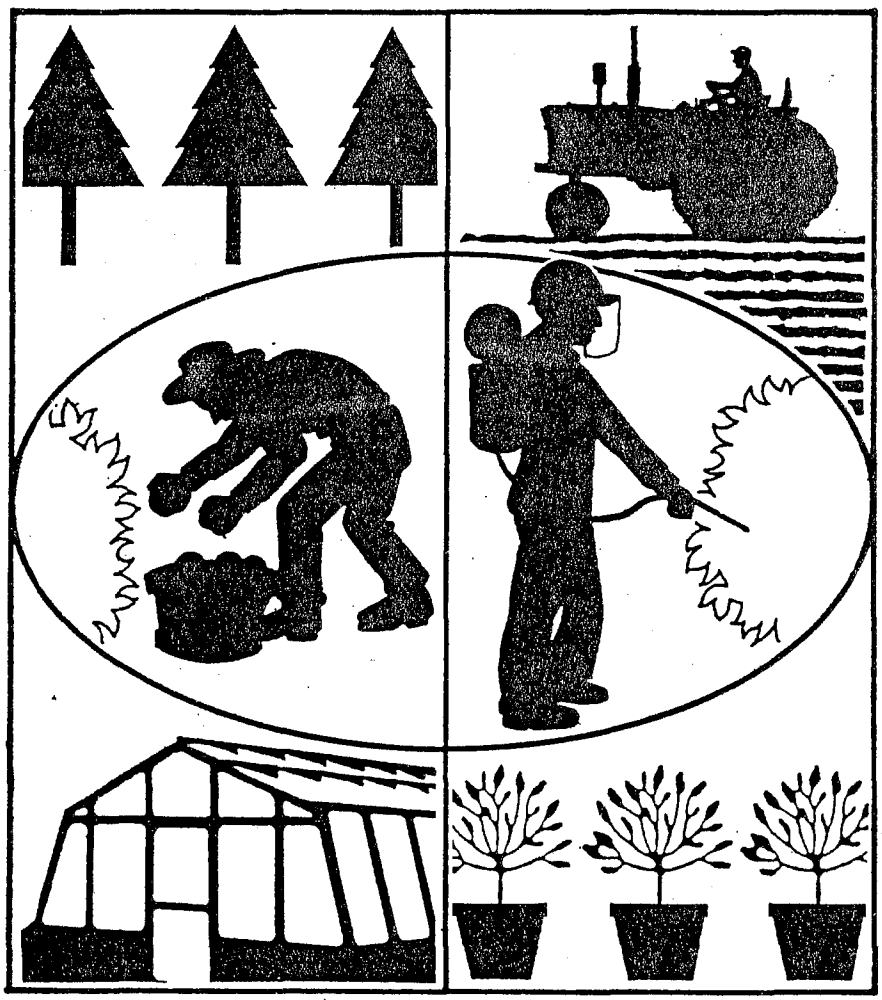
REGULATORY IMPACT ANALYSIS OF WORKER PROTECTION STANDARD FOR AGRICULTURAL PESTICIDES



OFFICE OF PESTICIDE PROGRAMS
U.S. ENVIRONMENTAL PROTECTION AGENCY

WASHINGTON, D.C. 20460

REGULATORY IMPACT ANALYSIS OF WORKER PROTECTION STANDARD FOR AGRICULTURAL PESTICIDES

Prepared by:

Biological and Economic Analysis Division
Office of Pesticide Programs
U.S. Environmental Protection Agency
Washington, D.C. 20460

with support from:

DPRA Incorporated

EPA Contract No.: 68-D1-0134
Work Assignment No.: 1-3

August 11, 1992

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PREFACE

This revised regulatory impact analysis represents a major update to a draft RIA completed in March of 1991. This revised RIA incorporates new cost analysis and an expanded benefits analysis reflecting revisions to the rule, review comments on the draft RIA and rule, new findings and data on farm workers and pesticide use and revised methodology. Louis True, Special Assistant to the Office Director, Office of Pesticide Programs (OPP), EPA, directed the preparation of the overall rulemaking package of which this report is a part. This RIA was prepared under the direction of Joseph Hogue, Biological and Economic Analysis Division (BEAD), OPP, EPA. Key EPA contributors to the report were:

Sally McDonald, OPP, EPA;
Joseph Reinert, Office of Policy, Planning and Evaluation (OPPE), EPA;
Jerome Blondell, Health Effects Division (HED), OPP, EPA; and
James Boland, Field Operations Divisions (FOD), OPP, EPA.

Economic and cost analysis support was also provided by DPRA Incorporated with key staff being Joanne Blair and Daniel W. Francke.

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I. INTRODUCTION

A. Purpose of Analysis

The Environmental Protection Agency (EPA or Agency) is responsible for regulating the use of pesticides in the United States. The legal authority for this regulation is found in the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), as amended. FIFRA requires, among other things, that pesticides may only be used to the extent that their usage does not cause unreasonable adverse effects on the environment. Unreasonable adverse effects on the environment are defined to include "any reasonable risk to man or the environment, taking into account the economic, social, and environmental cost and benefits of the use of any pesticide."

The Agency has recognized that risks to humans from pesticides may result from occupational exposure to pesticides and their residues during fieldworker activities that involve contact with treated surfaces and pesticide handling (mixing, loading, applying, etc.) activities. The Agency is revising Parts 170 and 156 (40 CFR) to afford agricultural workers and pesticide handlers better protection from risks resulting from occupational exposure to pesticides. **Agricultural workers** are persons who are occupationally exposed to agricultural-plant pesticides either indirectly through contact with residues on treated plants, soil, or water, or directly through accidental contact mainly with drift or misdirected application. **Pesticide handlers** are persons who mix, load, apply, or otherwise come into direct contact with pesticides through related pesticide-use activities. This report presents the results of a regulatory impact analysis to support the final regulation.

B. Description of the Regulation

The current 40 CFR 170 entitled, Worker Protection Standard (WPS) for Agricultural Pesticides, was promulgated in 1974. The regulation deals with the occupational health and safety of farmworkers performing hand-labor operations in fields during and after application of pesticides. The regulation currently in effect consists of four requirements: 1) a prohibition against exposing field workers to pesticides either directly or through drift during application; 2) the establishment of certain reentry intervals; 3) specification of the protective clothing that must be worn by a worker entering a field before the end of a reentry interval; and 4) warnings to workers about prior or future pesticide applications to fields. The Agency believes that the current 40 CFR 170 is now inadequate with respect to its scope of coverage and specific requirements.

The revisions to Part 170 include substantial changes in the following areas:

1) change in the scope of current regulations to include non-hand-labor crops on farms and to include nurseries, greenhouses, and forests;

2) change in scope to include persons who handle pesticides;

3) expansion of the requirements regarding restricted-entry intervals, including the establishment of interim restricted-entry intervals based on the acute toxicity of the component active ingredients of the pesticides;

4) standard requirements for personal protective equipment to be worn during the handling of pesticides and during entry (when such entry is permitted) into treated areas before restricted-entry intervals have expired;

5) more extensive requirements to provide information about pesticides hazards to workers and handlers, including mandatory pesticide safety training;

6) new requirements for the posting of treated areas and oral notification about pesticide treatments on agricultural establishments and for posting pesticide specific treatment information in a central location;

7) new decontamination requirements; and

8) new requirements to provide transportation for emergency medical treatment and to provide labeling information in cases of suspected poisoning or injury from pesticides.

The final rule also addresses selected labeling issues, expanding upon the current 40 CFR, Part 156 entitled, Labeling Requirements For Pesticides and Devices. This regulation first appeared in 40 FR 28268, July 3, 1975. General aspects related to labeling contents, legibility, language, labeling placement, misleading statements, and final printing requirements are covered in the current rule. Current labeling requirements also cover aspects related to product quality and content, hazard warning statements, first aid, directions for use, and use classification.

The revision to Part 156 will add a new Subpart K entitled, Worker Protection Statements. This new Subpart will address labeling improvements related to restricted-entry statements, notification statements, personal protective equipment statements, application restriction statements, certain product identification statements, Spanish-language statements, and WPS reference statements.

C. Requirements for Analysis

This report is intended to meet the requirements for regulatory analysis as established by Executive Order No. 12291, the Regulatory Flexibility Act and Section 25 of FIFRA. This document also provides input for preparation of any analysis which might be required under the Paperwork Reduction Act of 1980.

Executive Order 12291 requires that adequate information concerning the need for, and consequences of a proposed regulatory action be presented. The order requires a finding that potential benefits to society from a regulation would outweigh its potential costs; and that, of all alternative approaches for achieving a regulatory objective, the proposed action will maximize net benefits to society. In effect, a rigorous cost/benefit analysis should be prepared to the extent that data permit. This analysis is to show that reasonable alternative approaches were adequately considered. Finally, Executive Order 12291 recognizes that legal

constraints may play a role in selecting among alternative approaches to achieving regulatory objectives.

The Regulatory Flexibility Act requires agencies issuing regulations to pay special attention to the impact of proposed regulations on small entities, and attempt to minimize these impacts. The analytical requirements of the Regulatory Flexibility Act are to be combined with the analysis required under Executive Order 12291.

FIFRA, in Section 25, requires that the Administrator of EPA consider such factors as the effects of regulation on production and prices of agricultural commodities, retail food prices and otherwise on the agricultural economy, when issuing regulations affecting the sale and use of agricultural pesticides.

D. Methodology

Cost estimates for the final WPS rule were derived on a unit-by-unit basis for eight major site categories: feed and grain crops, cotton, tobacco, other field crops, vegetable/fruit/nut crops, nursery/greenhouse crops, forestry crops, and commercial pesticide handling establishments. Cost estimates for commercial pesticide handling establishments include costs applicable to commercial ground applicators, commercial aerial applicators, and commercial support personnel. Seven RIA cost factors are detailed under each category if applicable: restricted-entry, personal protective equipment, notification, training, decontamination, emergency assistance, and rule familiarization. One additional RIA cost-factor was estimated for the high cost option only: cholinesterase monitoring.

Cost factors for the seven major categories were derived by multiplying the cost of the factor by a unit measurement. Costs for restricted-entry were estimated by multiplying the base acreage of affected crops by the per-acre income (or yield/quality) loss that would occur if the new restrictions on routine entry to pesticide-treated areas to perform hand labor tasks during the restricted-entry interval were enacted. In addition, restricted-entry costs were added for providing personal protective equipment, labeling-specific information, and decontamination

to early entry workers to perform tasks on cut flowers and cut ferns provided this exception is granted. Personal protective equipment costs were derived on a per handler basis and then multiplied by the total number of commercial, hired, and family member handlers respectively. Costs due to notification were calculated by multiplying average per establishment costs by the total number of affected establishments. Training costs were derived on a per handler/per worker basis (like personal protective equipment) and then multiplied by the total number of hired (including commercial) handlers, and hired workers. Costs for commercial handlers' decontamination were estimated on a per handling site basis and then multiplied by the total number of sites (1.5 handlers per site). Decontamination costs for noncommercial hired handlers and for hired workers were calculated on a per person basis and then multiplied by the total number of hired handlers and hired workers. Emergency assistance costs were derived through multiplying the estimated number of physician-attended hired worker and hired handler poisoning incidents by the per-person per-incident cost of transportation to a medical facility and the per-person per-incident cost of conveying information to medical personnel. Finally, the cost to agricultural establishment owner/operators of becoming familiar with the WPS was calculated through multiplying the estimated time it would take for an owner/operator on each establishment to become familiar with the WPS by the owner/operator wage rate. This per-establishment cost of familiarization was then multiplied by the total number of establishments.

The sum of all cost factors for all site categories is the total estimated cost of the final rule to the pesticide user community. Incremental costs were derived by subtracting costs which are currently being incurred by the pesticide user community from total compliance costs. The one-time cost of labeling changes estimated for registrants is not subdivided or included in other cost factors. This cost to registrants is presented separately and added to user costs to get estimated total costs of the final rule.

II. SUMMARY OF FINDINGS

1. The Environmental Protection Agency (EPA) under the authority of the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) has responsibility for regulating the sale and use of pesticides. Included in its mandate, EPA has the responsibility for protecting agricultural workers from risks resulting from exposure to pesticides.

2. EPA is revising Parts 170 and 156 of CFR 40 to specify requirements that would mitigate the risks to pesticide handlers and agricultural workers from occupational exposure to agricultural pesticides and their residues.

3. EPA is issuing a regulation with additions or changes in the following areas: restricted-entry intervals, personal protective equipment, training, notification, decontamination, emergency assistance, and labeling changes. The regulatory development process, including a formal negotiation mechanism under the Federal Advisory Committee Act, has developed, considered, analyzed and chosen from among many approaches for achieving the desired regulatory goals. This RIA summarizes the costs and benefits of the regulation and the significant options that were considered.

4. U.S. agricultural pesticide usage in 1989 is estimated at 806 million pounds a.i. While the following table includes usage on livestock establishment sites that are not covered by the regulation, the majority of the pesticide use is on food, feed, and fiber crops, and commercial tree species, ornamentals, and turf, all of which are covered by the regulation.

U.S. Pesticide Usage--Agriculture

	Million lbs. a.i.	Percent of Total
Herbicides	520	65
Insecticides	151	19
Fungicides	65	8
Other	70	9
TOTAL	806	100

Source: EPA/BEAD. 1991 (July). Pesticide Industry Sales and Usage: 1989 Market Estimates. Washington, DC.

5. The estimated hired labor force of 1.5 million persons occupationally exposed to pesticides on agricultural-plant establishments, either directly or indirectly, includes 1.4 million hired workers/handlers on farms, 92,000 hired workers/handlers in nursery/greenhouses, 10,000 hired workers/handlers in forestry, and 38,000 commercial pesticide handlers.

6. Of the 1.4 million hired workers/handlers on farms, it is estimated that nearly 581,000 are pesticide handlers; of the 92,000 hired nursery/greenhouse workers/handlers, 37,000 are estimated to handle pesticides; and of the 10,000 hired forestry workers/handlers, nearly 7,300 are estimated to handle pesticides. By definition, all of the 38,000 commercial pesticide handlers handle pesticides. In total, it is estimated that 663,000 hired employees handle pesticides for use on agricultural plants.

