U.S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH

HEALTH HAZARD EVALUATION NO. 78-59-616
DIAMOND FRUIT GROWERS, INC.
DUCKWALL-POOLEY FRUIT CO.
STADELMAN FRUIT INC.
HOOD RIVER, OREGON

SEPTEMBER 1979

I. TOXICITY DETERMINATION

It has been determined on the basis of medical and environmental evaluations performed October 11-16, 1978, that workers handling apples and pears in packaging and sizing operations evaluated by NIOSH are exposed to a risk of skin rash. This evaluation was conducted in nine packaging and sizing plants (three companies) in northeastern Oregon. The extent of the rash problem varied somewhat between the plants tested. Three hundred sixtynine sorters and packers tested in the nine plants were evaluated and 18% gave a history of skin rash associated with work and 10% had an observable rash on exposed skin surfaces. 19 potential sensitizing and/or irritating chemicals were found in the fruit preparation process.

Interpretation of the information collected shows some trends and indicates a potential hazard for skin irritation and sensitization. With some exceptions, packers are affected more than sorters and the rates increase with duration of work. Although no control group was available for study, it is clear that some problem exists given that an average of 10% of the workers displayed some skin lesion consistent with an eczematous process. The degree of skin abnormalities varied with work location. The exact chemical(s) responsible for the rash could not be determined. Recommendations are made in Section IV H of this report.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this complete Determination Report are currently available upon request from NIOSH, Division of Technical Services, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After ninety (90) days, the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia. Information regarding its availability through NTIS can be obtained from NIOSH, Publications Office at the Cincinnati address.

Copies of this report have been sent to:

1. Diamond Fruit Growers, Inc., Hood River, Oregon.
2. Duckwall-Pooley Fruit Co., Hood River, Oregon
3. Stadelman Fruit, Inc., Hood River, Oregon

4. Teamsters, Food Processors, Local 670.

5. International Brotherhood of Teamsters.

6. Oregon State Accident Prevention Division.

7. U.S. Department of Labor, Occupational Safety and Health Agency (OSHA), Region X, Seattle, Washington.

8. NIOSH, Region X, Seattle, Washington.

For the purpose of informing the affected employees, the employer will promptly post this Determination Report in a prominent place(s), near the work area of the affected employees for a period of thirty (30) calendar days.

III. INTRODUCTION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6), authorizes the Secretary of Health, Education and Welfare, following receipt of 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 National Institute for Occupational Safety and Health received such a request from a representative of the employees to determine if the products used in the apple and pear packing process at Diamond Fruit Growers, Inc., Duckwall-Pooley Fruit Co., and Stadelman Fruit Inc., are toxic as used or found. The various chemicals and their use are shown in Tables 1 and 2.

IV. HEALTH HAZARD EVALUATION

A. Description of Process

The processing of apples and pears may vary slightly from plant to plant. The following is a general description where the fruit is sorted followed by packing.

The apples or pears are dumped from bin containers into water-filled tanks to float the fruit. Apples will float in water whereas pears, having a density greater than water, are floated in water to which sodium silicate or sodium sulfate has been added to increase the density. Chlorine or sodium orthophenylphenate is usually added to the water as a mold and fungi control. The fruit is then washed with a detergent, rinsed and is partially dried with sponge and brush rollers. The fruit is then sprayed with a solution that contains a wax, a chemical (ethoxyquin) to prevent scald in storage, and a fungicide, Benlate® (methyl 1- (butylcarbamoyl) 2- benzimidazolecarbamate). The fruit is then dried with sponge and brush rollers followed by a hot air dryer. After leaving the dryer, the fruit is manually sorted according to quality. The sorted fruit is automatically sized and the sized fruit is hand wrapped with a tissue type paper and packed into boxes.

Two of the plants evaluated were pre-size plants. In these the fruit was washed, sorted, sized, packed in large storage bins and stored until a later date when they were packed into boxes. In both of these plants, the solution containing the wax, ethoxyquin and Benlate®, was sprayed on after the fruit had been sorted, as compared with the other plants where the fruit was sprayed before sorting.

Two of the plants evaluated packed the fruit after it had been sorted and sized at a pre-size plant. One plant utilized only an overwrap packing process. In it the fruit was floated, dried, sorted and automatically placed on packing trays. The fruit is straightened (placed in a uniform direction) by hand, automatically wrapped in a polyvinyl chloride film and the trays placed in the box. In the second plant there were two packing lines, one overwrap line similar to the plant listed above, and one hand pack line. For both lines the fruit was floated, sorted, dried and packed.

Table 1 shows the chemical composition of the various products and their use in these plants. Tables 3 thru 11 show each plant process, the chemicals used, and the usage of rubber or cloth gloves.

B. Evaluation Design and Progress

1. General

An initial survey was conducted on March 21, 1978. None of the plants were in operation during this visit due to the seasonal nature of this business. An environmental-medical survey was conducted on October 10 thru 16, 1978.

2. Environmental

Air samples were not collected since it is believed that the rashes are caused by physical contact with the chemicals used in the plants. The process and chemicals used in each plant were observed and documented. These were later used for comparison purposes. The usage of gloves was also noted. Samples of the wrapping paper from each firm were collected and subsequently analyzed for the presence of ethoxyquin.

3. Medical

Workers involved in the processing of apples and pears were evaluated by questionnaire and skin examination for evidence of current and/or past skin rash.

C. Evaluation Methods

1. Environmental

The wrapping papers were analyzed for the presence of ethoxyquin by sonicating a 20 square inch sample in a methanol/acetonitrile mixture. The solutions were filtered and analyzed by HPCP using UV and fluorescence detectors. Chromatographic conditions were as follows:

Column:	Vydac 201 TP reverse phase
Solvent:	Methanol/acetonitrile, 62/38 (isocratic)
Flow rate:	0.5 ml/min
Injection volume:	25 ul
Detectors:	1. UV, 340 nm, .01 aufs.
	2. Fluorescence, 267 ex, 370 em, range 1.0, sensitivity 450

2. Medical

The medical evaluation was conducted by three groups of NIOSH personnel. Each group contained a physician, with a physician's assistant or clinical nurse. Both members of each group administered questionnaires and examined the workers' hands, arms, face, and neck. If a rash was found by a physician's assistant or nurse, the worker was referred to the physician in that group for characterization of the rash. This was done to gain better uniformity in the description of lesions.

