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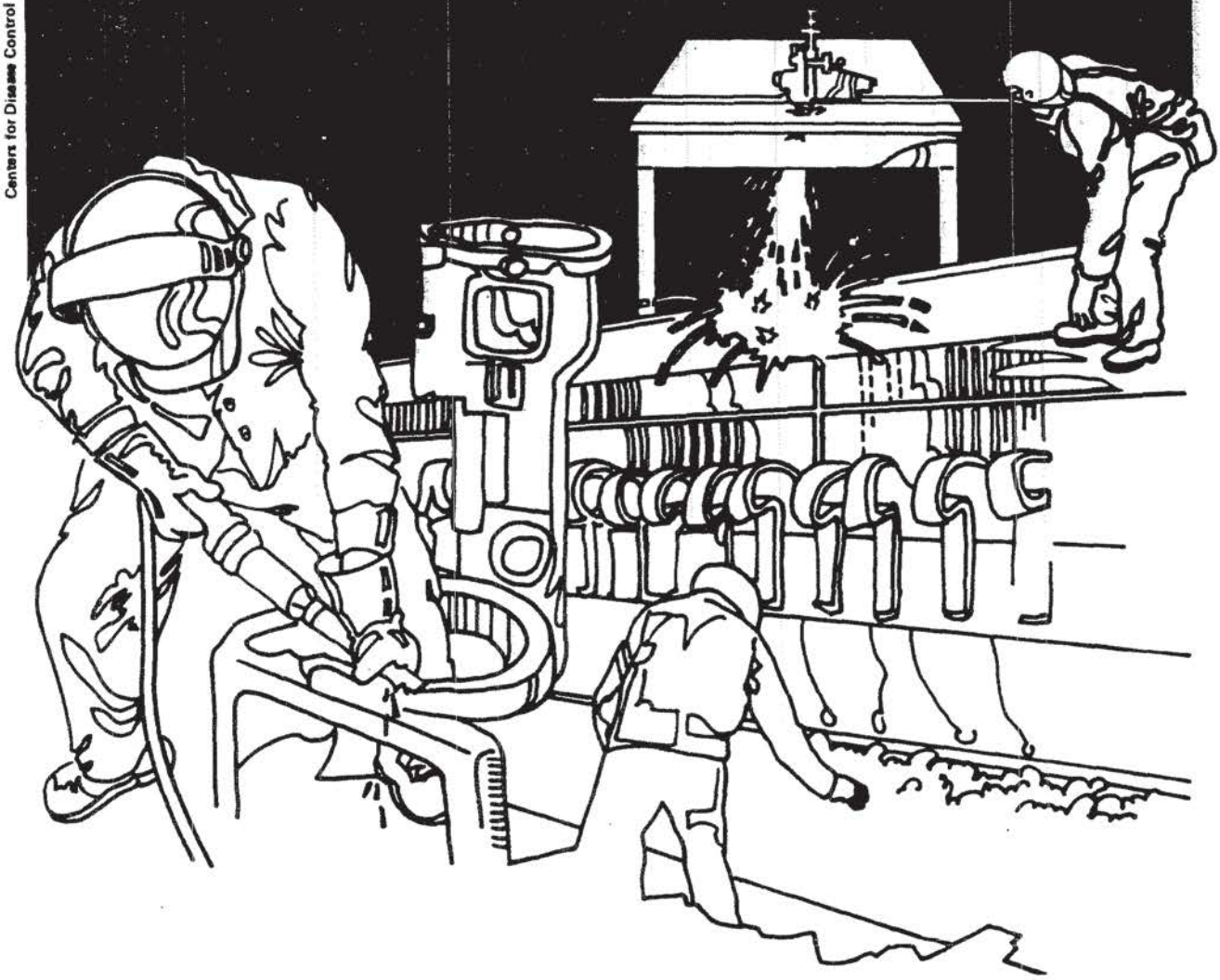
NIOSH