7. There are an estimated 2.4 million unpaid or family-member agricultural workers/handlers occupationally exposed to pesticides. Of these, nearly 1.0 million are farm operators, all of which are assumed to handle pesticides. The remaining 1.4 million unpaid/family-member employees are assumed to be agricultural workers who never handle pesticides.

8. First year incremental costs may be estimated from total costs, given existing regulations at the state and federal level, and voluntary compliance. Since all costs are not incurred every year, an "out" year incremental cost, or annual cost after the first year, can be projected. Estimated costs, by cost factor, are presented below:

	Worker Protection Standard compliance costs			
	First year total cost	Out year total cost	First year incremental cost	Out year incremental cost
	(Million $)			
COST FACTOR - TO AGRICULTURAL ESTABLISHMENTS				
Restricted-Entry Interval	39.4	39.3	21.1	21.1
Personal Protective Equipment	78.7	37.4	17.9	9.5
Notification	16.8	6.1	15.7	5.0
Training	11.1	3.8	6.9	2.3
Decontamination	30.2	23.2	12.4	8.9
Emergency Assistance	.04	.04	.01	.01
Rule Familiarization	6.1	1.0	6.0	1.0
Total	$182.3	$110.8	$80.0	$47.8
COST TO COMMERCIAL HANDLER FIRMS				
Personal Protective Equipment, Training, Decontamination, Emergency Assistance, and Rule Familiarization	7.8	4.8	2.3	1.6
COST TO REGISTRANTS				
Labeling Changes	12.0	0.0	12.0	0.0
TOTAL	**$202.1**	**$115.6**	**$94.3**	**$49.4**

While significant numbers in themselves, the above totals are relatively small when compared to user expenditures for all agricultural pesticides in the U.S. The total user expenditure for all conventional agricultural pesticides in 1988 is estimated at $5.11 billion (U.S. EPA, 1990). The Worker Protection Standard incremental out year costs represent less than one percent of 1988 total agricultural pesticide expenditures.

Another way to view the relative impacts of the WPS is to compare compliance costs with the value of the crops affected. With total incremental out year compliance costs estimated to be approximately $49 million and the total value of the affected crops estimated at nearly $51 billion, WPS incremental out year compliance costs account for less than one-tenth of one percent of the total value of the affected crops.

9. Costs associated with the regulation would affect sectors of the agricultural economy according to the intensity and type of pesticides used in each sector. The estimated incremental compliance costs to the user community of the regulation by sector, per establishment, is as follows:

User sector	Per establishment Worker Protection Standard compliance costs	
	Incremental first year cost	Incremental out year cost
	----------($/Establishment)----------	
Feed and Grain Crops	70	30
Cotton	135	63
Tobacco	116	49
Other Field Crops	118	43
Vegetable/Fruit Crops	440	357
Nursery/Greenhouses	190	105
Commercial Handler Firms	247	176

Source: Table IV-5.
Note: The cost to forestry is relatively insignificant and is not applicable on a per establishment basis. (See Appendix B for total sector cost calculation.)

10. The revised WPS will produce a wide range of benefits for various sectors associated with the sale, oversight, or use of agricultural-plant pesticides. Agricultural workers and pesticide handlers will derive the most substantial benefits. By lowering their occupational exposures to such pesticides, the WPS will enable them to have improved health and a better quality of life. Pesticide users, registrants, states, tribes, and territories should also receive direct and indirect benefits from the WPS.

III. NEED FOR REGULATION AND ALTERNATIVE APPROACHES

A. Overview of Pesticide Usage and Agricultural Worker Exposure

Annual usage of pesticides in the United States in 1989 was estimated to be about 1.07 billion pounds active ingredient (a.i.) (U.S. EPA, 1991). This total does not include about 1.6 billion pounds annual use of disinfectants and wood preservative chemicals, which FIFRA also defines as pesticides. Nor does it include about 200 million pounds of sulfur which has pesticidal properties in many uses. The revised Worker Protection Standard contains requirements to protect workers and handlers who may be occupationally exposed to agricultural pesticides or their residues. Pesticide use on food, feed, fiber, commercial tree species, ornamental and turf plants (on farms or in nurseries), commercial forests, or greenhouses, and related structures is the targeted exposure. Other uses of pesticides are not covered by the final rule. The following is a breakdown of the 1989 total annual usage of agricultural pesticides:

Type of pesticide	Pesticide Usage				
	Total		Agriculture		
	Million lbs. a.i.	Percent	Million lbs. a.i.	Percent	Percent of total usage in agriculture
Herbicides	655	61	520	65	79
Insecticides	226	21	151	19	67
Fungicides	111	10	65	8	59
Other	78	7	70	9	90
TOTAL	1,070	100	806	100	75

Source: EPA/BEAD, 1991 (July). Pesticide Industry Sales and Usage: 1989 Market Estimates. Washington, DC.

Another way to view pesticide usage and potential exposure involves the concept of "acre-treatments," which is one acre of crop receiving one application of a pesticide. This term allows for the identification of multiple applications on the same crop-acre throughout the growing season. The Worker Protection Standard is triggered, in some instances, by the

toxicity category of the active ingredients contained in pesticides as well as the frequency with which pesticides are applied. In 1989, out of a total annual 562 million acre-treatments of agricultural-plant pesticides, about 31 percent were toxicity category I applications (highest toxicity), 18 percent were toxicity category II applications, and 51 percent were toxicity category III-IV applications. Approximately 67 percent of total 1989 U.S. agricultural-plant pesticide acre-treatments were on feed and grain crops, primarily because of the large acreage involved.

One focus of the Worker Protection Standard is the health and safety of the hired labor force employed to work in the production of agricultural plants. Table III-1 provides estimates of the number and size of agricultural establishments with and without hired labor. According to USDA, nearly half of the 688,000 U.S. crop-producing farms, nurseries, and greenhouses hire employees. However, the agricultural establishments that do hire employees account for over 123 million acres of crops or 72 percent of the total crop acreage. Moreover, an average farm with hired labor averages 362 acres compared to a crop farm with family labor only, which averages 136 acres. As shown in Table III-2, there are approximately 1.6 million hired employees on agricultural-plant establishments (Oliveira and Cox, 1989). Some hired employees work on agricultural establishments that do not use pesticides and, after such an adjustment, nearly 1.5 million hired agricultural employees are potentially occupationally exposed to pesticides as pesticide handlers, agricultural workers, or both.

Also on WPS-covered agricultural establishments are many family and unpaid laborers who also may be exposed to pesticides and for whom many of the provisions of the final rule are intended. Unpaid workers are found on approximately 309,000 agricultural establishments using pesticides that also have hired labor, and on about 250,000 agricultural establishments using pesticides with only family or unpaid labor (Table III-3). In 1987, agricultural establishments using pesticides were estimated to include nearly 2.4 million owner/operators, family members, and other unpaid workers either handling pesticides or potentially exposed to pesticides in treated areas (Table III-4). Of the approximately 2.4 million unpaid (family) owner/operators and workers, nearly 1.0 million are estimated to handle pesticides (handlers), while almost 1.4 million are estimated to never handle pesticides (workers). Of the total

able III-1. Number of agricultural establishments with and without hired labor, acres grown, and size of establishment, 1990.

ROP/CROP ROUPING	(1) NUMBER OF ESTABLISHMENTS			(2) ACRES PLANTED/GROWN			(3) ACRES PER ESTABLISHMENT		
	TOTAL	WITHOUT HIRED LABOR	WITH HIRED LABOR	TOTAL	WITHOUT HIRED LABOR	WITH HIRED LABOR	ALL	WITHOUT HIRED LABOR	WITH HIRED LABOR
EED & GRAIN	338,000	196,000	142,000	128,000,000	41,800,000	86,200,000	379	213	607
OTTON	22,000	6,000	16,000	13,700,000	800,000	12,900,000	623	133	806
OBACCO	76,000	21,000	55,000	4,200,000	400,000	3,800,000	55	19	69
THER FIELD	123,000	76,000	47,000	16,000,000	3,600,000	12,400,000	130	47	264
EG/FRUIT/NUT	92,000	31,000	61,000	7,900,000	500,000	7,400,000	86	16	121
URSERY/G.H.	37,000	17,000	20,000	800,000	100,000	700,000	22	6	35
OTAL	688,000	347,000	341,000	170,600,000	47,200,000	123,400,000	248	136	362

ote: (1) Reported data rounded to the nearest 1,000.

OURCES:
),(2); USDA. 1990 Farm Costs and Returns Survey.
); Calculated from (1) and (2).

TABLE III-2. Hired labor activities on agricultural establishments with hired labor, 1990.

CROP/CROP GROUPING	TOTAL NUMBER OF ESTABLISHMENTS (1)	ESTABLISHMENTS WITH HIRED LABOR (2)	ESTABLISHMENTS THAT DON'T USE PESTICIDES (%) (3)	ESTABLISHMENTS THAT DON'T USE PESTICIDES (Number) (4)	ESTABLISHMENTS THAT DON'T USE PESTICIDES BUT DO HIRE LABOR (%) (5)	ESTABLISHMENTS THAT DON'T USE PESTICIDES BUT DO HIRE LABOR (Number) (6)	ESTABLISHMENTS WITH HIRED LABOR THAT USE PESTICIDES (7)	NUMBER OF HIRED EMPLOYEES TOTAL (8)	NUMBER OF HIRED EMPLOYEES PER ESTAB. (9)	NUMBER HIRED ON ESTABLISHMENTS THAT USE PESTICIDES HANDLERS (10)	NUMBER HIRED ON ESTABLISHMENTS THAT USE PESTICIDES WORKERS (11)
FEED & GRAIN	338,000	142,000	11%	37,180	25%	9,295	132,705	558,000	3.9	265,410	256,065
COTTON	22,000	16,000	6%	1,320	25%	330	15,670	105,000	6.6	31,340	71,494
TOBACCO	75,000	55,000	24%	18,000	25%	4,500	50,500	136,000	2.5	101,000	23,873
OTHER FIELD	123,000	47,000	42%	51,660	25%	12,915	34,085	317,000	6.7	68,170	161,722
VEG/FRUIT/NUTS	93,000	61,000	15%	13,950	25%	3,488	57,513	418,000	6.9	115,025	279,077
NURSERY/G.H.	37,000	20,000	15%	5,550	25%	1,388	18,613	99,000	5.0	37,225	54,907
TOTAL	688,000	341,000	19%	127,660	25%	31,915	309,085	1,633,000	4.8	618,170	847,138

SOURCES:
(1),(2); U.S. Department of Agriculture. 1990 Farm Costs and Returns Survey (rounded to the nearest 1,000).
(3); U.S. Department of Commerce. 1987 Census of Agriculture (establishments reported as not buying pesticides in 1987).
(4); Calculated, (1)X(3).
(5); Estimated by DPRA Inc. and EPA based on general knowledge.
(6); Calculated, (4)X(5).
(7); Calculated, (2)-(6).
(8); Oliveira, Victor J. and E. Jane Cox. (1989, May). The Agricultural Work Force Survey. U.S. Department of Agriculture.
(9); Calculated, (8)/(2).
(10); Estimated assuming two handlers per establishment with hired labor that use pesticides, 2 X (7).
(11); Calculated; ((9)-2)X(7). These are considered nonhandlers.

TABLE III-3. Establishments with family or hired labor that use pesticides, by crop or crop grouping, 1990.

CROP/CROP GROUPING	NUMBER OF ESTABLISHMENTS			ESTABLISHMENTS NOT USING PESTICIDES			ESTABLISHMENTS USING PESTICIDES		
	ALL	W/HIRED LABOR	FAMILY LABOR ONLY	ALL	W/HIRED LABOR	FAMILY LABOR ONLY	ALL	W/HIRED LABOR	FAMILY LABOR ONLY
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(7)	(7)
FEED & GRAIN	338,000	142,000	196,000	37,180	9,295	27,885	300,820	132,705	168,115
COTTON	22,000	16,000	6,000	1,320	330	990	20,680	15,670	5,010
TOBACCO	75,000	55,000	21,000	18,000	4,500	13,500	57,000	50,500	7,500
OTHER FIELD	123,000	47,000	76,000	51,660	12,915	38,745	71,340	34,085	37,255
VEG/FRUIT/NUTS	93,000	61,000	31,000	13,950	3,488	10,463	79,050	57,513	20,538
NURSERY/G.H.	37,000	20,000	17,000	5,550	1,388	4,163	31,450	18,613	12,838
Comm. Handlers	8,500						8,500		
TOTAL	696,500	341,000	347,000	127,660	31,915	95,745	568,840	309,085	251,255

SOURCES:
(1),(2),(3); U.S. Dept. of Agriculture. 1990 Farm Costs and Returns Survey (rounded to nearest 1,000). Commercial handling establishments from Table III-5.
(4) U.S. Dept. of Commerce (1989). 1987 Census of Agriculture (establishments reported as not buying pesticides in 1987).
(5) Calculated, 25% X (4) assuming establishments with hired labor are more likely to use pesticides than establishments with only family labor, or establishments not using pesticides are less likely to hire labor.
(6) Calculated, (4)-(5). See footnote (5).
(7) Difference between all establishments and those not using pesticides.

Table III-4. Unpaid workers and agricultural operators handling pesticides or potentially entering treated fields, by crop or crop grouping, 1987.