The questionnaire covered demography, occupational history, and skin related health problems as related to employment. The physical examination portion of the evaluation form characterized lesions by location and appearance. (See Attachment 1).

The case definition for this physical examination evaluation was any lesion which appeared red, raised, rough, flaking, or hyperkeratosized as consistent with acute or chronic eczema.

The results were divided by job description, job location and years exposed to the fruit processing operation. The largest job description groupings were packers and sorters. Although degree and method of exposure to chemicals may be different for a packer and a sorter, both have potential exposure to most the chemicals used in the plants. Exposure to fruit processing operation was defined as exposure to apple or pear processing or canning. Home processing was not included. Fruit picking or handling of fruit other than apples or pears was not considered as exposure for this evaluation. The job location groupings were the nine plants. The "years exposed" groupings consisted of those persons working in the processing plants for their first season and those who have worked previous seasons in fruit processing plants.

D. Evaluation Criteria

The potential toxicities of each of the chemicals used are listed in Table 2. There are a large number of chemicals in the list which are potential skin irritants and skin sensitizers. Some chemicals are irritants due to their acidity or alkalinity. Others are irritants due to their defatting action on the skin. Skin sensitizers may also be irritants. The sensitizers, however, cause dermatitis through an immunologic process. Irritated skin may be more susceptible to sensitization because the sensitizing agent may be allowed easier skin penetration.

Skin affected by irritants may show rough, red areas. The development of itching, papules, vesicles, or urticaria (welts) usually indicates sensitization. If exposure of sensitized skin to the specific agent is chronic, the skin may appear thickened and rough with small dry flakes.

E. Evaluation Results and Discussion

1. Environmental

The individual plant processes and the chemicals used in each operation are shown in Tables 3 to 11. The usage of gloves is also shown on the tables.

The processes in the plants that sort and hand pack immediately after sorting were all very similar. The only differences are related to the chemicals used. However, it is only a matter of choice as to which chemical is used to accomplish the same purpose. All of these plants utilize hot air dryers to dry the fruit after the application of the wax/chemical mixture. In all instances, the fruit appeared to be dry as it passed in front of the sorters. This was not the case at Diamond Central where the pre-sized fruit was packed. The hand pack line used only sponge rollers to dry the fruit after it had been floated. The fruit was still moist as it passed down the packing conveyor belt. The specialty fruit line used a forced air (room air temperature) dryer to dry the fruit. Wax was not applied so the moisture on the surface of the fruit would contain water, chlorine and Benlate ®.

The two plants (Diamond Central and Duckwall-Pooley) that utilize the overwrap process are very similar. The basic difference is that in Diamond Central the additional sorting is done when the fruit is wet, just before the hot air dryer, while in Duckwall-Pooley the additional sorting is done after the fruit has passed thru the hot air dryer. The rash rate experienced by the employees in these two plants cannot be compared since no distinction was made in the Diamond Central plant as to which of the three packing processes the examined employees were assigned.

The overwrap process uses an automatic machine whereby a sheet of polyvinyl chloride film is wrapped over a tray of fruit, the film is cut by a hot wire and the tray then proceeds to the heated machine where the film is shrunk tightly. The wrapping machine at Diamond Central did not use local exhaust ventilation to remove the fume generated when the film was cut by the hot wire. A similar type of film and hot wire cutting process is used in the meat wrapping industry. The fume generated from this process is suspected of causing a respiratory disorder labeled "meat wrappers asthma". The wrapping unit at Diamond Central should be equipped with local exhaust ventilation vented to the outside atmosphere.

There were two plants (Diamond Pine Grove and Duckwall-Pooley) that pre-sized the fruit for packing at a later date. In both of these the fruit was sorted before the wax/chemical mixture was applied. The fruit was moist with the rinse water used to rinse off the soaps and fungicides. As will be shown later, this group of sorters experienced a rash rate that was significantly less than that found among employees working in other processes.

The wax/chemical mixture at Duckwall-Pooley was applied by an automatic spray right next to the sorters. The spray can drift in the direction of the sorters. The unit should be enclosed as much as possible and a local exhaust ventilation system installed to remove the overspray.

In several plants the packers were observed using their arms to move the fruit on the conveyors and packing tables. This may be a significant route by which the wax/chemical mixture on the dried fruit is transferred to the workers' skin. This transfer can also occur by contact between the bare arms and the sides of the containers and work surfaces prior to packing.

The various papers used to wrap the fruit were analyzed for the presence of ethoxyquin. The results are shown in Table 12. Only two of the nine papers positively had no ethoxyquin on them. They were a yellow paper used by Diamond to wrap Bosc variety pears and a green paper used by Diamond on all the specialty fruit. Six of the remaining seven had an interference at the wave length where ethoxyquin is measured, so the presence of ethoxyquin could not be definitely established. Only on the white paper used by Stadelman was ethoxyquin positively identified. When new supplies of wrapping paper are ordered, they should be ordered without the addition of chemicals such as ethoxyquin and Benlate®, to reduce their potential exposures.

2. Medical

Packers and sorters constituted 90% (369 persons) of the workforce evaluated, so most comparisons were made between these two groups. The remaining 42 (10%) persons were divided among 17 reported job titles. The fruit and chemical exposure for these job titles varied, but they generally had less shin exposure to the chemicals used than the packers and sorters.

Participation rates varied with each plant. The actual participation rates are given in Table 13. Eighty (80) percent of the available packers and sorters participated in the survey.

The questionnaire and skin examination results for packers and sorters are given in Tables 14, 15, and 16. For each group is given the percentage of workers affected by a history of a rash that year or within the two prior years or current evidence of a rash. Current rashes are tabulated only under physical evidence and not under history unless the rash has occurred prior and resolved before this current episode. The workers are grouped by plant and the plants are grouped by company name. A total of 369 packers and sorters were evaluated and 36 (10%) had current rash on physical examination and 67 (18%) reported some past history of a rash related to work.

The 42 other workers were also assessed. Five (12%) had some dermatological lesion on physical examination and seven (17%) reported a history of a rash. These rates approximated the rate seen over the three companies for packers and sorters.