Health Hazard Evaluation Report

HETA 81-366-1248
WEST FOODS
VENTURA, CALIFORNIA

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

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West Foods
Ventura, California

NIOSH INVESTIGATORS:
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I. SUMMARY

On June 12, 1981, the National Institute for Occupational Safety and Health (NIOSH) received a request for a Health Hazard Evaluation (HHE) from an official representative of the United Farm Workers of America AFL-CIO, Oxnard, California. The requestor was concerned about potential hazards resulting from exposure to diazinon, vapona and other pesticides used in mushroom cultivation at the farm. A recent accidental exposure of one work crew to diazinon, and a recurrent skin rash thought to be a result of vapona exposure prompted the request.

To determine if health effects were related to exposures, NIOSH investigators reviewed both the list of pesticides used in mushroom cultivation and the work practices employed in handling these chemicals. NIOSH medical staff reviewed medical records from the diazinon exposure incident and with a consulting dermatologist interviewed workers from each step in the production process and physically examined eight workers with complaints of dermatitis. No environmental monitoring was conducted during the survey, but the industrial hygienist reviewed the protective equipment maintenance program, obtained copies of the material safety data sheets for all pesticides used at the farm, observed on pesticide (diazinon) mixing and spraying operation, and observed the chemical applicators' work procedures while using vapona insecticide in the growing house.

Pesticide applicators were found to have proper protective equipment, but an adequate respirator fit test program had not been established, and respirators were not cleaned at the end of each work shift. Workers had not received adequate training regarding the potential health hazards of pesticide exposures, and were in frequent and prolonged contact with mixtures of humid earth and pesticides. A pattern of irritant dermatitis consistent with these exposures was found in five of the workers examined. Two of the workers interviewed had previously handled a dithiocarbamate fungicide (zineb) and gave histories of symptoms consistent with direct irritation or sensitization to this compound. Work practices had been modified since onset of their complaints in order to decrease potential worker exposures.

Based on these findings, NIOSH concluded that there was a health hazard of dermatitis from exposure to pesticides and damp earth at West Foods-Ventura, and of acute organophosphate poisoning because of lack of health and safety training for non-applicators potentially exposed to pesticides. Deficiencies were also noted in the respirator program for applicators. Recommendations to control these hazards are found in Section VII of this report.

KEYWORDS: SIC 0721 (Crop Planting-Cultivation) mushrooms, dermatitis, organophosphate, dithiocarbamate, Lindane, Vapona, malathion, methoxychlor, pyrethrin, zineb, benlate, cholinesterase, formaldehyde, pesticides.

II. BACKGROUND

On May 20, 1981 a work crew known responsible for checking the mushroom beds for mushroom blight (verticillium and myxogene, known as "dry bubble" and "wet bubble" respectively) entered one of the growing rooms. There were 18 workers in the crew; their task was to inspect the beds for bubble and to cut out the parts of the beds in which the blight was found and then disinfect the remaining part of the bed with a salt solution. These rooms are relatively dark; there are two doors, one of which is kept closed, and no other source of ventilation. An applicator crew had recently sprayed the entrance of the room with diazinon, and organo-phosphate pesticide, but they had not posted the room to prevent work crews from entering before the pesticide had dissipated.

Within 15 to 20 minutes of entering the room, all but one of the workers developed symptoms of headache, dizziness, fatigue, and nausea. Four workers began to vomit and were taken to a local hospital, where they were admitted to the intensive care unit, decontaminated and treated with atropine. The other workers left the room and one went to find the applicator crew to find out what had been applied. All but one of the non-hospitalized workers were seen by the same physician who admitted the first four; cholinesterase levels were drawn and the patients were followed on an outpatient basis. Workers were not allowed to return to work for varying periods of time; the four hospitalized patients were finally released for work on June 2 with work restrictions including an insecticide-free environment for the following month.