CROP/CROP GROUPING	NUMBER OF UNPAID WORKERS (1)	NUMBER OF UNPAID WORKERS PER FARM (2)	NUMBER OF UNPAID WORKERS POTENTIALLY EXPOSED TO PESTICIDES (3)	NUMBER OF FARM OPERATORS (4)	NUMBER OF OPERATORS PER FARM (5)	NUMBER OF OPERATORS POTENTIALLY EXPOSED TO PESTICIDES (6)	TOTAL NUMBER OF UNPAID WORKERS AND FARM OPERATORS POTENTIALLY EXPOSED TO PESTICIDES		
							Handlers (7)	Workers (8)	Total (9)
FEED & GRAIN	675,000	2.0	600,710	578,000	1.7	514,386	514,386	600,710	1,115,096
COTTON	21,000	1.0	19,759	43,000	2.0	40,459	40,459	19,759	60,218
TOBACCO	159,000	2.1	120,840	159,000	2.1	120,840	120,840	120,840	241,680
OTHER FIELD	478,000	3.9	277,085	139,000	1.1	80,575	80,575	277,085	357,659
VEG/FRUIT/NUTS	354,000	3.8	300,710	207,000	2.2	175,839	175,839	300,710	476,548
NURSERY/G.H.	46,000	1.5	46,000	68,000	1.8	57,892	57,892	46,000	103,892
TOTAL	1,733,000	2.4	1,365,103	1,194,000	1.8	989,990	989,990	1,365,103	2,355,094

SOURCES:
(1),(4) U.S. Department of Agriculture. 1989. 1987 Agricultural Work Force Survey.
(2) Calculated, (1) divided by "All establishments" (Table III-3, column (1)). Does not include operators.
(3) Calculated, (2) X Establishments Using Pesticides (Table III-3, column 7). None of these unpaid workers handle pesticides (EPA estimate).
(5) Calculated, (4) divided by "All establishments" (Table III-3, column (1)).
(6) Calculated, (5) X Establishments Using Pesticides (Table III-3, column 7). All of these operators handle pesticides (EPA estimate).
(7) Repeat of (6).
(8) Repeat of (3).
(9) Calculated (7)+(8).

unpaid handlers and workers on agricultural-plant establishments which use pesticides, over 1.1 million (47 percent) were on feed and grain crop farms; about 0.48 million (20 percent) were on vegetable/fruit/nut farms; and about 0.36 million (15 percent) were on farms with primarily other field crops (peanuts, dry beans, sugarbeets, potatoes, etc.).

The revised final rule will also provide protection to handlers employed by commercial firms that apply agricultural pesticides. Growers often contract with commercial firms to apply pesticides on their property in contrast to application by the grower, the grower's family, or hired workers, which is commonly termed "private" application. It is estimated that about 60 percent of all agricultural-plant pesticide applications are made by commercial applicators. However, private application is still widespread on agricultural establishments and many establishments combine both commercial and private applications. The commercial handler segment of the agricultural-plant pesticide industry is estimated to comprise about 8,500 commercial pesticide handling establishments including dealer applicators, independent applicators, and aerial applicators (Table III-5). Commercial pesticide handling establishments employ about 38,000 people, all of whom would be considered handlers.

Thus, in total, the population of agricultural workers occupationally exposed to pesticides is estimated to be about 3,868,000 annually. The distribution by crop group and type of exposure is summarized below.

Crop/Crop Group	Handlers 1/		Workers		
	Hired	Unpaid/Family	Hired	Unpaid/Family	Total 2/
	----------1,000----------				
Feed & Grain	265	514	256	601	1,637
Cotton	31	40	71	20	163
Tobacco	101	121	24	121	367
Other Field	68	81	162	277	588
Veg./Fruit/Nuts	115	176	279	301	871
Nursery/Greenhouse	37	58	55	46	196
Forestry	7		3		10
Commercial Applicators	38 3/				38
TOTAL	662	990	850	1,366	3,868

Source: Tables III-2 and III-4; Appendix B for forestry; Table III-5 for commercial handlers.
1/ Handlers of pesticides may also work in fields but workers never handle pesticides.
2/ Totals may not add due to rounding.
3/ Includes operators and/or unpaid/family (not farmers).

TABLE III-5. Estimated number of commercial handlers of agricultural pesticides by category, 1990.

TYPE OF HANDLER	NUMBER OF ESTAB. (1)	EMPLOYEES PER ESTAB. (2)	HANDLERS PER ESTAB. (3)	NUMBER OF HANDLERS (4)	------HANDLER CATEGORY------ Ground App (5)	Aerial App (6)	Support (7)
Ag Chemical Dealer	5,500	7.6	4	22,000	11,000		11,000
Independent Appl.	1,000	4	4	4,000	2,000		2,000
Aerial Applicator	2,000	6	6	12,000		6,000	6,000
TOTAL	8,500			38,000	13,000	6,000	19,000
				------Uncertified/Need Training----			
Ag Chemical Dealer							5,500
Independent Appl.							1,000
Aerial Applicator							3,000
TOTAL				9,500	0	0	9,500

SOURCES:
(1) DPRA estimate based on conversations with experts within the industry.
(2) For ag chemical dealers, U.S. Dept. of Commerce, Bureau of the Census. 1988 COUNTY BUSINESS PATTERNS (December 1990). For other categories, DPRA estimate.
(3) DPRA estimate.
(4) Calculated,(1) X (3).

In developing the estimates in the RIA, the question arose as to whether to include livestock establishments and workers. The Agency is aware that feed is sometimes grown on livestock establishments and that some of these establishments might be included in the scope of the Worker Protection Standard due to these feed-production activities. However, the Agency also recognized that many feed and grain establishments also produce livestock. In neither case were any data available to indicate how many of these livestock or feed and grain establishments use pesticides in the production of the feed crops and hire labor to perform activities associated with those crops within 30 days of the application and restricted-entry interval. Since hand labor activities are relatively rare in feed crops and pesticides are only sparsely used on many of these crops, the impact of the WPS on these establishments is slight. In this analysis, EPA has chosen to include feed and grain establishments and exclude livestock establishments. The establishments were categorized based on whether crops or livestock contributed most to the gross sales on the farm. EPA believes there is an over-estimation due to the inclusion of all establishments and workers on feed and grain farms and an under-estimation due to the exclusion of all establishments and workers on livestock farms. Data are unavailable to assess the degree to which these two estimates offset one another.

Under the final rule, hired workers are required to have decontamination materials available within 1/4 mile of the work site while performing activities or tasks related to the production of agricultural plants in treated areas within the 30 day period following a pesticide's application or restricted-entry interval. Hired handlers are required to have decontamination materials available during all handling activities. Table III-6 gives the estimated annual average days of work spent in such a treated area for agricultural workers and days handling pesticides for commercial and hired handlers.

Data are not available on the frequency of exposure to pesticides of various toxicities by the agricultural workers identified in Table III-6. By definition, handlers would always be exposed. In lieu of pesticide exposure data for agricultural workers, DPRA Incorporated, along with EPA staff, developed general probabilities that workers would (1) be within 1/4 mile of treated areas during a pesticide application or during the restricted-entry interval

Table III-6. Annual average days of agricultural work, days performing fieldwork, and days handling pesticides for agricultural workers, commercial handlers, and hired and family-member handlers.

Crop Grouping	AVERAGE DAYS OF WORK PER WORKER, PER YEAR			AVERAGE DAYS OF WORK PER COMMERCIAL HANDLER, PER YEAR	AVERAGE DAYS OF WORK PER HIRED OR FAMILY-MEMBER HANDLER, PER YEAR				
		--DAYS IN FIELD--				--DAYS HANDLING--		--DAYS IN FIELD--	
	TOTAL (1)	(%) (2)	(Days) (3)	DAYS HANDLING (4)	TOTAL (5)	(Days) (6)	(%) (7)	(%) (8)	(Days) (9)
FEED & GRAIN	84	10%	8	33	84	6	7%	10%	8
COTTON	84	10%	8	33	84	21	25%	10%	6
TOBACCO	48	50%	24	33	48	1	2%	50%	24
OTHER FIELD	60	10%	6	33	60	3	5%	10%	6
VEG/FRUIT/NUT	105	80%	84	33	105	3	3%	80%	82
NURSERY	137	80%	110	33	137	8	6%	80%	103
GREENHOUSE	137	100%	137	0	137	50	36%	100%	87

SOURCES:

(1),(5); Oliveira, Victor J. and E. Jane Cox. 1989 (May). "The Agricultural Work Force Survey". U.S. Department of Agriculture.

(2),(8); Estimated by DPRA, Inc. and EPA based on general knowledge. Reflects time in fields that are within the 30-day period following a pesticide's restricted-entry interval.

(3); Calculated, (1) X (2).

(4); Commercial handlers based on the following:

--Total number of acre treatments of pesticides per year = 562,400,000 (Table III-8).

--60% of all acre-treatments are applied by commercial handlers (estimated by DPRA and Chris Myrick, National Agri-Chemicals Retailers Association).

562,400,000 total applications X 60% = 337,440,000 applied by commercial handlers.

--Ground applicators can cover 75-80 acres per day (Ohio State University).

--Aerial applicators can cover about 1,000 acres per day (Rick Hardcastle, Texas Ag Aviation Assoc.).

Average acres treated per day = (77.5 + 1,000)/2 = 540 acres per day.

--The number of treatment-days per year = 337,440,000/540 = 624,889.

--There are 19,000 commercial ground and aerial applicators (Table III-5).

--The average number of days per year that one commercial applicator applies pesticides:

624,889/19,000 = 32.9

*Note: It is assumed that only hired or family member handlers apply pesticides in greenhouses.

Footnotes continued . . .

Footnotes continued from Table III-6 . . .

(6); Hired and family member handlers based on the following:
--Total number of acre-treatments of pesticides per year = 562,400,000 (Table III-8).
--40% of all acre treatments are applied by hired and family-member handlers (100% - 60% applied by commercial handlers).
562,400,000 total applications X 40% = 224,960,000 applied by hired and family member handlers.
--Hired and family-member handlers only apply pesticides by ground and can cover 77.5 acres per day (See source above).
--The average number of days it takes to apply one pesticide treatment = acres per establishment per crop (Table III-1) divided by the average number of acres treated per day (77.5).
Feed & Grain: 379/77.5 = 4.89 or 5 days.
Cotton: 623/77.5 = 8.03 or 8 days.
Tobacco: 55/77.5 = .710 or 1 day.
Other field crops: 130/77.5 = 1.68 or 2 days.
Veg/fruit: 86/77.5 = 1.11 or 1 day.
Nursery/greenhouse: 22/77.5 = .284 or 1 day.
--The average number of days per year that one hired or family-member handler applies pesticides = the number of days to apply one pesticide treatment X the average number of treatments applied non-commercially (Appendix A, Table NP-3, column (7)-(8)).
Feed & Grain: 5 days per treatment X 1.2 treatments = 6.0.
Cotton: 8 days per treatment X 2.6 treatments = 20.8.
Tobacco: 1 day per treatment X 0.3 treatments = 0.3.
Other field crops: 2 days per treatment X 1.2 treatments = 2.4.
Veg/fruit: 1 day per treatment X 2.8 treatments = 2.8.
Nursery: 1 day per treatment X 7.7 treatments = 7.7.
Greenhouse: 1 day per treatment X 50 treatments = 50.

(7); Calculated, (6)/(5).
(9); Calculated, [(5)-(6)] X 8.

(0-48 hours) (Table III-7), or (2) be in treated areas after the expiration of the REI, but within 30 days of the REI (0-30 days) for various categories of pesticides (Table III-6).

This final rule establishes REIs for all agricultural pesticides. In general, highly toxic a.i.s (toxicity class I) require a 48-hour restricted-entry interval (REI); moderately toxic a.i.s require a 24-hour REI; and all other a.i.s require a 12-hour REI. Agricultural workers on feed and grain establishments would seldom have need to be near fields within 48-hours after a pesticide application, hence the low (5 percent) probability that workers would be present (Table III-7). However, the likelihood that agricultural workers would be near fields (within 1/4 mile) within 48 hours after a pesticide application on tobacco, vegetable/fruit/nut, and nursery/greenhouse crops is quite high--80 to 90 percent.

Finally, Table III-8 shows the estimated acre-treatments of pesticides by restricted-entry interval and crop grouping. In 1989, a total of 562 million acre-treatments were applied to the seven[1] agricultural crop groupings addressed by this rule. Of the total treatments, 31 percent were pesticides expected to have 48 hour restricted-entry intervals, 18 percent had 24 hour restricted-entry intervals and 51 percent had 12 hour restricted-entry intervals.

B. Overview of Adverse Health Effects

The widespread use of pesticides on agricultural plants, the large number of people working, and limited worker protection in these areas sets the stage for significant potential occupational exposure of workers to pesticides and resulting harmful health effects. It is undisputed that workers and handlers in the agricultural workforce are occupationally exposed to pesticides and pesticide residues and that such exposures can pose significant short-term and long-term health risks. The difficulty is in quantifying a specific level of risk and projecting the risk reduction that will result from this rule. There is, however, strong general evidence that such

[1]Pesticide use in forests is very limited. According to a 1991 U.S. Department of Agriculture publication, less than one percent of the total acreage of national forests and grasslands were treated with pesticides in 1990.

Table III-7. Expected probability that agricultural workers are within 1/4 mile of fields after applications of pesticides with 48/24/12 hour restricted-entry intervals

CROP/CROP GROUPING	Expected Probability that Workers are Within 1/4 Mile of Fields During a Pesticide Application and a 48-hr REI (1)	Expected Probability that Workers are Within 1/4 Mile of Fields During a Pesticide Application and a 24-hr REI (1)	Expected Probability that Workers are Within 1/4 Mile of Fields During a Pesticide Application and a 12-hr REI (1)
FEED & GRAIN	5%	5%	0%
COTTON	10%	10%	5%
TOBACCO	80%	50%	10%
OTHER FIELD	5%	5%	0%
VEG/FRUIT/NUTS	90%	50%	25%
NURSERY	90%	50%	25%
GREENHOUSE 2/	90%	50%	25%

SOURCES:
(1); Estimated by DPRA, Inc. and EPA based on general knowledge.
2/ Greenhouse establishments are based on the expected probability that workers would enter the greenhouse itself.

TABLE III-8. Acre-treatments of pesticides: 1989 numbers and percentages by pesticide restricted-entry intervals

CROP/CROP GROUPING	PESTICIDES w/48 HR RESTRICTED ENTRY INTERVALS * Million Acre Treatments (1)	As a Percent of All 48 Hr REI Acre Treatments (2)	As a Percent of All Acre Treatments (3)	Pesticides That Require Posting As a Percent of All 48-hr REI (4)	PESTICIDES w/24 HR RESTRICTED ENTRY INTERVALS Million Acre Treatments (1)	As a Percent of All 24 Hr REI Acre Treatments (2)	As a Percent of All Acre Treatments (3)	PESTICIDES w/12 HR RESTRICTED ENTRY INTERVALS Million Acre Treatments (1)	As a Percent of All 12 Hr REI Acre Treatments (2)	As a Percent of All Acre Treatments (3)	ALL PESTICIDES Acre Treatments, Million (1)	Percent (2)
FEED & GRAIN	100.9	58.9%	27.0%	18.6%	50.2	49.7%	13.4%	221.0	77.3%	59.1%	373.8	66.5%
COTTON	31.1	18.1%	36.5%	58.0%	25.6	25.3%	30.1%	27.1	9.5%	31.8%	85.1	15.1%
TOBACCO	0.6	0.4%	19.4%	61.4%	0.4	0.4%	12.9%	1.6	0.6%	51.6%	3.1	0.6%
OTHER FIELD	16.4	9.6%	43.3%	31.2%	7.6	7.5%	20.1%	13.7	4.8%	36.1%	37.9	6.7%
VEG/FRUIT/NUTS	17.4	10.2%	33.8%	45.0%	12.3	12.2%	23.9%	21.5	7.5%	41.7%	51.5	9.2%
NURSERY@	2.5	1.0%	45.0%	5.0%	2.5	1.0%	45.0%	0.5	1.0%	10.0%	5.5	1.0%
GREENHOUSE@	2.5	1.0%	45.0%	5.0%	2.5	1.0%	45.0%	0.5	1.0%	10.0%	5.5	1.0%
FORESTRY 5/												
TOTAL	171.4	100%	30.5%		101.1	100%	18.0%	286	100%	50.8%	562.4	100.0%

* Includes most of the active ingredients with REI's longer than 48 hours.
@ 1987 Agricultural Census. Horticultural specialties producers represent about 2% of the expenditures by all users for all agricultural chemicals. This is assumed to be split evenly between nurseries and greenhouses.