Interpretation of the information collected shows some trends and indicates a potential hazard for skin irritation and sensitization. With some exceptions, packers are affected more than sorters and the rates increase with duration of work. Although no control group was available for study, it is clear that some problem exists given that an average of 10% of the workers displayed some skin lesion consistent with an eczematous process. The degree of skin abnormalities varied with work location and a further breakdown of the problem will be given in the summary and conclusions.

F. Summary

1. The total number of sorters with a current rash in the two pre-size plants was 5 of 111 (4.5%), while the rate for the sorters in the plants that both sort and pack is 12 of 86 (14.0%). The difference between these two rates is significant (probability 0.02).

The Van Horn plant sorters inflated the latter figure as they had 6 of 27 with a rash. If the Van Horn plant is not included, then the rash rate is 6 of 59 (10.2%). Even with the Van Horn plant removed, the rash rate in the pre-size plants of 4.5% is still less than the other plant's rate of 10.2%, however, the probability for this difference is 0.08.

One major difference in the two types of plants is that in the pre-size plants the wax, Benlate®, and ethoxyquin are applied after the fruit is sorted; while in the other plants, they are applied before the fruit is sorted.

2. The number of packers with a current rash in the two plants packing pre-sized fruit was 5 of 33 (15.1%) (at Diamond Central the fruit was slightly moist when packed), while the rate in the plants that packed immediately after sorting was 14 of 136 (10.3%). The difference in these rates is not significant (probability 0.435).

3. Why the Van Horn plant, which was processing apples, had sorters with a rash rate of 6 of 27 (22.2%), and the packers with 0 rash rate (0 of 35) is not known. In the Parkdale plant, the reverse was found. The packers' rash rate was 8 of 52 (15.1%), while the sorters' was 2 of 31 (6.5%). The rates at the O'Dell plant were about equal with the sorters experiencing a rash of 6 of 27 (7.7%), and the packers a rate of 1 of 20 (5.0%). In the two Stadelman plants, the sorters had a rash rate of 2 of 13 (14.4%), and the packers' rash rate was 5 of 28 (17.9%). The rates are about equal. The waxes used by the Stadelman plants are different from the other firms in this study, but most of the other chemicals are the same.

4. The Van Horn sorters had a rash rate of 6 of 27 (22.2%), while the rash rate at the other plants (pre-size plant excluded) was 5 of 57 (8.9%). This difference is not significant (probability 0.144).

5. The difference between the packers rash by exam at the two plants packing pre-sized fruit (Duckwall-Pooley 1 of 17 or 5.9%, Diamond Central 4 of 16 or 25%) was not significant (probability 0.126). It is difficult to compare these two plants as Duckwall-Pooley was packing using the overwrap process, while at the Diamond Central, they were using the overwrap process on one line, and hand packing on two lines (one for pre-sized fruit and one for specialty fruit).

6. The different brands of waxes used was probably not a contributing factor in the rash rates in the various plants, because either the sorters or packers in one or more plants had a rash rate that was elevated while processing fruit that had different brands of wax applied. All plants applied Benlate® and ethoxyquin along with the wax.

7. Summary of the rash rates:

Years Experience	Number Examined	# with rash by exam	%	# with rash by history	%
less than 1 year	94	8	8.5	5	5.3
more than 1 year	275	28	10.2	62	22.5
total	369	36	9.8	67	18.2

As expected, the workers with more than one year experience in the fruit processing industry have a greater history of having had a rash at least one or more times.

8. The soaps and fungicides used in the process may also be the cause of some of the rashes as the sorters in the pre-size plants did experience some rash, although they handled the fruit before the wax, Benlate®, and ethoxyquin were applied.

9. The process for the plants that both sort and pack were all very similar. There were basically no observed differences in these processes that could account for any differences in the rash rates.

10. It could not be determined whether or not the use of rubber gloves had any effect on preventing rashes. Many individuals had rashes on their forearms. This can occur by touching the exposed skin with contaminated bare hands, or with contaminated gloves, or by contact with the treated fruit. The use of good personal hygiene, along with the use of rubber gloves is recommended. When the rash rate of all sorters is compared to all packers, the rates are almost equal. The sorters rate was 17 of 197 (8.6%), while the packers rate was 19 of 179 (10.6%). It was noted that none of the packers observed wore rubber gloves, while 135 of 199 sorters observed wore rubber gloves.

11. The paper used to wrap the fruit was analyzed for the presence of ethoxyquin. Of the nine different papers analyzed, only one definitely contained ethoxyquin. (Table 12). That paper was white wrapping paper used in the Stadelman plants.

G. Conclusions

1. The reduced rash rate among the sorters in the pre-size plants is probably due to the application of the wax, Benlate®, and ethoxyquin on the fruit after the fruit has been sorted rather than before sorting.

2. Other chemicals, in addition to ethoxyquin, may be causing the rashes. Many of the other chemicals used are known skin irritants.

3. A self-selection process has probably been in effect among the workers which results in those more sensitive persons who have much difficulty with the dermatitis electing not to work in the packing plant.

4. Even though it appears that the wax/chemical preservative coating applied to the fruit plays a significant role in the occurrence of dermatitis, other factors such as temperature, moisture (perspiration), sensitivity of individuals and dryness of the coating also appear to be major influences.

5. The occurrence of the rash on the face, neck, arms and other parts of the body may be a result of transfer of the chemicals with the contaminated hands or gloves. It may also result from prior sensitation of these areas.

H. Recommendations

1. Good personal hygiene and work habits will aid in preventing a rash from occurring. Things that the employees should practice are:

    a. Wash arms and hands at breaks, lunch and before going home.

    b. Avoid touching the bare skin with contaminated hands or gloves.

    c. The fruit should not be moved on the conveyor or packing table with the forearms.

    d. Change out of the work clothes at the plant or immediately upon arriving home.

    e. Wash the clothes daily.

    f. Wear gauntlets on the arms or long sleeved shirts.

    g. The use of barrier creams on the exposed skin may be helpful.

    h. Non abrasive soaps should be provided at all hand wash locations in the plants. Employees should avoid the use of abrasive soaps at all times during the packing season.

