral papers before and after the exposure scenario. With these results, there would be only a qualitative value in analyzing the floral papers because the spray is uniformly applied and there is no discernable difference in the residues after the subject's exposure due to the 5% coefficient of variation being greater than the amount of residue removed from the papers. This is similar to results of dislodgeable residues on trees before and after harvest where no change in the results is seen but in that case there are plenty of residues found on the workers clothing.

Other investigators[3,5] have already used foil spiked with pesticide to test the effectiveness of handwash or handwipe removal of residues. The use of the floral waxed paper and a linear spray table was to be a first step in using a procedure that would mimic a field application and allow for accurate measurements of the treatments and the amount of a subject's exposure. The inability to remove sufficient residues and the logistical problem of space required to perform the exposure scenario without more efficient removal of the pesticide residues makes this project problematic.

References:

1. Occupational and Residential Exposure Test Guidelines. OPPTS 875.2400 Dermal exposure. Prevention, Pesticides and Toxic Substances, U.S. EPA, 1996.

2. Fenske R, Birnbaum S, Methner M, Soto R. Methods for assessing fieldworker hand exposure to pesticides during peach harvesting. Bull Environ Contam Toxicol 43:805-813 (1989).

3. Fenske R, Lu C. Determination of handwash removal of the pesticide chlorpyrifos from skin by standard handwash techinques. Am Ind Hyg Assoc J 55(5): 425-432(1994).

4. Smith C, Welsh A, Saiz S, Haskell D, Dong M, Begum S, Carr J. Comparison of three methods used to monitor hand exposure to pesticides in grape vineyard workers. HS-1630, Sacramento, CA. Cal/EPA Department of Pesticide Regulation, Worker Health and Safety, (1991).

5. Geno P, Camann D, Harding H, Villalobos K, Lewis R. Handwipe sampling and analysis procedure for the measurement of dermal contact with pesticides. Arch. Environ. Contam. Toxicol. 30: 132-138(1996).