III. PROCESS DESCRIPTION

The West Foods mushroom farm has nine buildings. Seven of these are large warehouse style growing rooms, six of which are in actual operation. There is also one cold storage building where the harvested mushrooms are packed and stored prior to shipping, and an office building.

Within the mushroom growing rooms, mushrooms are grown in wooden frame beds, neatly stacked on top of each other with an approximate clearance of 18 to 24 inches between the beds. Wooden scaffolding divides the rooms into two "floors" of five beds each stacked vertically. The growing beds are arranged in rows which run the width of each room.

Approximately 355 workers employed at West Foods are divided into 13 separate work crews. Relatively strict segregation between the work crews is maintained, and workers on one work crew do not fill in for workers on another crew.

The process of cultivating mushrooms, with the potential health hazards of each state in the process, are presented as a flow chart in Table I and descrived below:

Stage 1: Composting

Manure and wheat straw are mixed and allowed to compost in piles in the

open air for 14 days (all time periods given are the usual operating cycle; in most stages the actual number of days can vary slightly). The compost piles are regularly turned by machine and intermittently watered and sprayed with malathion-8. At Day 7 of the cycle, organic nitrogen sources (urea, ammonium nitrate) are added.

When the compost reaches a temperature of 170 degrees Fahrenheit it is packed into the mushroom beds (wooden flats) and moved to the growing rooms.

Stage 2: Growing Bed Preparation

The growing rooms are pasteurized with live steam 140^{o}F for two hours then allowed to cool over 14 days until it reaches a growing temperature of 90-100 degrees. Just before the spores are spawned into the beds, the beds are sprayed with methoxychlor and a malathion + pyrethrin dust.

Stage 3: Spawning

Mushroom spores are spawned (planted) within the compost using a manual rototiller, and the beds are covered with plastic sheeting and allowed to germinate for 14 days. The wooden scaffolding and the plastic covering the beds are sprayed with lindane on the first day. The malathion + pyrethrin dust is applied manually four times during the spawning cycle using a back pack and wand applicator. Vapona is also vaporized in the growing rooms four times during the cycle.

Stage 4: Casing

The plastic sheeting is removed and the beds are covered with a one and one-half inch layer of peat moss, providing a reservoir source of water. The rooms are sealed, and carbon dioxide is produced by the growing plants, the rhizemore (mycelia) becomes visible on the surface of the beds within 7 days. At this point the rooms are unsealed, fresh air is introduced, and the air temperature drops to 60 degrees (this is called "shock"). The shock forces fruiting of the mushrooms, and small "pins" appear 7 days later. The beds are watered very heavily (one pound of water is applied for every pound of mushrooms picked), and three days later the first "flush" or growth of mushrooms is harvested.

The cycle takes 7 days to reach the visible rhizemore and 7 more days to the first pins. On Day 10 the "bubble crew" begins regular inspections of the beds for "dry bubble" (verticillium, a form of mushroom blight) and "wet bubble" (mycogene), the major threats to production of saleable product. (Mycogene is far less commonly found than verticillium, but poses a greater problem for control of spread within a room or production plant.)

The beds are irrigated with water + zineb on day 1 and day 12 and then between flushes. On Day 15 the beds are irrigated with water + chlorine as a bacteriocide.

Stage 5: Harvesting

Each room will produce approximately five flushes of mushrooms at 2-5 day periods. A mixture of zineb dust and malathion + pyrethrin dust is sprayed over the beds and vapona is vaporized in the rooms every two days on an alternating schedule. The beds are irrigated with zineb + water between each flush, and with benlate + water about twice per crop as needed. To pick the mushrooms, workers stand on the concrete floor or straddle the wooden scaffolding and reach between the vertically stacked beds, depositing the mushrooms in small plastic baskets hooked to their sides.

Stage 6: Room Pasteurization

When production of mushrooms has been exhausted, the room is "killed" with live steam and formaldehyde at 145^{o}F and allowed to cool overnight. The beds are then shoveled out by the dump crew onto a moving conveyor belt, washed out and pasteurized before re-use.