2. If rubber gloves are used, both the inside and the outside should be thoroughly washed every day.

3. The use of chemically treated wrapping paper should be discontinued.

4. The fruit should be thoroughly dry before reaching the sorter and packers.

5. During future revisions or installation of new lines, the process should be such that the fruit is sorted before the wax/chemical mixture is applied.

6. All overwrap machines should be vented by local exhaust systems to the outside atmosphere.

7. In the pre-size plants the sorters should be separated from the wax/chemical spray unit by placing the workers in an enclosure or by enclosing and/or hooding the spray unit in conjunction with the use of local exhaust ventilation.

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TABLE 1

PRUDUCT USE AND CHEMICAL COMPOSITION

DIAMOND FRUIT GROWERS, INC.,
DUCKWALL-POOLEY FRUIT CO., AND
STADELMAN FRUIT, INC.
HOOD RIVER, OREGON
HHE 78-59

PRODUCT IDENTIFICATION NO.	USE	CHEMICAL COMPOSITON
1	pear flotation	sodium sulfate
2	pear flotation	sodium silicate
3	mold & fungi control	sodium o-phenylphenate sodium silicate
4	mold & fungi control	chlorine (usually added as sodium hypochlorite)
5	detergent mold & fungi control	triethylamine sulfonate sodium o-phenylphenate potassium hydroxide sodium hydroxide
6	detergent	trisodium phosphate sodium carbonate
7	detergent	sodium alkylarylsulfonate 2-ethylhexanol
8	detergent	sodium phosphate sodium carbonate
9	antifoam emulsion	dimethyl polysiloxane (dimethicone)
10	sticker-spreader	alkylarylpolyethoxy ethanol fatty acids glycol ethers isopropyl alcohol di-alkyl benzenedicarboxylate
11	wax	carnuba wax fatty acids food grade shellac paraffin wax
12	wax	carnuba wax fatty acids food grade shellac
13	wax	food grade shellac fatty acid salts isopropyl alcohol morpholine (tetrahydro-p-oxazine)

TABLE 1 (CONT)

PRODUCT USE AND CHEMICAL COMPOSITION

DIAMOND FRUIT GROWERS, INC.,
DUCKWALL-POOLEY FRUIT CO., AND
STADELMAN FRUIT, INC.
HOOD RIVER, OREGON
HHE 78-59

PRODUCT IDENTIFICATION NO.	USE	CHEMICAL COMPOSITION
14	wax	food grade shellac fatty acid salts isopropyl alcohol morpholine(tetrahydro-p-oxizine) trace of sodium o-phenylphenate
15	fungicide (prevents scald on apples & pears in storage. Usually applied with the wax)	ethoxyquin (6-ethoxy-1,2-dihydro-2,2,4, trimethyl quinoline)
16	fungicide (usually applied with the wax)	methyl 1-(butylcarbamoyl)-2-benzimidazolecarbamate
17	wrapping paper for apples and pears	wrapping paper (tissue)

TABLE 2

SKIN TOXICITY OF PRODUCTS USED

DIAMOND FRUIT GROWERS, INC.,
DUCKWALL-POOLEY FRUIT CO., AND
STADELMAN FRUIT, INC.
HOOD RIVER, OREGON
HHE 78-59

CHEMICAL	PRODUCT # (TABLE 1)	DERMAL TOXICITY (REF.)
sodium sulfate	1	
sodium silicate	2,3	skin irritant 1
sodium o-phenylphenate	3,5	skin irritant 2
chlorine (ashypochlorite)	4	skin irritant 1
triethylamine sulfonate	5	skin irritant 1
potassium hydroxide	5	skin irritant 1
sodium hydroxide	5	skin irritant 1
trisodium phosphate	6	contact allergen 2
sodium carbonate	6,8	contact allergen 2
sodium alkylarylsulfonate	7	skin irritant (defatting) 1
2-ethylhexanol	7	? mild irritant 1
sodium phosphate	8	
dimethylpolysiloxane (dimethicone)	9	contact allergen 2
alkylarylpolyethoxy ethanol	10	rarely sensitizes or irritates 1
fatty acids	10,11,12	
glycol ethers	10	mild irritants 2
isopropyl alcohol	10,13,14	mild irritant (drying)
di-alkylbenzenedicarboxylate	10	(benzoic acid base) rare allergen 2
carnuba wax	11,12	contact allergen 2
food grade shellac	11,12,13,14	contact allergen 2
paraffin	11	contact allergen 2
fatty acid salts	13, 14	
morpholine (tetrahydro-p-oxazine)	13	skin irritant 1
ethoxyquin (6-ethoxy-1,2-dihydro-2,2.4-trimethyl quinoline)	15	contact allergen 2
methyl 1-(butylcarbamoyl)-2-benzimidazolecarbamate	16	no toxicological information found on this chemical

TABLE 2 (CONT.)

SKIN TOXICITY OF PRODUCTS USED

DIAMOND FRUIT GROWERS, INC.,
DUCKWALL-POOLEY FRUIT CO., AND
STADELMAN FRUIT, INC.
HOOD RIVER, OREGON
HHE 78-59

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1. Fisher, A.A., Contact Dermatitis, 2nd Ed. Lea & Febgin, Philadelphia, 1973