SOURCES:
(1); EPA proprietary data.
(2); Calculated from (1).
(3); (1) divided by all acre treatments of pesticides.
(4); EPA proprietary data. Represents the percentage of all 48-hr REI pesticide acre-treatments that are toxicity category I due to dermal toxicity or skin irritation potential.
(5); Pesticide use in forests is very limited. In 1990, less than one percent of the total acreage of national forests and grasslands were treated with pesticides (USDA. Report of the Forest Service Fiscal Year 1990).

risks are pervasive and that they can be substantially reduced through simple exposure-mitigation measures.

Adverse health effects to agricultural workers from occupational exposures to agricultural-plant pesticides include:

- acute effects,
- allergic or sensitization effects, and
- delayed effects.

The view that farmworkers suffer significant adverse health effects from pesticides is shared by other institutions. EPA's Science Advisory Board concluded in 1990 that agricultural workers are exposed to many toxic substances and such exposure can cause cancer and a wide range of non-cancer health effects. In 1992, the U.S. General Accounting Office concluded that farmworkers and their children are routinely exposed to pesticides and that their health and well-being is not adequately protected by Federal laws and regulations. Finally, the Council of Scientific Affairs of the American Medical Association (AMA) has identified the health of agricultural workers who are exposed to pesticides as in need of strong EPA and state regulatory support of occupational health.

C. Alternative Approaches to Reducing Worker Exposure to Pesticides

The Agency intends to promulgate a rule that, as a whole, will reduce agricultural workers' occupational exposure to pesticides, and hence, will reduce the incidence of adverse acute and delayed-onset health effects. Except for the cost of labeling changes to registrants, the costs of the requirements being promulgated in this final rule are in the following categories:

- Restricted-Entry Intervals;
- Personal Protective Equipment;
- Training;
- Notification;

- Decontamination;
- Emergency Assistance; and
- Rule Familiarization.

For each of these categories there have been a wide range of specific proposals identified by the Agency and by informed, interested outside groups who participated in this rulemaking effort. Table III-9 summarizes the specific requirements of the three major options considered during the development of the regulation. Labeling changes required of registrants and rule familiarization are not included in Table III-9 since the options do not differ significantly.

Requirements under this Rule were established after extensive evaluation of the risk/benefit tradeoff between requirement cost and protection provided. For example, a posting requirement every 100 feet for all areas treated with any pesticide may be considered ideal for maximum notification safety. This requirement, however, would be expensive for most growers and may seem unnecessary for large rural producers, such as wheat farms with vast acreage and no hired workers. Estimated costs for each of the three major options are presented in the next chapter.

Table III-9. Baseline, revised rule, and high and low options considered in WPS development

RIA cost factor	Baseline (current practice)	Revised rule	High option	Low option
Restricted-Entry Intervals (REI)	Product-specific REIs on some pesticides--24 or 48 hours on most Toxicity I organophosphates and n-methyl carbamates; Sprays have dried, or dusts have settled, on all other pesticides used on hand labor crops. Short-term tasks, emergencies, and special exceptions granted by EPA.	Interim REIs: 48 hours for Toxicity I dermal toxicity or skin or eye irritation potential; 24 hours for Toxicity II dermal toxicity or skin or eye irritation potential; 12 hours for others; 72 hours for Toxicity I organophosphates in arid areas. Early entry allowed with specified PPE only for short-term tasks or in emergencies. Affects: All hired workers/ handlers and unpaid/family member workers/handlers.	Interim REIs: 72 hours for Toxicity I 48 hours for Toxicity II 24 hours for others No early entry allowed.	24 hours for Toxicity I; sprays dried, dusts settled for all others. Early reentry with PPE allowed.
Personal Protective Equipment (PPE)	Handlers: specified on label. Early Entry Workers: hat, long-sleeved shirt, trousers, shoes, and socks.	PPE and work clothing as described in the matrices in the Final Rule. PPE provided, cleaned, and maintained by employer. Affects: All hired workers/ handlers and unpaid/family member workers/handlers.	PPE and work clothing as described in the matrices in the Final Rule. PPE and work clothing provided, cleaned, and maintained by employer.	PPE and work clothing described in the matrices in the rule. Neither PPE nor work clothing provided, cleaned, or maintained by employer.

continued....

Table III-9. Continued.

RIA cost factor	Baseline (current practice)	Revised rule	High option	Low option
Notification	Warnings may be oral and/or by posting signs at treated areas, and/or by posting information on central notice boards.	Treated area posting and oral warnings for pesticides which are Toxicity I for dermal toxicity or skin irritation potential. Mandatory posting for greenhouse applications. Oral warning or treated area posting for other applications on farms, forests, and nurseries. Pesticide-specific information on a central notice board. Affects: All hired workers/ handlers.	Treated area posting, oral warnings, and central notice board listing for all pesticide applications. Daily oral warning.	Treated area posting and oral warnings for pesticides with REIs > than 48 hours. Oral warning or treated area posting for all other applications. Pesticide-specific information available upon request.
Decontamination	OSHA Field Sanitation Standard: handwashing facilities for workers on farm establishments with 10 or more workers and for all workers on nurseries, forests, and greenhouses.	Handlers: water, soap and towels within 1/4 mile for routine washing of hands and face and emergency whole-body washing. Emergency change of clothing. Eyeflush water immediately available, if protective eyewear required. Workers (within 30 days of REI): water, soap, and towels within 1/4 mile for routine washing of hands and face. Early Entry Workers: same as workers plus eyeflush water immediately available, if protective eyewear required. Affects: All hired workers/ handlers.	Handlers: water, soap, and towels immediately available. Eyeflush dispensers for each handler required to wear protective eyewear. Hot water showers at site where PPE is removed. Workers: same as Final Rule, except (1) provided all season long, (2) emergency change of clothing required, and (3) eyeflush dispenser required. Early Entry Workers: same as workers above, plus (1) eyeflush dispensers, if required to wear protective eyewear, and (2) hot water showers at site where PPE removed.	Handlers and Early Entry Workers: same as Final Rule. Workers: no wash facility required.

continued....

Table III-9. Continued.

RIA cost factor	Baseline (current practice)	Revised rule	High option	Low option
Training	Certification and Training for handlers of restricted use pesticides. OSHA Hazard Communication Standard: Training for workers/handlers on agricultural establishments with 11 or more employees.	Training about pesticide safety and correct handling practices for all handlers. Training about pesticide safety for all early entry workers. Training about pesticide safety for all workers. Safety Poster. Affects: All hired workers/ handlers.	Certification and training for all handlers of Toxicity Category I pesticides. Handler-level training for early entry workers. Training about pesticide safety for workers. Safety Poster in language(s) spoken by workers on establishment.	Training about pesticide safety and correct handling practices for handlers. Training about pesticide safety for early entry workers. No training for workers. No safety poster.
Emergency Assistance	Nothing	Employers provide emergency transportation to workers and handlers. Employers provide pesticide-specific information to workers, handlers, and medical personnel in an emergency. Affects: All hired workers/ handlers.	Same as Final Rule. Pesticide labels, pesticide fact sheets, or Material Safety Data Sheets for each pesticide are made available to all workers and handlers.	Nothing.
Cholinesterase Monitoring	Nothing	Nothing	Cholinesterase monitoring for all commercial handlers. Affects: All commercial handlers.	Nothing.

IV. COMPLIANCE COSTS AND ECONOMIC IMPACT ANALYSIS

A. Total and Incremental Costs by Cost Factor

The regulation and optional approaches would impose a variety of direct and indirect costs on employers of agricultural workers and employers of agricultural pesticide handlers. Direct costs would include personal protective equipment, decontamination items, pesticide safety posters, and treated-area notification signs, while indirect costs would include worker, handler, and supervisor/employer wages during notification, training, emergency assistance, rule familiarization, PPE maintenance, and decontamination-related tasks. Additionally, direct costs will be incurred by registrants for labeling changes.

To the extent possible, the Agency has used a variety of published data from various sources such as the U.S. Department of Agriculture, U.S. Department of Commerce, and the U.S. Department of Labor. When necessary, published data are supplemented with proprietary data and estimates by knowledgeable persons both in EPA and in the agricultural sector. When compiled, these values were used to approximate the various cost factors of the regulation and of the major alternative approaches to the different user sectors.

Total first year user compliance costs of the regulation, along with total first year high and low option costs, are summarized in Table IV-1. The revised final rule has a total first year cost to users of approximately $190 million, while the high and low option costs are estimated at $365 million and $55 million, respectively. Total compliance costs assume that no portion of the regulation are currently being incurred, either from State or federal regulations, or through voluntary compliance.

Some portions of these total costs are already being incurred by growers or commercial applicator firms as a result of (1) existing regulations promulgated at the state and federal levels, (2) existing labeling requirements, and (3) voluntary compliance.

Table IV-1. Summary of total first year user compliance costs for the revised final rule, high option, and low option

Cost Factor	Current revised final rule	High option	Low option
	----------(Million $)----------		
Establishments:			
Restricted-Entry Interval	39.4	117.5	18.6
Personal Protective Equipment	78.8	100.4	2.2
Notification	16.8	24.0	8.2
Training	11.1	18.7	5.0
Decontamination	30.2	71.0	13.5
Emergency Assistance	0.04	0.08	0.0
Rule Familiarization	6.0	6.0	6.0
SUBTOTAL	182.3	337.7	53.5
Commercial Handler Firms:			
Cholinesterase Monitoring 1/	0.0	9.5	0.0
Other Requirements 2/	7.8	17.7	1.8
SUBTOTAL	7.8	27.2	1.8
GRAND TOTAL	**190.1**	**364.9**	**55.3**

1/ Cholinesterase monitoring is only required for commercial handlers, under the high option.
2/ Other requirements for commercial handlers include the cost of PPE, training, emergency assistance, decontamination, and rule familiarization.

Source: Appendix A for current revised final rule costs and Appendix C for high and low option compliance costs.

The original Worker Protection Standard for agricultural hand-labor crops and the Product Registration (PR) Notice (83-2), through which the provisions of the Standard were incorporated onto pesticide product labeling, established the current requirement for pesticides used on labor-intensive crops, that warnings must be given to workers who are expected to be in a treated area or in an area about to be treated. Therefore, the costs for oral notification requirements associated with fruit/vegetable/nut, cotton, and tobacco crops are already being incurred.

OSHA has promulgated a national Field Sanitation Standard (FSS), requiring water, soap, and towels for many agricultural workers, which will be sufficient for EPA's WPS decontamination requirements for those workers. OSHA's Hazard Communication Standard (HCS) is also expected to mitigate the cost impact of training requirements established by this rule.

Arizona, California, Texas, Oregon, Washington, and other states have existing regulations designed to protect agricultural workers from occupational pesticide exposures. These include requirements that pertain to oral warnings and treated-area posting, decontamination facilities, training, restrictions on entry, and emergency response.

EPA has issued Registration Standards for approximately 80 percent of the pesticide active ingredients used in the production of agricultural plants. In addition, EPA has issued amended labeling requirements for several such active ingredients. These labeling requirements and Registration Standards have resulted in some of the WPS requirements, in particular personal protective equipment requirements, being already incorporated into the pesticide labeling.

Finally, EPA believes that many employers of agricultural workers and pesticide handlers are already voluntarily complying with several of the WPS requirements. In particular, EPA believes that many such employers are providing their employees with water for routine and emergency washing and that most are providing them with transportation and pesticide-specific information in poisoning emergencies.

Table IV-2 summarizes incremental first and out year user compliance costs of the regulation by cost factor. Incremental first year costs of the regulation are estimated at approximately $94 million, while incremental out year costs are estimated to be about $49 million.

B. Economic Impacts by Agricultural Sector

The Worker Protection Standard would impact the production of all significant agricultural commodities to some extent. Pesticides are a common input in the production of many agricultural commodities. The relative significance of the costs of the regulation can be expected to vary according to two factors; (1) the intensity and toxicity of pesticide use, and (2) the amount of hand labor required in the production of the commodity.

Table IV-3 and Figure IV-1 show the estimated first year incremental WPS compliance costs by agricultural sector for each of the major cost factors. Incremental first year costs range from a low of $0.3 million for forestry, to a high of nearly $35 million for vegetable/fruit/nut establishments. Total incremental first year costs of the regulation for all agricultural-plant establishments is estimated at approximately $82.3 million.

Estimated incremental out-year compliance costs are given in Table IV-4 and in Figure IV-2. Out year incremental costs to comply with the WPS to owners of agricultural establishments are approximately $49.4 million. Several factors associated with first year costs have more than one year's usefulness, so costs are reduced or even eliminated in out years. For example, in out years only 20 percent of the treated area posting signs will likely need replacement. Other examples of reduced out-year costs include certain personal protective equipment, safety posters, and water containers for decontamination. Some first year compliance cost items are totally eliminated in out years--for example, the cost to registrants of changing pesticide labeling are all incurred in the first year. After the changes are made the first year, the labeling will not change in out years due to the WPS regulation.