Stage 7: Packing

Harvested mushrooms are brought to the cold storage shed, where they are sorted and packed in a semi-automated process before storage and shipping.

In addition, a maintenance crew of 12 workers and a motor pool crew of 5 workers are employed. The maintenance crew may be potentially exposed to pesticides in the course of repair operations in the growing rooms.

In addition to the required state pesticide applicator training for all applicators, the irrigators, applicators and supervisors attend a class on pesticide hazards and safe work practices offered every six months by the Ventura County Department of the California Department of Food and Agriculture Worker Health and Safety Unit; this course is offered in English and Spanish.

All applicators receive monthly red blood cell and serum cholinesterase tests. Irrigators were currently receiving baseline cholinesterase tests after the termination of vacation periods at the time of the NIOSH investigation. There is no regular medical surveillance for other employees; a local physician is retained by the company for surveillance of the applicators and irrigators, and to see cases of other employees potentially poisoned by pesticides; cases of dermatitis are referred to a local dermatologist.

IV. METHODS AND MATERIALS

A. Environmental

No environmental monitoring was conducted during the survey, but

the NIOSH industrial hygienist reviewed the protective equipment maintenance program, obtained copies of the material safety data pesticide, (diazinon) mixing and spraying operation, and observed the chemical applicators' work procedures while using vapona insecticide in the growing house.

B. Medical

Prior to the site visit, the NIOSH medical officer reviewed medical records for nine workers who had been seen by a physician for effects of exposure to diazinon on May 20, 1981 described in Section II. During the site visit, workers involved in each step of the cultivation process were questioned regarding work and other symptoms. Private interviews and physical examinations for dermatological complaints were offered to all workers. Eight workers presented for examination, although many more were observed to have findings of contact irritant dermatitis during the tour of the worksite.

V. EVALUATION CRITERIA AND HEALTH EFFECTS

A. Environmental

Occupational exposure criteria have been developed to evaluate worker's exposure to chemical substances. The criteria are based on the best available information from industrial experience, from experimental human and animal studies, and, when possible from a combination of the three. These values below represent concentrations to which it is believed that nearly all workers may be exposed for an 8-10 hour day, 40-hour work week throughout a lifetime without experiencing adverse health effects.

Three sources of criteria generally used to evaluate the workroom concentrations of air contaminants: (1) NIOSH criteria for recommended standards; (2) recommended Threshold Limit Values (TLV's) and their supporting documentation as set forth by the American Conference of Governmental Industrial Hygienists (ACGIH), 1981; and (3) California-Occupational Safety and Health Administration (CAL-OSHA) standards (1981).

TABLE A

Permissible Exposure Limit (PEL)[1] - mg/m^3[2]

	NIOSH	CAL-OSHA	TLV
Malathion (Skin)[3]	15	10	10
Dichlorovos (Skin)	--	1	1
Methoxychlor	--	10	10
Benomyl	--	10	10 15 (STEL)[4]
Pyrethrin	--	5	5 10 (STEL)
Lindane (Skin)	--	0.5	0.5 1.5 (STEL)
Formaldehyde	Lowest Feasible Limit	3(C)[5]	3(C)

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1) PEL — NIOSH exposure is based on a workday up to 10 hours long, whereas the CAL-OSHA and the TLV is based on an 8-hour workday.

2) mg/m^3 — Milligram of substance per cubic meter of air.

3) Skin — This notation refers to the potential contribution to the overall exposure by the cutaneous route (mucous membrane and eye).

4) (STEL) — The maximum concentration of an airborne contaminant to which an employee can be exposed for a period up to 15 minutes.

5) (C) — The maximum concentration of an airborne contaminant to which an employee can be exposed at any time.