2. Gleasin, M.N., et al, Clinical Toxicology of Commercial Products, 3rd Ed. Williams & Wilkins Co., Baltimore, 1969

PLANT NAME, PROCESS & PRODUCTS USED AND NUMBER OF WORKERS SHOWING GLOVE USAGE

DIAMOND FRUIT GROWERS, INC.,
DUCKWALL-POOLEY FRUIT CO., AND
STADELMAN FRUIT, INC.
HOOD RIVER, OREGON
HHE 78-59

PLANT	# SHIFTS	PROCESS & PRODUCTS USED (see table 1)	PERSONS HANDLING FRUIT AFTER FLOTATION AND/OR CHEMICALS				OTHERS
			SORTERS		PACKERS		
			# wearing gloves	total	# wearing gloves	total	
Diamond Fruit Growers Central Plant Hand Pack Line	1	packing Anjou pears that were pre-sized at the Pine Grove Plant flotation (2) sodium silicate (4) chlorine additional sorting sponge rollers (dryers) pack (hand wrap and pack (17) wrapping paper Note: the pears were still moist when reaching the packers	2 - rubber gloves	2	8 - no gloves 3 - one cloth glove 3 - two cloth gloves	14	mechanic
Overwrap Line	1	packing Anjou pears that were pre-sized at the Pine Grove Plant flotation (2) sodium silicate (4) chlorine additional sorting hot air dryer tray feeders fruit straightening in the trays overwrapping (polyethylene film) heat shrink pack trays in boxes Note: pears were moist coming out of the dryer.	2 - rubber gloves	2	fruit straighteners 7- no gloves 3- rubber gloves on both hands	10	mechanic
Diamond Fruit Growers Central Plant Specialty Fruit Line	1	processing Forelles variety pears (very small pear) dry dump - no flotation wash-spray (4) chlorine (16) Benlate® methyl 1-(butylcarbamoyl)-2-benzimidazolecarbamate dry - forced air dryer using room air (no heat) sort pack (hand wrap and pack)	3-rubber gloves both hands 1- no gloves	4	2- no gloves 1- one cloth glove 5- two cloth gloves	8	mechanic

PLANT NAME, PROCESS & PRODUCTS USED AND NUMBER OF WORKERS SHOWING GLOVE USAGE

DIAMOND FRUIT GROWERS, INC.,
DUCKWALL-PUOLEY FRUIT CO., AND
STADELMAN FRUIT, INC.
HOOD RIVER, OREGON
HHE 78-59

PLANT	# SHIFTS	PROCESS & PRODUCTS USED (see table 1)	PERSONS HANDLING FRUIT AFTER FLOTATION AND/OR CHEMICALS				OTHERS
			SORTERS		PACKERS		
			# wearing gloves	total	# wearing gloves	total	
Diamond Fruit Growers	2	processing Anjou Pears	10- rubber gloves on both hands	21/night	sample packer	1/day 1/night	mechanic
Pine Grove		flotation (2) sodium silicate					
Pre-size Plant		(4) chlorine	11 - no gloves			2-total	
		wash-tank (2) sodium silicate					
		(7) sodium alkylaryl sulfonate 2-ethylhexanol	13 - rubber gloves on both hands	24/day			
		(8) sodium phosphate sodium carbonate	11 - no gloves				
		(9) dimethyl polysiloxane (dimethicone)		45-total			
		brush rollers					
		rinse-spray					
		sort					
		wax-spray (11) carnuba wax fatty acids food grade shellac paraffin wax (15) ethoxyquin (16) Benlate® methyl 1-(butylcarbamoyl) -2-benzimidazolecarbamate					
		hot air dryer					
		size (automatic)					
		pack in bins (automatic)					

TABLE 5

PLANT NAME, PROCESS & PRODUCTS USED AND NUMBER OF WORKERS SHOWING GLOVE USAGE

DIAMOND FRUIT GROWERS, INC.,
DUCKWALL-POOLEY FRUIT CO., AND
STADELMAN FRUIT, INC.
HOOD RIVER, OREGON
HHE 78-59

PLANT	# SHIFTS	PROCESS & PRODUCTS USED (see table 1)	PERSONS HANDLING FRUIT AFTER FLOTATION AND/OR CHEMICALS				OTHERS
			SORTERS		PACKERS		
			# wearing gloves	total	# wearing gloves	total	
Diamond Fruit Growers Van Horn Plant	1	processing Red Delicious Apples (3 lines, all similar) flotation (4) clorine flood wash (7) sodium alkylaryl sulfonate 2-ethylhexanol (6) trisodium phosphate sodium carbonate (9) dimethyl polysiloxane (dimethone) brush rollers cold water rinse sponge rollers wax-spray (12) carnuba wax fatty acids food grade shellac (15) ethoxyquin (16) Benlate® methyl 1-(butylcarbamoyl) -2-benzimidazolecarbamate hot air dryer sort size (automatic) pack (hand wrap and pack) hand wrap top layer only (17) wrapping paper	6 - rubber gloves on both hands 4 - cloth gloves on both hands 15 - no gloves	25	10 - cloth gloves on both hands 3 - cloth glove on one hand 24 - no gloves	37	mechanic

TABLE 6

PLANT NAME, PROCESS & PRODUCTS USED AND NUMBER OF WORKERS SHOWING GLOVE USAGE

DIAMOND FRUIT GROWERS, INC.,
DUCKWALL-POOLEY FRUIT CO., AND
STADELMAN FRUIT, INC.
HOOD RIVER, OREGON
HHE 78-59

PLANT	# SHIFTS	PROCESS & PRODUCTS USED (see table 1)	PERSONS HANDLING FRUIT AFTER FLOTATION AND/OR CHEMICALS				OTHERS
			SORTERS		PACKERS		
			# wearing gloves	total	# wearing gloves	total	
Diamond Fruit Growers O'Dell Plant	2	processing Bosc Pears (ran Anjou pears until 2 weeks before this survey) flotation (1) sodium sulfate (4) chlorine wash (7) sodium alkylaryl sulfonate 2-ethylhexanol (6) trisodium phosphate sodium carbonate (9) dimethyl polysiloxane (dimethicone) rinse-spray sponge rollers wax-spray (11) carnuba wax fatty acids food grade shellac paraffin wax (16) Benlate® methyl 1- (butylcarbamoyl) -2-benzimidazolecarbamate Note: ethoxyquin was not used on Bosc pears at this plant sponge rollers hot air dryer sort size (automatic) pack (hand wrap & pack) (17) wrapping papers	3 - rubber gloves on both hands 5 - no gloves 5 - rubber gloves on both hands	8/day 10/night 18/total	1 - one cloth glove 12- cloth gloves on both hands 2 - one cloth glove 12- cloth gloves on both hands	13/day 29/total	mechanic

