REPORT OF FIELD WORKER ILLNESSES IN STANISLAUS COUNTY DURING AUGUST 1980 ATTRIBUTED TO EXCESSIVE EXPOSURE TO GUTHION AND ITS OXON

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HS-858 September 10, 1981

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SUMMARY

During August 1980 in Stanislaus County, California, 6 peach harvesters (in a crew of 22) became ill with signs and symptoms of organophosphate poisoning; 3 were hospitalized. Blood samples of the 22 workers revealed that all had substantial cholinesterase depression. Studies of application histories and dislodgeable leaf residues of 8 peach orchards where they had worked during the 28 days before they became ill revealed some possible exposure to very low levels of Zolone (phosalone) and Zolone oxon, but somewhat higher levels of Guthion (azinphos-methyl) and Guthion oxon. The levels of Zolone and Zolone oxon were calculated as being too low to induce cholinesterase depression. It was determined that the exposure to Guthion and Guthion oxon caused the cholinesterase depression and consequent illnesses.

INTRODUCTION

On August 14, 1980, 3 agricultural field workers were admitted to the hospital in Stanislaus County with symptoms of organosphosphate poisoning. The following afternoon, 3 more workers sought medical attention but were not hospitalized. Two of the 3 hospitalized workers were released 48 hours after being admitted, and the third worker was released after being hospitalized 4 days.

For 28 days prior to their illness, the workers had been harvesting peaches in several orchards on 1 farm. Guthion had previously been used in the pest management program during the month of July.

Guthion is registered for use on a wide variety of fruit and vegetable crops to control numerous insect pests. The dermal LD_{50} for Guthion is 220 mg/kg, and it is a potent cholinesterase inhibitor. In the past, there have been several peach picker poisonings in California attributed to exposure to Guthion residues on leaves. The reentry period established by the California Department of Food and Agriculture is 14 days after application on peach trees.

The Department was called in to assist in the investigation of these illnesses. The decision was made to take leaf disc samples of the orchards the workers had harvested prior to their illness. This method has been used successfully many times in the past in evaluating pesticide degradation and its metabolites.[1/] Other treated orchards within the county were also selected for sampling to identify any general area problems that might be due to climatic or pollutant conditions such as substantial conversion of organophosphates to oxons.

MATERIALS AND METHODS

The work history sequence of the pickers for a 30-day period was determined. Leaf punch discs were collected from orchards where the workers had entered prior to being hospitalized. Leaf discs were taken using a 2.5 cm punch, 4 punches per tree. The center row in each block of trees was identified, and 10 trees in the row were sampled. Forty discs per sample were taken, and this was repeated to obtain a replicate for each sample.

Peach orchards in other areas were sampled by proceeding to the center of the orchard from 3 different diagonals. This gave a total of 30 trees and 120 discs per sample.

All samples were chilled to 6°C. after being taken, and were received by the chemistry laboratory within 24 hours.

The methods used for analysis are given in the appendix. The workers who became ill had blood samples drawn when they received medical attention. To identify possible clinical illnesses, cholinesterase testing was done on all workers in the crew, including the workers who had returned to work after being ill.

RESULTS

The cholinesterase levels of 2 of the workers who were hospitalized were extremely depressed, while the third worker's level was just below normal. While all the other workers had low RBC cholinesterase levels, the plasma tests were in or near the normal range.

The results for the leaf disc samples are in Tables I and II. The pesticide residue levels found in both the orchards surveyed and where the illnesses occured were not usually high according to previously published information.[2/]

DISCUSSION

During the investigation, application dates were identified, and no reentry periods were determined to have been violated. The investigation also identified the earlier use of Zolone in some of the orchards, and this brought up the possibility of pesticide potentiation. Information from animal research reports available to the Department demonstrated the possibility of potentiation when the chemicals were administered orally, but when the oral doses were dropped to one-quarter of the LD_{50}, no potentiation occurred. In studies using 21 other pesticides, Guthion showed a moderate ability to potentiate or be potentiated by certain pesticides but, again, lower concentrations did not exhibit potentiation. The levels of Zolone found were very low, and previous studies available to the Department in trade secret information from the registrant have shown that even relatively high residue levels of Zolone on foliage have not resulted in cholinesterase depression of pickers in experimental exposures.

From the research information mentioned above, and the fact that Zolone is not readily absorbed through the skin, pesticide potentiation probably did not occur.

This was an incident due to overexposure to a cholinesterase inhibitor, and Guthion and its oxon are the only possible sources of such a chemical that were found. While the dislodgeable residues of Guthion and its oxon were not considered high enough to cause this field worker poisoning in one day's exposure, we do not know exactly what levels were in all areas of the orchard just before the illness occurrence or if there was a small area of an orchard which received an accidental double application that we did not detect in our testing of the suspect orchards. In the past, repeated low level exposures to organophosphates have caused significant cholinesterase inhibition, and workers have become physically ill. This has been particularly so in field workers who have not bathed daily and have not put on clean clothes each day. When working with residues of organophosphates on crops, it is desirable to have a daily bath and clean clothes daily. In this particular situation, attention to personal hygiene and the use of clean clothes daily was far from satisfactory. Because this is a common situation for work crews in California vineyards and orchards, the Department has determined it must keep in effect worker safety intervals with wide margins of safety that could be considerably shorter if clean clothes each day and a daily bath were common practice.