B. Medical

Symptoms and physical findings of dermatitis related to exposure to the pesticides used at West Foods are detailed in Section VI-B. The eight workers seen by a physician subsequent to exposure to diazinon in the incident on May 20 had not had a prior baseline cholinesterase established, and evaluation criteria were the comparison of the group's cholinesterase levels immediately after the incident with the laboratory normal range and with their own cholinesterase levels drawn 15 days after the incident.

C. Toxicological

Potentially hazardous substances at West Foods identified during the NIOSH investigation are listed below, with their potential health effects.

1)	Organophosphates:	malation dichlorvos (Vapona) methoxychlor
2)	Carbamates:	benomyl (Benlate)
3)	Dithicarbamates:	zeneb
4)	Pyrethrin	
5)	Organochlorines:	lindane
6)	Formaldehyde	
7)	Fertilizers:	urea ammonia nitrate
8)	Physical Hazards:	Humidity Cold Temperaturs Heavy Lifting

Dermatitis:

Direct contact with the following chemicals or conditions may cause an irritant dermatitis: malathion, methoxychlor, pyrethrin, lindane, Vapona, zineb, benomyl, compost, urea, ammonium nitrate, mushrooms chlorinated irrigation water, and elevated relative humidity. Sensitization (an "allergy") may develop in some workers exposed to malathion, benomyl, zineb, and Vapona; this can develop suddenly after months to years of work in contact with these substances during which the worker has had no symptoms. (1)

Systemic Effects of Organophosphates and Carbamates:

Organophosphates and carbamates may be absorbed into the body through the skin, by inhalation, or by mouth. They cause inhibition (reduce the activity) of an enzyme necessary to the normal functioning of the nervous system, cholinesterase. Blood tests can determine the level of cholinesterase activity in red blood cells (RBC) or in the serum; the RBC level reflect the effect on the nervous system and therefore should be used rather than the serum level to evaluate the health of workers. Because of the wide variation in normal levels of cholinesterases among individuals, a pre-exposure baseline value is extremely useful in evaluating cases of moderate poisoning; symptoms may occur in workers who do not have a baseline value and who present after exposure with cholinesterase levels in the laboratory low normal range for the general population.

Mild effects of poisoning include headache, dizziness, nausea, malaise, visual disturbances and anxiety. In moderate poisoning, pinpoint pupils (miosis), vomiting, abdominal cramps, diarrhea, difficulty breathing, sweating, and tremors are seen. In severe cases, ataxia (difficulty walking), respiratory paralysis, coma and death may occur. After cases of moderate or low levels of these pesticides, general CNS symptoms of headache, fatigue, insomnia, anxiety and restlessness may persist for weeks to months after the more acute symptoms have been resolved. (2)

VI. RESULTS

A. Environmental

The chemical applicators wear the following protective equipment whenever they mix or apply pesticides: full-face respirator with a cannister, rubber rain gear, rubber boots and gloves. A chemical applicator demonstrated the application of diazinon to the inlet air vents and door frames of growing houses. The applicator wore proper protective equipment; however, no warning signs were placed outside the growing house to alert other workers that chemical spraying was in progress or that the room had been recently sprayed.

The chemical applicators were also observed applying vapona to the growing house by vaporizing about 35 milliliters of the liquid with the use of an electric hot plate. The applicators followed previously established application procedures established by the company. Based on the application procedures and the work practices, worker exposure to vapona was not likely to occur.

A review of the respirator maintenance program indicated that workers are not properly fitted for respirators, and that proper cleaning was not routinely performed at the end of each work day.

B. Medical

(1) Diazinon exposure on May 20: During interviews with the exposed workers, all gave a history of symptoms of mild or moderate poisoning immediately or shortly after the exposure; at least four of them continued to have persistent headache, visual disturbances, malaise and anxiety. RBC cholinesterase levels for the exposed workers who were seen by a local physician are presented in Table II. The normal range for the laboratory conducting the testing is 0.55 - 1.25 delta pH units (Michel method).