TAL

PLANT NAME, PROCESS & PRODUCTS USED AND NUMBER OF WORKERS SHOWING GLOVE USAGE

DIAMOND FRUIT GROWERS, INC.,
DUCKWALL-POOLEY FRUIT CO., AND
STADELMAN FRUIT, INC.
HOOD RIVER, OREGON
HHE 78-59

PLANT	# SHIFTS	PROCESS & PRODUCTS USED (see table 1)	PERSONS HANDLING FRUIT AFTER FLOTATION AND/OR CHEMICALS				OTHERS
			SORTERS		PACKERS		
			# wearing gloves	total	# wearing gloves	total	
Diamond Fruit Growers Parkdale Plant	2	processing Anjou Pears (3 lines, all identical) flotation (2) sodium silicate (4) chlorine wash-flowed on (7) sodium alkylaryl sulfonate 2-ethylhexanol (8) sodium phosphate sodium carbonate (9) dimethyl polysiloxane (dimethicone) brush rollers rinse-spray sponge rollers wax-spray (11) carnuba wax fatty acids food grade shellac paraffin wax (15) ethoxyquin (16) Benlate® methyl 1-(butylcarbamoyl) -2-benzimidazolecarbamate hot air dryer sort. size (automatic) pack (hand wrap & pack) (17) wrapping paper Note: pears were dry coming out of the dryer	12 - rubber gloves on both hands 6 - no gloves not observed during night shift	18/day 18	23- cloth gloves on both hands 8- cloth glove on one hand 10- no gloves not observed during night shift	41/day 41	mechanic

TABLE 8

PLANT NAME, PROCESS & PRODUCTS USED AND NUMBER OF WORKERS SHOWING GLOVE USAGE

DIAMOND FRUIT GROWERS, INC.,
DUCKWALL-POOLEY FRUIT CO., AND
STADELMAN FRUIT, INC.
HOOD RIVER, OREGON
HHE 78-59

PLANT	# SHIFTS	PROCESS & PRODUCTS USED (see table 1)	PERSONS HANDLING FRUIT AFTER FLOTATION AND/OR CHEMICALS: SORTERS # wearing gloves	SORTERS total	PACKERS # wearing gloves	PACKERS total	OTHERS
Duckwall-Pooley Pre-Size Plant 1st year in operation	2	processing Anjou pears flotation (1) sodium sulfate wash-spray (5) triethylamine sulfonate sodium o-phenylphenate potassium hydroxide sodium hydroxide brush rollers flotation (1) sodium sulfate (4) chlorine rinse-spray sponge rollers sort wax-spray (11) carnuba wax fatty acids food grade shellac paraffin (15) ethoxyquin (16) Benlate® methyl 1-(butylcarbamoyl)-2-benzimidazolecarbamate brush rollers hot air dryer size (automatic) pack in bins (automatic)	65 wore rubber gloves on both hands rubber gloves are mandatory	65 32/day 32/night 1 extra			mechanic quality control checker

TABLE 9

PLANT NAME, PROCESS & PRODUCTS USED AND NUMBER OF WORKERS SHOWING GLOVE USAGE

DIAMOND FRUIT GROWERS, INC.,
DUCKWALL-POOLEY FRUIT CO., AND
STADELMAN FRUIT, INC.
HOOD RIVER, OREGON
HHE 78-59

PLANT	# SHIFTS	PROCESS & PRODUCTS USED (see table 1)	PERSONS HANDLING FRUIT AFTER FLOTATION AND/OR CHEMICALS				OTHERS
			SORTERS		PACKERS		
			# wearing gloves	total	# wearing gloves	total	
Duckwall-Pooley Packing Plant 1st year using overwrap packing	2 (not working during survey)	flotation (1) sodium sulfate wax-spray (apples only. Wax is applied on pears at the pre-size plant) hot air dryer Sort pack on trays (automatic) fruit straightening overwrap (polyethylene film) heat shrink overwrap film pack trays in boxes	not observed. Plant not in operation	8 4/shift	fruit straightening not observed, plant not in operation	12 6/shift	

PLANT NAME, PROCESS & PRODUCTS USED AND NUMBER OF WORKERS SHOWING GLOVE USAGE

DIAMOND FRUIT GROWERS, INC.,
DUCKWALL-POOLEY FRUIT CO., AND
STADELMAN FRUIT, INC.
HOOD RIVER, OREGON
HHE 78-59

PLANT	# SHIFTS	PROCESS & PRODUCTS USED (see table 1)	PERSONS HANDLING FRUIT AFTER FLOTATION AND/OR CHEMICALS				OTHERS
			SORTERS		PACKERS		
			# wearing gloves	total	# wearing gloves	total	
Stadelman Fruit Inc. Whitney Plant	1	processing Bosc Pears. (ran Anjou pears until week of the survey flotation (1) sodium sulfate (3) sodium o-phenylphenate sodium silicate conveyor wash-spray (5) triethylamine sulfonate sodium o-phenylphenate potassium hydroxide hot water rinse-spray spray (15) ethoxyquin (16) Benlate® methyl 1-(butylcarbamoyl) -2-benzimidazolecarbamate (10) alkylarylpolyethoxy ethanol fatty acids glycol ethers isopropyl alcohol di-alkyl benxedicarboxylate sponge rollers brush rollers wax-spray (13) food grade shellac fatty acid salts isopropyl alcohol morpholine (tetrahydro-p-oxazine) brush rollers hot air dryer sort size (automatic pack (hand wrap & pack)	12- rubber gloves 1- rubber glove on one hand	13	13 - no gloves 2 - cloth gloves on one hand 7 - cloth gloves on both hands	22	mechanic

PLANT NAME, PROCESS & PRODUCTS USED AND NUMBER OF WORKERS SHOWING GLOVE USAGE

DIAMOND FRUIT GROWERS, INC.,
DUCKWALL-POOLEY FRUIT CO., AND
STADELMAN FRUIT, INC.
HOOD RIVER, OREGON
HHE 78-59

PLANT	# SHIFTS	PROCESS & PRODUCTS USED (see table 1)	PERSONS HANDLING FRUIT AFTER FLOTATION AND/OR CHEMICALS				OTHERS
			SORTERS		PACKERS		
			# wearing gloves	total	# wearing gloves	total	
Stadelman Fruit Inc. Mt. Hood Plant	1	processing Anjou pears flotation (1) sodium sulfate (3) sodium o-phenylphenate sodium silicate conveyor wash-spray (5) triethylamine sulfonate sodium o-phenylphenate potassium hydorxide sodium hydroxide hot water rinse-spray brush rollers followed by sponge rollers wax-spray (13) food grade shellac fatty acid salts isopropyl alcohol morpholine (tetrahydro-p-oxazine) (15) ethoxyquin (16) Benlate® methyl 1-(butylcarbamoyl) -2-benzimidazolecarbamate (10) alkylarylpolyethoxy ethanol fatty acids glycol ethers isopropyl alcohol di-alkyl benzedicarboxylate brush rollers hot air dryer SORT size (automatic) pack (hand wrap 7 pack)	4 - no gloves 5 - rubber gloves on both hands	9	14 - no gloves	14	mechanic