Table IV-5 shows various key statistics about the agricultural-plant sectors that will be affected by the WPS. There are 688,000 agricultural establishments with 170.6 million acres

Table IV-2. Summary of incremental first and out year user compliance costs

Cost Factor	Current Revised Final Rule	
	Incremental first year	Incremental out year
	----------(Million $)----------	
Establishments:		
Restricted-Entry Interval	21.1	21.1
Personal Protective Equipment	17.9	9.5
Notification	15.7	5.0
Training	6.9	2.3
Decontamination	12.4	8.9
Emergency Assistance	0.01	0.01
Rule Familiarization	6.0	1.0
SUBTOTAL	80.0	47.8
Commercial Handler Firms:		
Training	0.06	0.05
Decontamination	0.4	0.4
Personal Protective Equipment	1.6	1.1
Emergency Assistance	.0002	.0002
Rule Familiarization	0.2	0.01
SUBTOTAL	2.3	1.6
Registrants:		
Labeling Changes	12.0	0
GRAND TOTAL	**94.3**	**49.4**

Source: Appendix A and B.
Note: Totals may not add due to rounding.

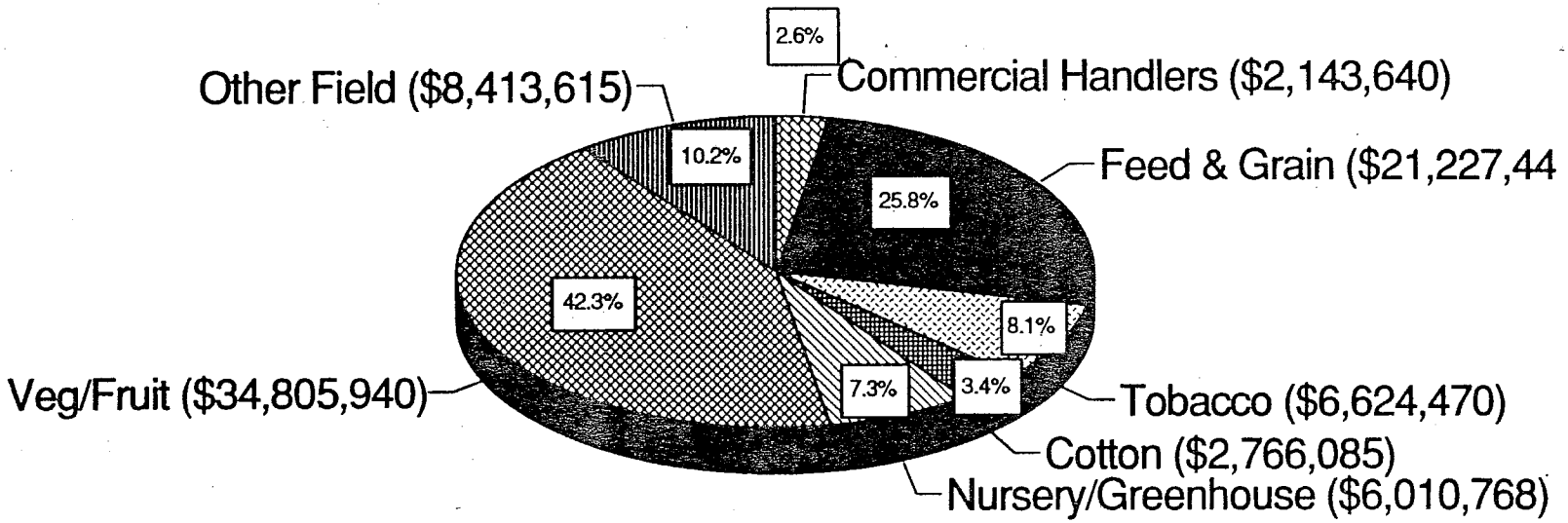
Table IV-3. First year incremental WPS compliance costs by cost factor and agricultural sector

Sector	Restricted Entry	Training	Decontamination	Personal Protective Equipment	Notification	Emergency Assistance	Rule Familiarization	TOTAL
				($)				
Feed & Grain	Not Signif.	2,624,899	3,785,480	8,498,202	3,280,806	3,385	3,034,675	21,227,447
Cotton	Not Signif.	436,530	587,797	814,424	672,216	668	254,450	2,766,085
Tobacco	Not Signif.	773,172	1,267,690	2,535,653	1,287,644	811	759,500	6,624,470
Other Field	Not Signif.1/	968,581	1,247,629	1,702,249	3,755,689	1,492	737,975	8,413,615
Veg/Fruit/Nut	20,711,251	1,653,331	4,347,143	3,244,038	3,898,355	2,559	949,263	34,805,940
Nursery/greenhouse	434,837	426,424	1,058,963	1,059,045	2,680,026	598	350,875	6,010,768
Commercial Handlers	None	61,275	421,210	1,575,908	None	247	85,000	2,143,640
Forestry	Not Signif.	58,870	88,534	80,102	102,204	70	16,000	345,780
Agri-Plant Establishments SUBTOTAL								82,337,745
Labeling Changes								12,000,000
TOTAL	21,146,088	7,003,082	12,804,446	19,509,621	15,676,940	9,830	6,187,738	$94,337,745

Source: Appendix A and B.

1/ May be costs associated with seed corn, but otherwise not significant.

Figure IV-1. Incremental first year WPS compliance costs and percent of total incremental costs by agricultural sector



Total Incremental First Year WPS Compliance Costs = $82.3 Million*

*Includes a $345,780 compliance cost to forestry; excludes one-time cost of label changes to registrants.

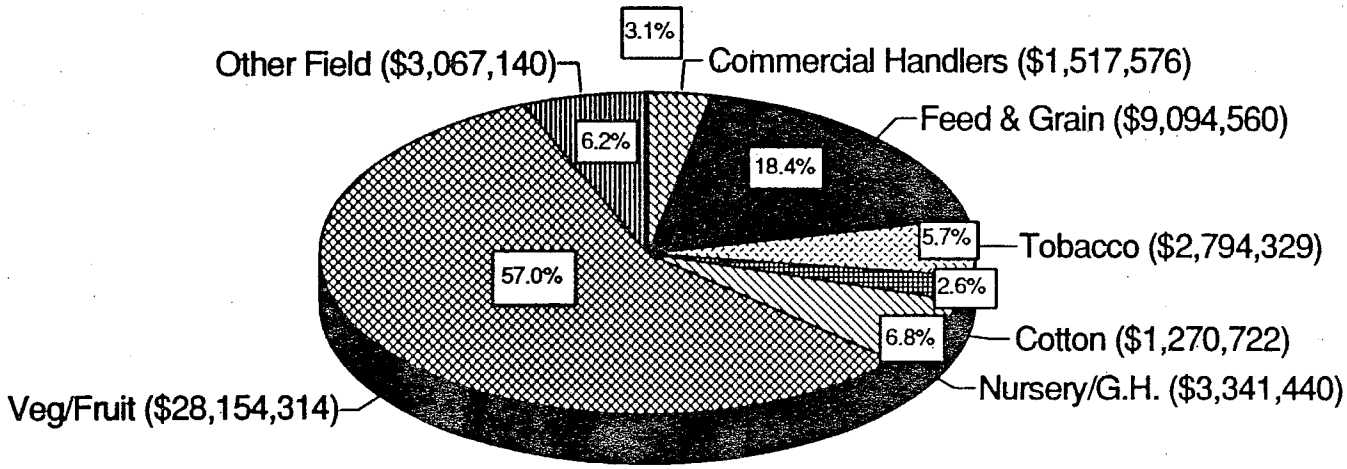
Table IV-4. Out year incremental WPS compliance costs by cost factor and agricultural sector

Sector	Restricted Entry	Training	Decontamination	Personal Protective Equipment	Notification	Emergency Assistance	Rule Familiarization	TOTAL
				($)				
Feed & Grain	Not Signif.	866,030	2,267,375	4,444,864	1,007,127	3,385	505,779	9,094,560
Cotton	Not Signif.	152,893	397,155	441,217	236,381	668	42,408	1,270,722
Tobacco	Not Signif.	239,276	734,481	1,382,541	310,637	811	126,583	2,794,329
Other Field	Not Signif.1/	340,191	829,460	929,080	843,921	1,492	122,996	3,067,140
Veg/Fruit/Nut	20,711,251	581,620	3,714,044	1,732,142	1,254,487	2,559	158,211	28,154,314
Nursery/greenhouse	434,837	144,773	864,245	564,632	1,273,876	598	58,479	3,341,440
Commercial Handlers	None	55,148	366,406	1,081,608	None	247	14,167	1,517,576
Forestry	Not Signif.	18,515	50,220	42,818	31,363	70	3,000	145,986
Labeling Changes								0
TOTAL	21,146,088	2,398,446	9,223,386	10,618,902	4,957,792	9,830	1,031,623	$49,386,067

Source: Appendix A and B.

1/ May be costs associated with seed corn, but otherwise not significant.

Figure IV-2. Incremental out year WPS compliance costs and percent of total incremental costs by agricultural sector



Total Incremental Out Year WPS Compliance Costs = $49.4 Million*

*Includes a $145,986 compliance cost to forestry.

Table IV-5. Number of establishments, acres planted; market value, compliance costs, and compliance costs as a percentage of market value by agricultural crop sector

Crop Sector	All Agricultural Establishments 1/	Acres planted 1/	Market Value of crop 2/	WPS Compliance Cost		Per establishment first year incremental 5/	Per establishment out year incremental 6/	First year incremental cost as a percent of market value 7/
				First year incremental 3/	Out year incremental 4/			
	---(number)---	---(million)---	---(billion $)---	---(million $)---	--(million $)--	--($/estab.)--	--($/estab.)--	---(%)---
Feed and Grain	338,000	128	22.4	21.2	9.1	70	30	0.09
Cotton	22,000	13.7	4.2	2.8	1.3	135	63	0.07
Tobacco	76,000	4.2	1.5	6.6	2.8	116	49	0.44
Other Field	123,000	16	5.7	8.4	3.1	118	43	0.15
Vegetable/Fruits/Nuts	92,000	7.9	11.3	34.8	28.2	440	357	0.31
Nursery/Greenhouse	37,000	0.8	5.7	6.0	3.3	190	105	0.11
Forestry				0.3	0.1			
Commercial handler firms	8,500	___	___	2.1	1.5	247	176	___
TOTAL	696,500	170.6	$50.8	$82.3	$49.4			0.16

Sources:

1/ Table III-3, column (1); Table III-1, column (2). Commercial handler firms Table III-5, column (1).

2/ U.S. Department of Commerce. 1987 Census of Agriculture. The Census reports the total market value of crops which includes crops treated with pesticides as well as crops not treated with pesticides.

3/ Table IV-3.

4/ Table IV-4.

5/ Calculated; first year incremental cost/the number of establishments with and without hired labor that use pesticides (Table III-3, column (7) "All").

6/ Calculated; out year incremental cost/the number of establishments with and without hired labor that use pesticides (Table III-3, column (7) "All").

7/ Calculated; first year incremental cost divided by market value of crop which includes crops treated with pesticides as well as crops not treated with pesticides.

of planted crops, in addition to 8,500 commercial handler firms that could potentially be affected by the regulation. The total market value of production of the six crop sectors was approximately $50 billion in 1987 (U.S. Department of Commerce, 1989).

While the total first year incremental cost of the WPS to agricultural-plant establishments and commercial-handler firms is estimated at $82.3 million, this total represents a small fraction of one percent of the market value of production of the six agricultural sectors (Table IV-5). The vegetable/fruit/nut sector incurs the single largest compliance cost from the regulation of $34.8 million for the first year and $28.2 million in out years. However, with an annual market value of vegetable/fruit/nut crops at slightly over $11 billion, WPS compliance costs account for less than one-third of one percent of the sector's annual market value. In fact, compliance costs represent far less than one percent of the total market value for each one of he six individual crop sectors. On average, it will cost individual operators of agricultural establishments from $70 on feed and grain farms to $440 on vegetable/fruit/nut farms to comply with the WPS regulations in the first year. Out year incremental compliance costs are reduced by at least half as much as first year costs on feed and grain, cotton, tobacco, and other field crop farms. Nursery/greenhouse establishments' compliance costs are reduced by almost one-half in out years and vegetable/fruits/nuts by nearly twenty percent. Overall first year incremental costs of compliance with the WPS are expected to total less than two-tenth's of one percent of the total value of the crops affected.

The somewhat wide variability in the cost per establishment across the commodity groups analyzed, results from the variation in pesticide use practices, including the different types of pesticides used, as well as the variation in intensity of hand labor practices. Pesticide usage in feed/grain and other field crops tends, for the most part, to be herbicide application with relatively less insecticide usage. Herbicides tend to have lower acute toxicity levels, and hence, trigger less costly requirements under the WPS. Another factor is that following herbicide application and planting, there is little need for entry into the fields of feed/grain or other field crops to perform hand labor tasks. However, tobacco, vegetable/fruit/nut, and nursery/greenhouse crops often require insecticide treatments throughout the growing season and these types of pesticides tend to have higher acute toxicity values, and therefore, trigger

more requirements in the WPS. These crops also tend to require significant hand labor during the entire cultivation cycle. Therefore, the higher potential for occupational pesticide exposure of workers in these labor intensive crops, triggers requirements under the WPS regulations that are more costly than for the non-labor intensive field crops.

C. Economic Impacts: Annualized Costs by Agricultural Sector

As previously mentioned, the costs of complying with the WPS will decrease after the first year due to the fact that some costs are not incurred every year. While it is likely that compliance costs will be reduced even further in successive out years (due to changes in pesticide use, development of non-chemical methods of pest control, development of pest-resistant crop varieties, etc.), they cannot be accurately estimated without further study. Therefore, compliance costs are assumed to be the same in years two through ten.

Another way to view compliance cost streams is to calculate their equivalent, constant-level cost per year. The equivalent value is referred to as the annual revenue stream requirement (ARR) because the present value of such an annual revenue stream equals the present value of the cost stream. In order to calculate an ARR for a cost stream the following three steps are taken.

STEP 1: Prepare Cash Flow Estimates and Assumptions.

First and out year incremental compliance costs of the WPS by industry were estimated earlier in this chapter. These are the initial year and annual cash flow estimates, respectively. Cash flow estimates are in constant 1991 dollars and are computed as before tax values per standard regulatory impact analysis guidelines. Calculating present values requires that all future period streams be

discounted[1] at a specified rate of return, with appropriate consideration for inflation.