TABLE II

ERYTHROCYTE CHOLINESTERASE LEVELS AMONG

WORKERS EXPOSED TO DIAZINON ON MAY 20, 1981

ID NUMBER	May 20/21/22	May 25	June 4
1	0.63	0.54	0.80
2	0.69	0.58	0.86
3	0.60	0.51	0.78
4	-	0.56	0.86
5	0.62	-	0.91
6	0.70	-	-
7	0.62	-	0.85
8	0.52	-	0.78
9	0.53	-	0.73

(All values are in delta pH units)

All nine of these workers' initial levels (May 20-25) fall in the low normal or below normal range for this laboratory. Moreover, every one of the workers has a marked increase in cholinesterase levels by June 4, placing them well within the middle of the normal range. This strongly suggests an initial depression in cholinesterase level with a subsequent return towards baseline, consistent with organophosphate poisoning and the severe symptoms with which at least four of the workers initially presented.

(2) Dermatologic examinations: One female and 5 male employees from the picking crew were examined. One female from the bubble crew was also examined. All complained of itching, primarily of the exposed surfaces of the dorsal hands,

forearms and upper arms, face, neck and shoulders. One employee complained of itching around the waist and groin as well. Another employee complained of itching behind the knees. All of these employees complained that a white powder (malathion + pyrethrin) aggravated their symptoms. All stated that vacation periods or time off from work resulted in improvement or remission of their symptoms.

Five of these six employees presented a similar clinical picture on examination, varying only in degree and extent of involvement.

These clinical findings included poorly marginated patches of dermatitis, with dry superficial scaling and lichenification accentuated on the flexural aspects of the elbows, sides of the neck, waist, groin, and backs of the knees. These locations are not only sites for increased friction and rubbing of clothing against the skin but also for trapping and occlusion of exogenous exposures between clothing and skin. One employee had follicular papules come up primarily over the exposed areas of the outer arms, shoulders, lateral chest and back; in some areas, this eruption appeared acneiform, but in other areas it clearly extended beyond usual areas of acne involvement. This latter case did not resemble the clinical appearance of the previous five cases.

None of the above employees gave a personal or family history of atopy or atopic dermatitis. It is concluded that the cause of this dermatitis is multifactorial, and has been precipitated by combined exposure to chlorinated irrigation water, wetting of clothing, contact with compost, the high relative humidity and cool temperatures inside the growing rooms, and skin contact with soil and malathion + pyrethrin dust. Because of this dermatitis, increased dermal absorption of malathion is possible.

Two employees from the irrigation crew were evaluated. One complained of itching of the arms, while the other complained of generalized itching. Both attributed their symptoms to exposure to a mixture of zineb in water. Symptoms were worse when irrigation of overhanging mushroom beds was required, permitting this solution to run back down their arms from above. Work practices had been changed to avoid this problem after their symptoms first appeared in severe form. On examination, one of the irrigators had dry skin, associated with keratosis pilaris confined to the upper arms above the elbow. The other had moderate dermographism, as well as one small patch of numular eczema on the left lower calf. Zineb is capable of causing allergic dermatitis, as well as a direct contact irritation. The clinical picture did not strongly suggest that sensitization had occurred, and the severity of reaction of one of the employees is related to underlying demographism.

VII. RECOMMENDATIONS

1. The company should institute a formal respirator program in accordance with the Occupational Safety and Health Act (OSHA) requirements outlined in 29 CFR Part 1910.134. The respirator program should include the following: proper respirator selection, training and education of the user, fit testing, maintenance of equipment, proper and adequate storage, periodic inspection, surveillance of work area conditions, periodic inspection of program to determine the continued effectiveness and medical examination of workers using the respirators.

2. The company should institute a training program in English and Spanish for all employees on the potential health hazards of exposures as outlined in Section V-C above, and on the proper work practices which may prevent health effects.

3. The company should provide waterproof clothing covering the neck, arms and upper torso to prevent contact dermatitis among those workers who develop the condition or request the clothing.