TABLE 12

PRESENCE OF ETHOXYQUIN ON FRUIT WRAPPING PAPER

DIAMOND FRUIT GROWERS, INC.,
DUCKWALL-POOLEY FRUIT CO., AND
STADELMAN FRUIT, INC.
HOOD RIVER, OREGON
HHE 78-59

SAMPLE NUMBER	COLOR	PLANT	ETHOXYQUIN PPM
1	yellow	Diamond	42
2	yellow	Diamond	39
3	yellow	Diamond - used on Bosc pears	ND
4	green	Diamond	ND
5	green	Diamond - used on specialty fruit	51
6	white	Diamond - used on Bosc Pears	45
7	green	Stadelman	58
8	green (plain)	Stadelman - used as dividers	48
9	white	Stadelman	178

There were interfering peaks in the UV and minor interferences in the fluorescence. Only sample #9 unequivocably contained ethoxyquin

TABLE 13

Participation rates among sorters and packers by plant

DIAMOND FRUIT GROWERS, INC.,
DUCKWALL-POOLEY FRUIT CO., AND
STADELMAN FRUIT, INC.
HOOD RIVER, OREGON
HHE 78-59

	SORTERS		PACKERS				
	Participants	Total Workers	Participants	Total Workers	Total Participants	Total Workers	% Total Participants
Diamond							
Central	2	8	16	32	18	40	45%
O'Dell	13	18	20	29	33	47	70%
Parkdale	31	36	53	82	84	118	71%
Van Horne	25	25	36	37	61	62	98%
Pine Grove (Pre-size)	46	46	2	2	48	48	100%
Total Diamond					244	315	78%
Duckwall-Pooley							
Pre size	65	65	1	2	66	67	99%
Packing	0	8	17	12	17	20	85%
Total Duckwall-Pooley					83	87	98%
Stadelman							
Mt. Hood	9	9	12	14	21	23	91%
Whitney	4	13	16	22	20	35	57%
Total Stadelman					41	58	71%
TOTAL	195	228	173	232	368	460	80%

TABLE 14

Extent of rash in workers exposed to fruit processing
by employment location

DIAMOND FRUIT GROWERS, INC.,
DUCKWALL-POOLEY FRUIT CO., AND
STADELMAN FRUIT, INC.
HOOD RIVER, OREGON
HHE 78-59

	less than 1 season exposure										more than 1 season exposure									
	SORTERS					PACKERS					SORTERS					PACKERS				
	Total	rash on P.Exam.	rash by history	% with rash on P.Exam.	% with rash by history	Total	rash on P.Exam.	rash by history	% with rash on P.Exam.	% with rash by history	Total	rash on P.Exam.	rash by history	% with rash on P.Exam.	% with rash by history	Total	rash on P.Exam.	rash by history	% with rash on P.Exam.	% with rash by history
Diam. Cent.	0	0	0	0	0	8	0	0	0	0	2	1	1	50	50	8	4	2	50	25
Diam. Pre-S.	13	0	1	0	8	0	0	0	0	0	33	2	2	6	6	2	0	0	0	0
Van Horne	11	3	1	27	9	3	0	0	0	0	16	3	4	19	25	32	0	9	0	28
O'Dell	2	0	0	0	0	2	0	0	0	0	11	1	1	9	9	18	1	5	6	28
Parkdale	7	0	0	0	0	9	1	1	11	11	24	2	2	8	8	44	7	16	15	36
Total Diamond	33	3	2	9	6	22	1	1	5	5	86	9	10	10	12	104	12	32	12	31
Duckwall Pre-S.	19	1	1	5	5	0	0	0	0	0	46	2	7	7	17	1	0	0	0	0
Duckwall Pack.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	1	8	6	47
Total Duckwall	19	1	1	5	5	0	0	0	0	0	46	2	7	7	17	18	1	8	6	44
Mt. Hood	6	0	0	0	0	11	3	1	27	9	3	1	1	33	33	1	0	0	0	0
Whitney	0	0	0	0	0	3	0	0	0	0	4	1	1	25	25	13	2	3	14	23
Total Stadelman	6	0	0	0	0	14	3	1	21	7	7	2	2	29	29	14	2	3	14	21
Ind. Wide	58	4	3	7	5	36	4	2	11	6	139	13	19	9	14	136	15	43	11	32

Total		
Tot	PE	Hx
369	36	67
	%	%
	10	18

TABLE 15

Extent of rash in workers exposed to fruit processing
by plant process

DIAMOND FRUIT GROWERS, INC.,
DUCKWALL-POOLEY FRUIT CO., AND
STADELMAN FRUIT, INC.
HOOD RIVER, OREGON
HHE 78-59

	less than 1 season exposure										more than 1 season exposure									
	SORTERS					PACKERS					SORTERS					PACKERS				
	Total	rash on P.Exam.	rash by history	% with rash on P.Exam.	% with rash by history	Total	rash on P.Exam.	rash by history	% with rash on P.Exam.	% with rash by history	Total	rash on P.Exam.	rash by history	% with rash on P.Exam.	% with rash by history	Total	rash on P.Exam.	rash by history	% with rash on P.Exam.	% with rash by history
Diamond Pre-Size	13	0	1	0	0	0	0	0	0	0	33	2	2	6	6	2	0	0	0	0
Duckwall Pre-Size	19	1	1	5	5	0	0	0	0	0	46	2	7	2	15	1	0	0	0	0
Total Pre-Size Plants	32	1	2	3	6	0	0	0	0	0	79	4	9	5	11	3	0	0	0	0
Duckwall Packing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	1	8	7	47
Diamond Packing	0	0	0	0	0	8	0	0	0	0	2	1	1	50	50	8	4	2	50	25
Total Packing Plants	0	0	0	0	0	8	0	0	0	0	2	1	1	50	50	25	5	10	5	40
Parkdale	7	0	0	0	0	9	1	1	11	11	24	2	2	8	8	44	7	16	16	36
O'Dell	2	0	0	0	0	2	0	0	0	0	11	1	1	9	9	18	1	5	6	28
Van Horne	11	3	27	1	9	3	0	0	0	0	16	3	4	19	25	32	0	9	0	28
Mt. Hood	6	0	0	0	0	11	3	1	27	9	3	1	1	33	33	1	0	0	0	0
Whitney	0	0	0	0	0	3	0	0	0	0	4	1	1	25	25	13	2	3	15	23
Total Combined Process Plants	26	3	12	1	4	28	4	14	2	7	58	8	14	9	16	108	10	9	33	31