REFERENCES

1/ Gunther, F.A., Westlake W.E., and Barkley J.H.: Establishing Dislodgeable Pesticide Residues on Leaf Surfaces. Bull. Environm. Contam. Toxicol., 1973, Vol. 9, No. 4.

2/ Knaak J., Iwata Y.: The Safe Level Concept and the Rapid Field Method: A New Approach to Solving the Reentry Problem. American Chemical Society Annual Meeting, Las Vegas, Nevada, August 25-29, 1980.

Table I

Dislodgeable Residues for Fields Harvested
Prior to Worker Illnesses

Field Number	Sample Days After[a] Last Application	ug/cm²[2] Guthion	Zolone[b]	Guthion Oxon	Zolone[a] Oxon
4	48	1.32		.017	
"	57	.75		.036	
"	"	1.07		.023	
"	"	.87		.026	
"	"	.90		.018	
6	41	1.43		.023	
"	"	1.4		.020	
3	41	.71	.12	No Analysis	ND[c]
"	"	.36	.07	.002	.001
"	"	.26	.015	.008	.003
"	"	.25	.079	.011	.022
8	42	.75		.02	
7	43	.70		.012	
"	57	.69		.028	
"	"	.46		.017	
"	"	1.47		.023	
"	"	.89		.02	
5	41	.25		.012	
"	"	.28	.037	.012	.010
"	"	.15	.025	.006[d]	.005
2	47	.06	.15	-[d]	.001
1	48	.13	.07	-	ND[c]

[a] Treatment dates: May 14-20 and July 2-9 @ 1.5#a.i/100g/ac

[b] Zolone was found only in samples showing results in above columns

[c] ND = none detected

[d] Unable to identify Guthion oxon in these samples because of Zolone peak

Table II

Dislodgeable Residues From Field Samples
in Other Areas of Stanislaus County

Mg/cm^2

Field Number	Sample Days After Last Application	Guthion	Guthion Oxon
801	20	.98	.015
804	90	.25	.031
807	48	.022	-
810	90	.15	.017
813	48	.16	ND
816	50	.46	.89
819	50	.016	-
822	43	.35	-
825	86	.07	ND
828	46	.035	-
831	46	.49	ND
834	93	.016	ND
837	56	.43	.005
840	55	.33	.011
843	93	.025	-
846	54	.092	.011
849	117	.15	.004
852	117	.15	.004
855	54	.34	.015
858	54	.36	ND

Table IV

Chronological Order of Harvest

Date of Harvest	Field Number								Notes
	1	2	3	4	5	6	7	8	Workers Began Work on Farm
July 19	X								
20	X								
22	X								
25		X							
27		X							
30			X						
31			X						
Aug 1									
3									
4				X					
5				X	X				
6						X			
7						X	X		
8							X		
10							X	X	
11			X					X	
12			X						
13			X						
14			X	X		X			3 workers hospitalized
15				X		X			3 additional workers ill

APPENDIX

GUTHION, ZOLONE, AND IMIDAN

Dislodgeable Residues

1. Fifty milliliters of water and approximately 4 drops of Sur-Ten solution (1:50) is added to the sample containers. The containers are capped and placed in a multi-purpose rotator and rotated at 30 cycles/min for 20 min. The aqueous solution is decanted through a glass wool plug into a 500 ml separatory funnel. Repeat 2 times.

2. The aqueous solution is extracted 3 times with 50 ml of $CHCl_3$. Shake carefully to avoid emulsions. The solvent is filtered through sodium sulfate into a 250 ml beaker, evaporated with flowing air over a hot plate to just dryness.

3. The residue is redissolved in hexane, made to 10 ml final volume and submitted for gas chromatography.

   Chromatographic conditions: The chromatograph used was a Perkin Elmer Sigma-2 or a Hewlett-Pack and S730 under the following conditions:

Detector: Nitrogen-Phosphorus Controlled Temperature
Bead @ 350°
Detector gases: H_2 60 ml/min
Air 100 ml/min

Columns: Glass, 26" x 2 mm i.d. with 3% OV-17
on 100/120 Gas Chrom Q @ 220°C

or

6' x 2 mm i.d. 4% OV101 and
6% OV210 on 120/120 Gas Chrom Q

Carrier Gas: N_2 at 40 ml/min

A Tracor 540 Gas Chromatograph using the same conditions but equipped with a flame photometric detector, sulfur filter, attenuation: 64×10^{-9}, @ 250°C.

Oxones were analyzed with liquid chromatography:

Instrument: Perkin - Elmer LC-55

Column: 30cm x 4mm Stainless Steel Column, C-18 uBondapak on 10um Zorbax

Mobile Phase: 25/75 Acetonitrile/Water @ 1 ml/min

Detector: UV @ 285 nm

References:

Kvaluag, J., D.E. Ott and F.A. Gunther. Journal of the A.O.A.C. 60(4): 911-917 (1977).

Gunther, F.A., Bulletin of Environmental Contamination and Toxicology. 9:243-249 (1973).