STEP 2: Calculate Present Values for Each Year and the Total Present Value of the Cost Stream

The present value of the cost stream by industry is multiplied by the discount factor to convert the future sum to a present value. The discount factor (DF) for k percent interest[2] and n periods is calculated with the formula:

$$DF_{k,n} = \frac{1}{(1+k)^n}$$

Annual NPVs are summed by industry to obtain a total present value (TPV) of the overall cash flow.

STEP 3: Compute the Capital Recovery Factor and Estimate Annual Revenue Requirement

The annual revenue requirement (ARR) is obtained by converting the total NPV into an equivalent, constant-level cash flow, i.e. the average annual revenue required to provide an equivalent total present value. A capital recovery factor (CRF) is used to convert the NPV into an annual stream that is equivalent given the underlying economic assumptions. The relationship is:

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[1]Discounting is a technical procedure by which costs of a regulation which occur over a specified time period are set equal to current costs. Projects that have different time horizons will have different net present values (NPV); using different discount rates also leads to different NPVs.

[2]The social rate of discount rate is the rate at which society is willing to trade current consumption for future consumption. The appropriate discount rate to use is the post-tax risk-free long-run consumer rate of time preference since society is understood to be trading present for future consumption on behalf of consumers by engaging in a public project. Empirical observations suggest that, all other things being equal, consumers prefer consumption in the present to that in the future, so that the discount rate obtained from the rate that existing consumers trade across time should also be positive.

$$ARR = CRF \times TPV$$

where:

ARR = annual revenue requirement

CRF = capital recovery factor, and,

TPV = total present value.

The equation to calculate the CRF is:

$$CRF = \frac{(1+i)^n(i)}{(1+i)^n-1}$$

where:

i = the real rate of return on invested capital, excluding inflation

n = the effective operating life of the asset.

Cash flow, net present value, total present value, annual revenue requirement, and annual revenue requirement per establishment for WPS compliance by industry are given in Tables IV-6 through IV-9. Worker Protection Standard total ARRs for all affected agricultural industries and registrants is estimated to range between $53.9 - $56.0 million, depending upon the discount rate. This compares to first year cash flows (costs) of $94.3 million and out year costs of $49.4 million. A comparison of Tables IV-6 to IV-9 show that the ARRs are insensitive to the choice of discount rates used in this sensitivity analysis.

ARRs are quite variable by industry. The vegetable/fruit/nut sector is estimated to incur the largest ARR, ranging between $28.8 - $29.1 million per year, while the forestry sector is estimated at less than $200,000. Per establishment ARRs are based on the total number of establishments in the particular industry that use pesticides. ARRs range from $369 (10% discount rate) on vegetable/fruit/nut establishments to about $34 (not discounted) on feed and grain farms.

Table IV-6. Annualized WPS incremental compliance costs by industry, constant 1991 dollars, discounted at 10% for 10 years

Year	Feed & Grain		Cotton		Tobacco		Other Field		Veg/Fruit/Nuts		Nursery/Greenhouse		Commercial Handlers		Forestry		Labeling Changes		Total	
	Cash Flow	Net Present Value	Cash Flow	Net Present Value	Cash Flow	Net Present Value	Cash Flow	Net Present Value	Cash Flow	Net Present Value	Cash Flow	Net Present Value	Cash Flow	Net Present Value	Cash Flow	Net Present Value	Cash Flow	Net Present Value	Cash Flow	Net Present Value
											($1,000)									
1	21,227	19,295	2,766	2,514	6,624	6,021	8,414	7,648	34,806	31,639	6,011	5,464	2,144	1,949	346	315	12,000	10,908	94,338	85,753
2	9,095	7,512	1,271	1,050	2,794	2,308	3,067	2,533	28,154	23,255	3,341	2,760	1,518	1,254	146	121	0	0	49,386	40,793
3	9,095	6,830	1,271	955	2,794	2,098	3,067	2,303	28,154	21,144	3,341	2,509	1,518	1,140	146	110	0	0	49,386	37,089
4	9,095	6,212	1,271	868	2,794	1,908	3,067	2,095	28,154	19,229	3,341	2,282	1,518	1,037	146	100	0	0	49,386	33,731
5	9,095	5,648	1,271	789	2,794	1,735	3,067	1,905	28,154	17,484	3,341	2,075	1,518	943	146	91	0	0	49,386	30,669
6	9,095	5,130	1,271	717	2,794	1,576	3,067	1,730	28,154	15,879	3,341	1,884	1,518	856	146	82	0	0	49,386	27,854
7	9,095	4,666	1,271	652	2,794	1,433	3,067	1,573	28,154	14,443	3,341	1,714	1,518	779	146	75	0	0	49,386	25,335
8	9,095	4,247	1,271	594	2,794	1,305	3,067	1,432	28,154	13,148	3,341	1,560	1,518	709	146	68	0	0	49,386	23,063
9	9,095	3,856	1,271	539	2,794	1,185	3,067	1,300	28,154	11,937	3,341	1,417	1,518	644	146	62	0	0	49,386	20,940
10	9,095	3,511	1,271	491	2,794	1,078	3,067	1,184	28,154	10,867	3,341	1,290	1,518	586	146	56	0	0	49,386	19,063
Total NPV		66,908		9,168		20,648		23,704		179,025		22,954		9,896		1,079		10,908		344,289
Annual Revenue Requirement 1/		10,889		1,492		3,360		3,858		29,135		3,736		1,610		176		1,775		56,031
Total Revenue Requirement Per Establishment ($)		36.20		72.15		58.95		54.08		368.57		118.59		189.47		--NA--		---- Not Applicable ----------		

1/ Annual Revenue Requirement = Capital Recovery Factor (CRF) X Total Net Present Value (NPV).

$CRF = (1 + i)^n (i) / (1 + i)^n - 1$

Where: i = the real rate of return on invested capital, excluding inflation (10%)
n = the effective operating life of the asset (10 years)

Table IV-7. Annualized WPS incremental compliance costs by industry, constant 1991 dollars, discounted at 6% for 10 years

Year	Feed & Grain		Cotton		Tobacco		Other Field		Veg/Fruit/Nuts		Nursery/Greenhouse		Commercial Handlers		Forestry		Labeling Changes		Total	
	Cash Flow	Net Present Value	Cash Flow	Net Present Value	Cash Flow	Net Present Value	Cash Flow	Net Present Value	Cash Flow	Net Present Value	Cash Flow	Net Present Value	Cash Flow	Net Present Value	Cash Flow	Net Present Value	Cash Flow	Net Present Value	Cash Flow	Net Present Value
											($1,000)									
1	21,227	20,017	2,766	2,608	6,624	6,246	8,414	7,934	34,806	32,822	6,011	5,668	2,144	2,022	346	326	12,000	11,316	94,338	88,961
2	9,095	8,095	1,271	1,131	2,794	2,487	3,067	2,730	28,154	25,057	3,341	2,973	1,518	1,351	146	130	0	0	49,386	43,954
3	9,095	7,640	1,271	1,068	2,794	2,347	3,067	2,576	28,154	23,649	3,341	2,806	1,518	1,275	146	123	0	0	49,386	41,484
4	9,095	7,203	1,271	1,007	2,794	2,213	3,067	2,429	28,154	22,298	3,341	2,646	1,518	1,202	146	116	0	0	49,386	39,114
5	9,095	6,794	1,271	949	2,794	2,087	3,067	2,291	28,154	21,031	3,341	2,496	1,518	1,134	146	109	0	0	49,386	36,891
6	9,095	6,412	1,271	896	2,794	1,970	3,067	2,162	28,154	19,849	3,341	2,355	1,518	1,070	146	103	0	0	49,386	34,817
7	9,095	6,048	1,271	845	2,794	1,858	3,067	2,040	28,154	18,722	3,341	2,222	1,518	1,009	146	97	0	0	49,386	32,842
8	9,095	5,703	1,271	797	2,794	1,752	3,067	1,923	28,154	17,653	3,341	2,095	1,518	952	146	92	0	0	49,386	30,965
9	9,095	5,384	1,271	752	2,794	1,654	3,067	1,816	28,154	16,667	3,341	1,978	1,518	899	146	86	0	0	49,386	29,237
10	9,095	5,075	1,271	709	2,794	1,559	3,067	1,711	28,154	15,710	3,341	1,864	1,518	847	146	81	0	0	49,386	27,557
Total NPV		78,371		10,763		24,173		27,612		213,458		27,104		11,761		1,263		11,316		405,821
Annual Revenue Requirement 1/		10,648		1,462		3,284		3,752		29,002		3,683		1,598		172		1,537		55,138
Total Revenue Requirement Per Establishment ($)		35.40		70.71		57.62		52.59		366.88		116.91		188.00		--NA--		---- Not Applicable ------		

1/ Annual Revenue Requirement = Capital Recovery Factor (CRF) X Total Net Present Value (NPV).

$$CRF = (1 + i)^n (i) / (1 + i)^n - 1$$

Where: i = the real rate of return on invested capital, excluding inflation (6%)
n = the effective operating life of the asset (10 years)

Table IV-8. Annualized WPS incremental compliance costs by industry, constant 1991 dollars, discounted at 3% for 10 years

Year	Feed & Grain		Cotton		Tobacco		Other Field		Veg/Fruit/Nuts		Nursery/Greenhouse		Commercial Handlers		Forestry		Labeling Changes		Total	
	Cash Flow	Net Present Value	Cash Flow	Net Present Value	Cash Flow	Net Present Value	Cash Flow	Net Present Value	Cash Flow	Net Present Value	Cash Flow	Net Present Value	Cash Flow	Net Present Value	Cash Flow	Net Present Value	Cash Flow	Net Present Value	Cash Flow	Net Present Value
	($1,000)																			
1	21,227	20,611	2,766	2,686	6,624	6,432	8,414	8,170	34,806	33,797	6,011	5,837	2,144	2,082	346	336	12,000	11,652	94,338	91,602
2	9,095	8,577	1,271	1,199	2,794	2,635	3,067	2,892	28,154	26,549	3,341	3,151	1,518	1,431	146	138	0	0	49,386	46,571
3	9,095	8,322	1,271	1,163	2,794	2,557	3,067	2,806	28,154	25,761	3,341	3,057	1,518	1,389	146	134	0	0	49,386	45,188
4	9,095	8,076	1,271	1,129	2,794	2,481	3,067	2,723	28,154	25,001	3,341	2,967	1,518	1,348	146	130	0	0	49,386	43,855
5	9,095	7,849	1,271	1,097	2,794	2,411	3,067	2,647	28,154	24,297	3,341	2,883	1,518	1,310	146	126	0	0	49,386	42,620
6	9,095	7,613	1,271	1,064	2,794	2,339	3,067	2,567	28,154	23,565	3,341	2,796	1,518	1,271	146	122	0	0	49,386	41,336
7	9,095	7,394	1,271	1,033	2,794	2,272	3,067	2,493	28,154	22,889	3,341	2,716	1,518	1,234	146	119	0	0	49,386	40,151
8	9,095	7,176	1,271	1,003	2,794	2,204	3,067	2,420	28,154	22,214	3,341	2,636	1,518	1,198	146	115	0	0	49,386	38,966
9	9,095	6,967	1,271	974	2,794	2,140	3,067	2,349	28,154	21,566	3,341	2,559	1,518	1,163	146	112	0	0	49,386	37,830
10	9,095	6,767	1,271	946	2,794	2,079	3,067	2,282	28,154	20,947	3,341	2,486	1,518	1,129	146	109	0	0	49,386	36,743
Total NPV		89,351		12,292		27,549		31,350		246,585		31,088		13,555		1,439		11,652		464,862
Annual Revenue Requirement 1/		10,475		1,441		3,230		3,675		28,907		3,644		1,589		169		1,366		54,496
Total Revenue Requirement Per Establishment ($)		34.82		69.68		56.66		51.52		365.68		115.70		186.95		--NA--		------ Not Applicable ----------		

1/ Annual Revenue Requirement = Capital Recovery Factor (CRF) X Total Net Present Value (NPV).

$CRF = (1 + i)^n (i) / (1 + i)^n - 1$

Where: i = the real rate of return on invested capital, excluding inflation (3%)
n = the effective operating life of the asset (10 years)

Table IV-9. Annualized WPS incremental compliance costs by industry, constant 1991 dollars, discounted at 0% for 10 years

Year	Feed & Grain Cash Flow	Cotton Cash Flow	Tobacco Cash Flow	Other Field Cash Flow	Veg/Fruit/Nuts Cash Flow	Nursery/Greenhouse Cash Flow	Commercial Handlers Cash Flow	Forestry Cash Flow	Labeling Changes Cash Flow	Total Cash Flow
				($1,000)						
1	21,227	2,766	6,624	8,414	34,806	6,011	2,144	346	12,000	94,338
2	9,095	1,271	2,794	3,067	28,154	3,341	1,518	146	0	49,386
3	9,095	1,271	2,794	3,067	28,154	3,341	1,518	146	0	49,386
4	9,095	1,271	2,794	3,067	28,154	3,341	1,518	146	0	49,386
5	9,095	1,271	2,794	3,067	28,154	3,341	1,518	146	0	49,386
6	9,095	1,271	2,794	3,067	28,154	3,341	1,518	146	0	49,386
7	9,095	1,271	2,794	3,067	28,154	3,341	1,518	146	0	49,386
8	9,095	1,271	2,794	3,067	28,154	3,341	1,518	146	0	49,386
9	9,095	1,271	2,794	3,067	28,154	3,341	1,518	146	0	49,386
10	9,095	1,271	2,794	3,067	28,154	3,341	1,518	146	0	49,386
Annual Revenue Requirement 1/	10,308	1,421	3,177	3,602	28,819	3,608	1,581	166	1,200	53,881
Total Revenue Requirement Per Establishment ($)	34.27	68.69	55.74	50.49	364.57	114.54	185.95	--NA--	--- Not Applicable ---	

1/ Annual Revenue Requirement = Sum of 10 year cash flow divided by 10.