TABL .6

Extent of rash in workers exposed to fruit processing by plant process and employer disregarding exposure duration

DIAMOND FRUIT GROWERS, INC.,
DUCKWALL-POOLEY FRUIT CO., AND
STADELMAN FRUIT, INC.
HOOD RIVER, OREGON
HHE 78-59

PLANTS	SORTERS					PACKERS				
	Total	rash on P.Exam.	rash by history	% with rash on P.Exam.	% with rash by history	Total	rash on P.Exam.	rash by history	% with rash on P.Exam.	% with rash by history
Diamond and Duckwall Pre-size	111	5	11	5	10	3	0	0	0	0
Diamond and Duckwall Packaging	2	1	1	50	50	33	5	10	15	30
Diamond and Stadelman Combination Plants	84	11	10	13	12	28	5	4	18	14
All Diamond Plants	119	12	12	10	10	126	13	33	10	26
All Duckwall Plants	65	2	8	3	12	18	1	8	6	44
All Stadelman Plants	13	2	2	15	15	28	5	4	18	14

ATTACHMENT 1

PHYSICAL EXAMINATION HHE 78-59

1. RIGHT HAND: (IF, "WITHIN NORMAL LIMITS" CHECK BOX) /___/

DESCRIPTION	FINGERS	PALMS	BACKS	WRISTS	EXTENT
FLAKING SKIN	___	___	___	___	_____
SLOUGHING SKIN	___	___	___	___	_____
RAISED	___	___	___	___	_____
ROUGH	___	___	___	___	_____
PAPULES	___	___	___	___	_____
VESICLES	___	___	___	___	_____
PUSTULES	___	___	___	___	_____
ERYTHEMA	___	___	___	___	_____
MACULE	___	___	___	___	_____

OTHER, DESCRIBE: _____

_____

2. LEFT HAND: (IF, "WITHIN NORMAL LIMITS" CHECK BOX) /___/

DESCRIPTION	FINGERS	PALMS	BACKS	WRISTS	EXTENT
FLAKING SKIN	___	___	___	___	_____
SLOUGHING SKIN	___	___	___	___	_____
RAISED	___	___	___	___	_____
ROUGH	___	___	___	___	_____
PAPULES	___	___	___	___	_____
VESICLES	___	___	___	___	_____
PUSTULES	___	___	___	___	_____
ERYTHEMA	___	___	___	___	_____
MACULE	___	___	___	___	_____

OTHER, DESCRIBE: _____

_____

3. RIGHT FOREARM: (IF, "WITHING NORMAL LIMITS" CHECK BOX) /___/

DESCRIPTION	FLEXOR SURFACE	EXTENSOR SURFACE	DISTAL 1/3	MID 1/3	PROXIMAL 1/3	EXTENT
FLAKING SKIN	___	___	___	___	___	_____
SLOUGHING SKIN	___	___	___	___	___	_____
RAISED	___	___	___	___	___	_____
ROUGH	___	___	___	___	___	_____
PAPULES	___	___	___	___	___	_____
VESICLES	___	___	___	___	___	_____
PUSTULES	___	___	___	___	___	_____
ERYTHEMA	___	___	___	___	___	_____
MACULE	___	___	___	___	___	_____

OTHER, DESCRIBE: _____

_____

CDC/NIOSH (C) TF 2.70C
10/5/78 EXP. 1/79

4. LEFT FOREARM: (IF, "WITHIN NORMAL LIMITS" CHECK BOX) /___/

DESCRIPTION	FLEXOR SURFACE	EXTENSOR SURFACE	DISTAL 1/3	MID 1/3	PROXIMAL 1/3	EXTENT
FLAKING SKIN	___	___	___	___	___	_____
SLOUGHING SKIN	___	___	___	___	___	_____
RAISED	___	___	___	___	___	_____
ROUGH	___	___	___	___	___	_____
PAPULES	___	___	___	___	___	_____
VESICLES	___	___	___	___	___	_____
PUSTULES	___	___	___	___	___	_____
ERYTHEMA	___	___	___	___	___	_____
MACULE	___	___	___	___	___	_____

OTHER, DESCRIBE: _____

_____

5. FACE: (IF, "WITHIN NORMAL LIMITS" CHECK BOX) /___/

DESCRIPTION	FOREHEAD	RIGHT CHEEK	LEFT CHEEK	CHIN	EXTENT
FLAKING SKIN	___	___	___	___	_____
SLOUGHING SKIN	___	___	___	___	_____
RAISED	___	___	___	___	_____
ROUGH	___	___	___	___	_____
PAPULES	___	___	___	___	_____
VESICLES	___	___	___	___	_____
PUSTULES	___	___	___	___	_____
ERYTHEMA	___	___	___	___	_____
MACULE	___	___	___	___	_____

OTHER, DESCRIBE: _____

_____

6. NECK: (IF, "WITHIN NORMAL LIMITS" CHECK BOX /___/

DESCRIPTION	ANTERIOR	LEFT LATERAL	RIGHT LATERAL	POSTERIOR	EXTENT
FLAKING SKIN	___	___	___	___	_____
SLOUGHING SKIN	___	___	___	___	_____
RAISED	___	___	___	___	_____
ROUGH	___	___	___	___	_____
PAPULES	___	___	___	___	_____
VESICLES	___	___	___	___	_____
PUSTULES	___	___	___	___	_____
ERYTHEMA	___	___	___	___	_____
MACULE	___	___	___	___	_____

OTHER, DESCRIBE: _____

_____