4. Warning signs should be posted during the application of diazinon or any other chemical pesticide to the air vents and door frames of the growing houses. The signs should remain in place until a safe period of time has elapsed, e.g., the pesticide has dried or it is not smelled.

5. Formaldehyde air-monitoring should be done periodically to determine whether workers are exposed to these vapors which are irritating to the eyes, skin and upper respiratory tract at very low concentrations and it is considered a potential occupational carcinogen.

VIII. REFERENCES

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X. DISTRIBUTION AND AVAILABILITY OF REPORT

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Copies of this report have been sent to:

1. United Farm Workers of America, AFL-CIO, Oxnard, California
2. West Foods, Incorporated, Ventura, California
3. NIOSH - Region IX
4. CAL-OSHA
5. U.S. Department of Labor (OSHA) - Region IX

For the purpose of informing the affected employees, a copy of this report shall be posted in a prominent place accessible to the employees for a period of 30 calendar days.

TABLE I.

PHASE	PROCESS	POTENTIAL EXPOSURE	CREW
1. Compost	Horse manure/straw piled on compost warf, turned with machines. 14 day cycle. Day 7 add nitrogen meal residues and water. Temperature rises to 170°F. Compost surface sprayed once with vaponite and malathion.	Vaponite (liquid) Malathion 8 (") Urea crystals ammonia nitrate crystals	Compost (7) Applicators (3)
II. Growing Room Pasteurization	Pasteurize with live steam to 140°F, let cool until ammonia smell gone (80-90°F) - approximately 14 days. Then just before spawn, spray with methoxychlor and malathion + pyrethrin dust.	Live steam Methoxychlor 50% (Marlate) Malathion dust 5% with pyrethrin 1%.	Fill (9) Applicators (3)
III. Spawn	Spawn mixed into soil with "rototiller," then covered with plastic and treated with: 1) lindane spray once on 1st day 2) malathion + pyrethrin dust (manual applic. with back pack and wand) four times 3) vapona vaporization four times (every other day)	Lindane (liquid) Malathion + pyrethrin dust Vapona (vaporization)	Spawn (8) Irrigators (15) Applicators (3)

PHASE	PROCESS	POTENTIAL EXPOSURES	CREW
IV. Casing	Spawn bed covered with 1-1/2 layer of peat moss. Room sealed, CO_2 builds up, forces production of rizemore; when mycelia/rizemore visible, CO_2 exhausted and fresh air introduced "shock". Air temperature drops to 60°F, shock causes fruiting. Approximately 7 days to rizemore, 7 days from shock to first "pins". Day 10 bubble crew begins search for verticillium (dry bubble) or mycogene (wet bubble). Bed irrigation with H_2O + Zineb on day 1, day 12, then between flushes. Day 15 irrigate with H_2O + chlorine (bacteriocide).	Zineb (liquid) Chlorine (liquid) Malathio + pyrethrin dust Vapona	Irrigators (15) Applicators (3) Case (7) Bubble (15)
V. Harvesting	Picking is done every 2-3 days; mushrooms grow in "flushes" - usually 5 flushes per cycle. Apply pesticides as follows: 1) Zineb 15 (dust) Spray together 2) Malathion + pyrethrin dust) every two days 3) Vapona vaporiation every 2 days 4) Zineb + H_2O irrig. between every flush 5) Benlate + H_2O irrig. about twice per crop.	Zineb 15 (dust) Malathion + pyrethrin dust Vapona Zineb (liquid) Benlate (")	Pickers (120) Irrigators (15) Applicators (3) Bubble (15) Pickup (13)
VI. Pasteurize Room	Room "killed" with live steam + formaldehyde to 145°F, cooled overnight, then dump crew removes earth from bed. Room is washed out and pateurized again.	live steam formaldehyde 13% liquid	Dump (7)

Maintenance crew of 12 potentially exposed at any stage.

Motor pool crew of five not known to be exposed to above substances.

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