D. Economic Impacts on Agricultural Workers

With only narrow exceptions, the revised Worker Protection Standard (WPS) prohibits entry to treated areas during a restricted-entry interval to perform routine hand labor tasks, such as harvesting, pruning, or tying. Should this prohibition result in workers not being employed during the restricted-entry interval, the resulting wage loss would be a cost attributable to the WPS. EPA believes that workers would be unemployed during the restricted-entry interval only in rare circumstances. First, only a few crop-task combinations require the application of a pesticide at a frequency that would cause the restricted-entry interval to interfere with necessary and time-sensitive hand labor tasks. In most circumstances in those few crop-task combinations, the grower can avoid either crop loss or loss of worker employment with careful scheduling of workers and pesticide applications. Even in those situations where the application frequency and the time-sensitivity of the hand labor task directly conflict, EPA believes that agricultural employers' least cost method of responding would have little impact on the demand for workers.

EPA has identified four possible ways that a grower may respond when the frequency of pesticide application conflicts with a time-sensitive hand labor task:

1. The grower does not apply any pesticide and accepts the resultant loss in crop yield or quality due to the pest infestation. The workers would be employed to perform the necessary hand labor task as scheduled. Indeed, in some pest control situations such as weed control, the use of labor might increase to provide a non-chemical alternative to the use of pesticides.

2. The grower applies a pesticide with a shorter restricted-entry interval and accepts the resultant loss in crop yield or quality due to incomplete control of the pest infestation. The workers would be employed to perform the necessary hand labor task as scheduled.

3. The grower applies the pesticide, reschedules the hand labor task, and accepts the loss in crop yield or quality due to poorly timed hand labor activities. The workers would be employed for the same number of days overall, but the timing of their employment would be altered.

4. The grower applies the pesticide, cancels the employment of workers to perform the necessary hand labor task, and accepts the loss in crop yield or quality due to poorly timed hand labor activities. One or more days of hand labor activity, such as harvesting, are skipped entirely. In locations and times where the demand for agricultural laborers temporarily exceeds the supply, workers would usually be able to find alternative employment on nearby agricultural establishments with no loss in wage. In locations and times where the supply of agricultural labor temporarily exceeds the demand, workers might be unable to find alternative employment on nearby agricultural establishments and would incur a wage loss.

Only scenario #4 might result in a loss of income to the workers, and that loss would occur only in locations and times with a surplus of labor. EPA believes that scenario #4 may be the least likely scenario, because growers would most often opt to harvest a crop with poorer yield or quality than to forgo the harvest entirely.

In those situations where the WPS would result in a wage loss to workers, the RIA has already assumed the costs of such a loss. The lost wage would be a transfer of costs from the grower who suffered the crop loss, but did not have to pay the workers' wage, to the workers who suffer a wage loss.

The RIA assumed a cost impact from the WPS-imposed restricted-entry intervals due to a loss in crop yield or quality. That loss in crop yield or quality was assessed on a per acre crop production value basis, i.e., the gross revenue from marketing the crop. In the first three scenarios, the loss is incurred entirely by the grower. In the last instance, the total loss is the same, but is shared by the grower and the workers. The grower receives less income from marketing the crop, but has less expenditure to be debited from that income due to reduced

labor costs. The worker incurs a cost due to reduced wages. In any case, the total costs are reflected in the RIA.

E. Economic Impacts on Registrants

The final regulations would be applicable to most pesticide products registered for use on agricultural plants including forestry and ornamental crops. A review of EPA records has found that currently there are about 18,000 registered pesticide products. Of this total, approximately 8,000 products are estimated to contain agricultural sites on their labeling. The registrants of these products would be required to amend their product labeling to reflect requirements associated with the Worker Protection Standard.

Available information indicates that such changes to labeling would require total expenditures (labor, materials, support needs, overhead, etc.) of between $1,000 and $2,000 per product. Thus, the total cost to registrants of agricultural-plant pesticide products is estimated to range from $8.0 to $16.0 million with a midpoint (or expected cost) of $12.0 million. This would be a one-time expense necessary to meet regulation requirements and would not be borne subsequent to the first year under the final Rule.

Other impacts on registrants are less certain, and hence, cannot be addressed in any detail by this analysis. There has been speculation that the requirements associated with restricted-entry intervals and personal protective equipment could produce shifts in user preference toward products that are less toxic. A shift to less toxic pesticides could also reduce the number of pesticide-related poisonings, thus potentially increasing the general health of those persons exposed. Assuming that users shift to less toxic products, income transfers among registrants would likely occur, however, there is insufficient basis on which to make credible quantitative estimates of these impacts.

F. Economic Impacts on States, Tribes, and Territories

The Worker Protection Standard and other pesticide regulations, are, in general, enforced by states[3], both independently and within a framework of cooperative agreements with EPA. Therefore, the revised WPS could be expected to add to the regulatory burden currently being incurred by states. State inspectors will have to be trained about the requirements of the revised WPS and to develop compliance monitoring strategies specific to the revised Rule.

There is not, however, expected to be an increased financial burden to states due to promulgation of the WPS. Since fiscal year 1990, EPA has been providing states, tribes, and territories with funding specifically set aside for WPS compliance. In fiscal year 1990, $1 million out of a total pesticide compliance budget of $12.8 million was set aside for WPS compliance. In fiscal years 1991 and 1992, the amount set aside for WPS enforcement was increased to $1.5 million. Funding for WPS compliance is expected to increase for fiscal year 1993 to $2.6 million. In fiscal year 1994, WPS compliance funding is expected to be at the fiscal year 1993 level or higher and, in addition, will be allocated to states based on relative need for WPS funding.

To date, states have used the WPS monies to devise compliance monitoring strategies, hire WPS-specific personnel, and develop agreements with other state agencies that clarify and assign responsibilities for implementing and enforcing the WPS.

[3]The term "state", as used here, includes tribes and territories.

V. BENEFITS ASSESSMENT

The revised Worker Protection Standard (WPS) will produce a wide range of benefits for various sectors associated with the sale, oversight, or use of agricultural-plant pesticides. Agricultural workers and pesticide handlers will derive the most substantial benefits. By lowering their occupational exposures to such pesticides, the WPS will enable them to have improved health and a better quality of life. Pesticide users--both growers and commercial pesticide handlers--will benefit directly from the WPS through the increased standardization of both pesticide-use directions and pesticide-related requirements. The indirect benefits to pesticide users through compliance with this rule will stem from having a more informed and healthier workforce, which should lead to improved productivity, lower liability risks, reduced legal costs, and lower insurance rates. Registrants will benefit directly through standardization and reduction of labeling language and indirectly through having more informed pesticide users, resulting in lower liability risks, reduced legal costs, and lower insurance rates. States, tribes, and territories will benefit from increased standardization of pesticide-use directions and pesticide-related requirements that will be more easily conveyed, interpreted, and enforced. Many states, tribes, and territories may also benefit by not having to enact their own worker protection regulations.

This section will discuss the potential benefits of the WPS to the following four entities:

- agricultural workers and pesticide handlers,
- users of agricultural-plant pesticides,
- registrants of agricultural-plant pesticides, and
- states, tribes, and territories.

In many cases, data are sparse for topics such as worker exposure, resultant health effects (both acute and delayed), and potential amelioration attributable to this rule. However, the weight of evidence, combined with facts about agricultural workers' activities and risks, indicate substantial benefits from this rule.

A. Benefits to Agricultural Workers and Pesticide Handlers

The use of agricultural-plant pesticides in the United States potentially exposes about 4 million members of the agricultural workforce, including hired workers, unpaid workers (presumably family members), and agricultural establishment owner/operators, to risks of adverse health effects. Pesticide handlers are persons who mix, load, apply, or otherwise come into direct contact with pesticides through related pesticide-use activities. The number of pesticide handlers nationwide is estimated at 1.66 million. Approximately 1 million are owner/operators of agricultural establishments, approximately 620,000 are hired to work on agricultural establishments, and approximately 40,000 work for commercial pesticide handling establishments. Agricultural workers do not handle pesticides directly, but they may be exposed to agricultural-plant pesticides either indirectly (through contact with residues on treated plants, soil, or water) or directly (through accidental contact, mainly with drift or misdirected application). The number of agricultural workers nationwide is estimated at 2.25 million. Approximately 1.4 million are unpaid (family-member) workers, and approximately 850,000 are hired workers.

By initiating several interrelated exposure-reduction measures, the revised final rule is expected to substantially mitigate for these workers and handlers the adverse health effects (acute, allergic, and delayed) from occupational exposures to such pesticides. These measures include requirements intended to:

- Ensure that employees are informed about the hazards of pesticides--The WPS includes such provisions as pesticide safety training for workers and handlers, use of a pesticide safety poster, access to labeling information, and access to information about what pesticides have been used on the establishment.

- Eliminate or reduce exposure to pesticides--For example, the WPS imposes restrictions during applications and restricted-entry intervals and requires use of personal protective equipment, decontamination facilities for routine washing, and notification to workers of treated areas so they can avoid inadvertent exposures.

- Mitigate the effects from exposures that occur--the WPS requires such things as decontamination facilities for emergency washing, and prompt emergency assistance if pesticide poisoning is suspected.

One benefit of the rule to pesticide handlers is the exceptions to personal protective equipment requirements if engineering controls are used. For example, when enclosed cabs are used during pesticide application, pesticide handlers have the attractive option of forgoing the sometimes hot and cumbersome personal protective equipment. Pesticide handlers will be both more protected and more comfortable when engineering controls are adopted.

It is undisputed that workers and handlers in the agricultural workforce are occupationally exposed to pesticides and pesticide residues and that such exposures can pose significant short-term and long-term health risks. The difficulty is in quantifying a specific level of risk and projecting the risk reduction that will result from this rule. There is, however, strong general evidence that such risks are pervasive and that they can be substantially reduced through simple exposure-mitigation measures.

Adverse health effects to agricultural workers from occupational exposures to agricultural-plant pesticides include:

- acute effects,
- allergic or sensitization effects, and
- delayed effects.

1. Acute (and Allergic) Effects

a. Hospitalized acute poisoning incidents

A recently released study (Keefe et al., 1990) estimated the nationwide incidence rates for hospitalized acute pesticide poisoning cases among persons admitted to general-care hospitals during the years 1977 to 1982 and estimated such rates for selected occupations, including farmer, agricultural worker, and commercial applicator. The study estimated that an average

of 168 farmers, 130 agricultural workers, and 180 commercial applicators were hospitalized annually due to occupational pesticide poisonings. Virtually all of the hospitalized cases in the categories "farmer" and "agricultural worker" should be persons within the scope of this final rule. The only exception would be persons who are poisoned through exposure to pesticides used on livestock, and these are known to be relatively rare. The average annual estimated hospitalized occupational pesticide poisonings for the categories "farmer" and "agricultural worker" is 298.

168 (farmer) + 130 (agricultural worker) = 298

In addition, some fraction of the hospitalized cases in the category "commercial applicator" would be persons within the scope of this final rule because they would be applying agricultural-plant pesticides, but the Agency is unable to ascertain from the data what that fraction is. If all of these cases were persons within the scope of this final rule, then an upper-bound estimate can be derived. As many as 478 annual hospitalized acute pesticide poisoning cases could be attributed to occupational exposures to agricultural-plant pesticides.

168 (farmer) + 130 (ag worker) + 180 (commercial appl.) = 478

Therefore, for the purposes of this analysis, EPA proposes to use a range of 300 to 450 for this value.

b. Nonhospitalized physician-diagnosed acute poisoning incidents

The population at risk of pesticide poisoning and subject to this final rule is the entire population of agricultural workers and pesticide handlers--paid and unpaid--who perform tasks related to the production of agricultural plants on establishments where pesticides are used in such production. EPA estimates there are 3.9 million agricultural workers and pesticide handlers nationwide who perform duties related to the production of agricultural plants on these establishments. These workers and handlers are the primary beneficiaries of this rule,

which is intended principally to mitigate occupational exposure to agricultural-plant pesticides.

(1) Use of California data to estimate national physician-diagnosed incidents. **The California Reporting System.** The California reporting system receives the majority of the reports of illness and injury potentially related to pesticide exposure through two main methods (Calif. EPA, 1991). Physicians in California are required by law to report any illness or injury suspected of being related to pesticide exposures. In addition, State government or insurance programs supervised by the State compensates physicians for the examination of any person who is injured or becomes ill as a result of circumstances within the workplace. Other more minor mechanisms for reporting pesticide-related cases include complaints reported to local or State government agencies and reports received from poison control centers. Once a report is received by the California Environmental Protection Agency (CEPA), it is sent to the local County Agricultural Commissioner (CAC) for follow-up investigation.

Information received from the CAC investigation, the physician's report(s), toxicological data, and any other pertinent background information is used by CEPA in the evaluation of each incident reported. The incidents are first evaluated as to the completeness of the information submitted. If sufficient information is for a determination of exposure/illness relationship, no conclusion is made about the case and it is listed as "unclassifiable." For those incident reports determined to be "complete" or "adequate," the cases are further classified as to the likelihood of a relationship between the reported pesticide exposure and the illness/injury occurrence. Each case is classified as:

- Definite,
- Probable--there is close correspondence between the pattern of exposure and the illness/injury experienced,
- Possible--there is some correspondence between the pesticide exposure described and the illness/injury experienced,

- Unlikely--the signs and symptoms reported are not typical of the exposure suspected, but the possibility that the victim is suffering the effects of pesticide exposure cannot be discounted,

- Asymptomatic--the subject was exposed to pesticides, but suffered no illness/injury in consequence,

- Indirect--the illness/injury appears to have been caused not be pesticide exposure, but by measures prescribed for avoiding pesticide exposure.

Both California and EPA generally use the first three classifications (definite, probable, and possible) in assigning a number for illnesses and injuries associated with pesticide use.

Extrapolating from California data. Since California maintains the most reliable reporting system for physician-diagnosed poisoning incidents that are related to occupational exposures to agricultural-plant pesticides, EPA used California data to derive a reasonable estimate of the national rate of such incidents. When extrapolating California data to the rest of the Nation, EPA looked for evidence that might indicate how best to extrapolate the data--directly or with an adjustment based on the expected degree to which California data might over- or underestimate national cases. EPA considered several factors, including handler exposures, worker exposures, and the existence of the comprehensive California worker protection standard.

Pesticide Handlers. The Agency has no reason to believe that the conditions and activities affecting agricultural pesticide handler exposures to pesticides vary across the country. Pesticide handler poisoning incidents do not appear to be related to climatic conditions, such as aridity. Therefore, pesticide handler exposures in California would not be expected to differ from those in the rest of the United States.

Agricultural Workers. The Agency believes that consideration should be given to the fact that pesticides generally degrade much more slowly in arid regions. This persistence might cause a greater opportunity for exposures to pesticides among agricultural workers in California (and other states with arid agricultural regions) than would be expected in most of

the Nation. Therefore, on this basis alone, agricultural-worker exposures in California could be expected to differ from those in the United States as a whole.

California Worker Protection Standard. California has implemented the most comprehensive agricultural worker protection regulations in the Nation. The protections for workers and handlers include: (1) reentry intervals of as long as 90 days with no early entry to perform hand labor tasks, (2) decontamination sites, (3) mandatory field posting under certain conditions, (4) mandatory oral warnings for all treated areas, (5) training for and monitoring of pesticide handlers, (6) cholinesterase monitoring for handlers of organophosphates and N-methyl carbamates, (7) increased level of personal protective equipment and closed-system mixing/loading for handling highly toxic pesticides, and (8) emergency assistance. As a result, California may have already experienced reduction in poisoning incidents. Therefore, on this basis alone, California may be expected to experience poisoning rates below those experienced nationwide.

Integrating the Factors. Because the arid California climate might lead to an over-estimate of agricultural worker poisoning incidents and the comprehensive California worker protection standard might lead to an under-estimate of pesticide handler and agricultural worker poisoning incidents, EPA sought a means of determining how these possibly conflicting influences might be integrated.

To extrapolate the California incident rate to a national incident rate, EPA has considered several different methods of extrapolation. These include extrapolation based on:

- the percent of the total agricultural-plant workforce that is employed in California,
- the percent of the hired agricultural-plant workforce that is employed in California,
- the percent of the hired agricultural-plant workforce's workdays that are worked in California,
- the percent of national agricultural-plant pesticide expenditure that is expended in California,

- the percent of total pounds of insecticide applied to agricultural plants nationally that is applied in California,
- the percent of national hospitalized acute pesticide poisoning cases due to occupational exposures by farmers and agricultural workers that occur in California.

There are plausible reasons why each of these extrapolations might be appropriate. In fact, the Agency is aware of one study that shows a correlation between the pounds of certain pesticides (mostly insecticides) applied and acute pesticide poisoning hospitalizations, and a weaker correlation between the size of the workforce and the number of hospitalizations. However, some of the other extrapolation methods have not been studied, so the Agency is unable to ascertain with confidence which might provide the most appropriate method. Indeed, all of the various extrapolation methods involve the use of incomplete or inconclusive data.

(2) Extrapolation method for this analysis. For the purposes of this analysis, the Agency has chosen to use a relatively simple, but, in the Agency's view, plausible, basis for extrapolation--the ratio of estimated hospitalized acute poisoning incidents due to occupational pesticide exposures to farmers and agricultural workers occurring in California to the estimated national rate of such incidents. EPA acknowledges that it has no hard data to support the assumption that one can extrapolate directly from hospitalized acute poisoning incidents to physician-diagnosed acute poisoning incidents. That is, EPA is unaware of data demonstrating that the ratio of such hospitalized cases to total physician-diagnosed cases in California is the same as that nationwide. However, hospitalized poisoning cases are a subset of physician-diagnosed cases and the Agency has no reason to believe the ratio of hospitalized pesticide poisoning cases to physician-diagnosed cases would be different for California than for the remainder of the Nation.

Hospitalization data. EPA used data from the Third National Study of Hospitalized Pesticide Poisonings in the United States, 1977-1982 (Keefe et al., 1990) to make the extrapolation. The study estimates an average of 298 hospitalized acute pesticide poisoning

cases annually due to occupational poisonings to farmers and agricultural workers. The study estimates that EPA Region IX, which includes California, Arizona, Nevada, and Hawaii, has an annual average of 22.3 such cases. The Agency is unable to ascertain from this third study what percent of EPA Region IX cases are from California. However, such data are available from the first two studies of hospitalized pesticide poisonings in the United States, which covered the period of 1971-1976 (Griffith et al., 1976; Savage et al., 1980). These data estimate that California represents approximately 78 percent of Region IX's hospitalized poisoning incidents to farmers and agricultural workers. Assuming that the ratio remained the same for the years 1977-1982, the Agency is able to estimate that an average of 17.4 cases occur annually in California. This computes to 5.8 percent of the estimated national hospitalized acute pesticide poisoning cases due occupational exposures to farmers and agricultural workers.

$$78\% \text{ X } 22.3 \div 298 = 5.8\%$$

California physician-diagnosed cases. The Agency is aware of the difficulties inherent in using data from the California pesticide poisoning reporting system. The data were not collected or categorized with the WPS in mind, so they do not directly capture the poisonings that would occur only to those persons within the scope of this final rule. However, EPA has identified two subsets of California data that do allow the Agency to estimate the number of poisonings occurring annually in California to the WPS-covered workforce. One subset of data published annually by California is designated as the number of "agricultural pesticide poisonings" for a given year, including occupational and nonoccupational poisoning incidents. The average number of agricultural physician-diagnosed poisoning cases (after removing poisonings resulting from exposures to commodities in packing houses) from these data is 821 cases per year for the years 1982-1989 (CDFA, 1983, 1984, 1985, 1986, 1987; Edmiston, 1988; Mehler, 1990, 1991, 1992).

The other subset of data were recently obtained from the California Environmental Protection Agency and were based on a computer search designed to obtain "agricultural occupational

pesticide poisonings." The average number of agricultural occupational physician-diagnosed poisoning cases from these data is 698 cases per year for the years 1982-1990 (Mehler, 1992).

Both data subsets probably include some poisoning cases that occur to persons who are outside the scope of the WPS and probably exclude some poisoning cases that occur to persons who are within the scope of the WPS. The Agency does not know the extent of this over- or under-reporting. Therefore, for the purposes of this analysis, EPA will use these two data subsets to express a range of possible numbers of physician-diagnosed poisoning cases occurring annually in California to persons included in the scope of the WPS. The range is 698 to 821.

California reporting system 85% - 95% reliable. California has the most reliable physician-diagnosed pesticide reporting system in the country. However, no reporting system can achieve 100-percent reporting precision. Some cases that a physician diagnoses as being related to pesticide exposure will not be reported to the system. Indeed, a 1989 paper by California Department of Food and Agriculture cited a study that found the California reporting system to be 90-percent reliable in recording cases where physicians diagnosed an illness or injury as being possibly pesticide related (Maddy et al., 1990). Therefore, the Agency has assumed that the California system records approximately 85 to 95 percent of physician-diagnosed pesticide poisoning incidents, with 90 percent used for the calculations.

(3) Estimate of national physician-diagnosed incidents. The Agency has estimated the national physician-diagnosed pesticide poisoning incidents by adjusting the California rate (698-821) for the 90-percent reliability and extrapolating to achieve a national estimate by using the percent of national agricultural occupational hospitalized poisoning cases occurring in California (5.8%).

$$698 \div 0.9 \div 0.058 = 13{,}372$$
$$821 \div 0.9 \div 0.058 = 15{,}728$$

EPA adjusts this estimate to remove the annual hospitalized agricultural occupational pesticide poisonings already accounted for in section (a) above to estimate annual physician-diagnosed (not hospitalized) pesticide poisonings occurring to agricultural workers and pesticide handlers covered by the scope of the WPS.

$$13{,}372 - 298 = 13{,}074$$
$$15{,}728 - 298 = 15{,}430$$

This yields a range of 13,000 to 15,000 for this estimate of the most likely value.

Finally, due to the uncertainties at several stages of this estimating technique, EPA concludes that the actual value may fall somewhere within a wider range. For the purposes of this analysis, it may, therefore, be reasonable to estimate a rough range of possible values of from 10,000 to 20,000 annual physician-diagnosed (not hospitalized) pesticide poisonings for the WPS-covered workforce.

c. Concerns about pesticide-incident reporting systems

Only one state, California, has a mandatory and reasonably reliable pesticide-poisoning reporting requirement. Other states, including Arizona, Florida, and Texas, require similar reporting, but widespread noncompliance renders these systems of little value. Even the California reporting system is not without concerns. A 1991 report by the California Environmental Protection Agency states: "The completeness of the reporting system is an ongoing concern." (Calif. EPA, 1991)

EPA has identified at least four steps that are necessary before a pesticide-related illness can be recorded by any counting system: (1) workers must perceive that they have treatable symptoms; (2) workers must seek medical attention; (3) the physician must diagnose the symptoms as being pesticide related; and (4) the incident must be reported to the correct recordkeeping system and be recorded as being pesticide-related.

(1) Workers must perceive that they have treatable symptoms. Symptoms of acute pesticide poisoning illnesses and injuries are, unfortunately, usually not uniquely indicative of pesticide effects. Dermatologic and ophthalmologic effects, such as skin rashes and eye irritation, also have many other causes. Systemic poisoning by some of the more common pesticides results in flu-like or cold-like symptoms, such as headache, nausea, vomiting, dizziness, and a general feeling of malaise. Allergic effects may be either upper-respiratory problems that mimic hayfever symptoms, or dermatologic effects similar to those caused by exposure to poison ivy. Therefore, many workers may not perceive that their symptoms are related to pesticide exposures and may not realize that the illness or injury can be ameliorated medically.

(2) Workers must seek medical attention. Except in life-threatening emergencies, many pesticide-related acute health effects will gradually disappear without medical intervention. For example, the cholinesterase enzyme, which, when inhibited, causes some of the more common acute systemic poisoning symptoms, will gradually (depending on the family of pesticide, severity, and repetition of exposure) regenerate without treatment. Allergic, dermatologic, and ophthalmologic effects will gradually disappear when exposure to the causal pesticide diminishes. Therefore, many agricultural workers with treatable symptoms may not seek physician care.

Furthermore, agricultural workers' access to medical care is poor. A GAO report states:

> - Hired farmworkers have limited access to Medicaid assistance. Many are ineligible for the program. In addition, state enrollment procedures and other administrative requirements pose a barrier to eligible farmworkers. This is because some of these farmworkers leave the state before their Medicaid applications are processed. Furthermore, those migrant farmworkers approved for Medicaid are often unable to find a health provider who will treat a patient with an out-of-state Medicaid card. Most migrant farmworkers do not receive medical services provided by the Migrant Health Program's rural health clinics. The Department of Health and Human Services estimates that because of budget constraints, the program serves less than 15 percent of the nation's migrant farmworkers.

- Poor and uninsured farmworkers have reduced access to physician care and hospital services. About half of these workers and their families are estimated to have incomes below the poverty level, with the median family income between $7,500 and $10,000 a year. Also, about four out of five farmworkers do not have employer-provided health insurance (U.S. GAO, 1992).

According to the Census Bureau's March 1991 Current Population Survey, 39 percent of people whose family head was in agriculture had no health insurance at all, more than twice the average rate (Numbers News, 1992).

Many agricultural workers average 6-day work weeks during their peak work season. Without sick leave or similar benefits and often already below the poverty level, they may be reluctant to miss a day's work (and, thus, a day's wage) to seek medical care. A 1988 Evergreen Legal Services survey of Washington State farm workers found that only 8 to 15 percent of farmworkers who perceive they may have symptoms related to pesticide exposures seek medical treatment (Mentzer and Villalba, 1988). Furthermore, farmworkers in the survey were unaware that their medical bills would be covered by workers compensation and feared employer disapproval if it were discovered that they reported that their illness was caused by an unsafe practice on the farm. Another 1988 survey of farmworkers in British Columbia, California, Louisiana, and Ohio found that most farmworkers do not seek a doctor for pesticide-related illness (Moses, 1988). Many workers did not know whether they were covered by workers compensation. Even when they did know, they often did not report for fear of retaliation by the employer and loss of their jobs.

(3) The physician must diagnose the symptoms as being pesticide related. Physicians and other healthcare providers often have difficulty in ascertaining the cause of agricultural workers' illnesses and injuries, since the symptoms mimic those of other illnesses and injuries. A California report that summarizes the pesticide-related poisonings reported in 1986 states:

> We recognize that there may be a number of pesticide exposure incidents which result in vague signs and symptoms and the physician may not diagnose

> the condition as a pesticide-related illness of injury. In recent years, particularly in rural areas, physicians and health officials have received training in the recognition and management of illness and injuries related to pesticide exposure. However, physicians cannot possibly be aware of all the pesticides and pesticide products available in the marketplace today. More than 13,000 pesticide products are registered for use in California which contain more than 800 active ingredients and more than 1,000 inert ingredients. These products are formulated in many different ways . . . Thus, the combinations of active ingredients and inert ingredients to which a person may be exposed number in the thousands. . . In addition, the person seeking medical care may not identify the chemical which resulted in the illness or injury as a pesticide (Calif. Dept. of Food and Ag., 1987b).

A second concern regarding correct medical diagnosis is that medical personnel rarely receive training in the recognition and management of pesticide poisonings during their formal schooling. The California report above mentions that some physicians in recent years have been receiving such training while practicing medicine in rural areas. Such training has, until recently, been relatively rare. A report that will soon be published by the Pesticide Farm Safety Center (PFSC) Advisory Panel states that there is a great need for more training of healthcare professionals on the recognition and management of pesticide illnesses. The report explains: "The lack of information about pesticide-related health problems is symptomatic of a lack of training in medical and public health schools in the broad field of occupational and environmental medicine, and more instruction in this discipline should be included in the medicine curriculum." (Univ. of Calif., 1992)

Another concern regarding physician diagnosis of poisonings as being pesticide-related is the lack of or expense of laboratory tests to confirm diagnosis. The PFSC Advisory Panel report observed that physicians who treat farmworkers often are unable to test for the cause of the illness or injury, and, therefore, treat symptoms only.

A 1990 report by the Arizona Office of the Auditor General (OAG) regarding an audit of the Arizona Department of Health Services activities related to agricultural pesticides stated:

> Even for those who do seek medical care, physicians and clinic staff told us that illnesses related to pesticides may not be diagnosed as such. Our review of medical articles and studies performed in other states confirmed this. Except in severe cases, the symptoms of pesticide-related illnesses are similar to those of a number of common complaints such as flu, gastroenteritis, and allergies. Dermatitis, the most common pesticide-related ailment, has many causes. Tests to confirm diagnosis are often expensive and uncertain, and for some types of pesticides, no lab test exists. Diagnosis may be even more difficult for healthcare professionals who don't often encounter these cases. Doctors, who work regularly with fieldworkers, said milder cases of pesticide-related illness may be misdiagnosed if a healthcare professional is not alert to the possibility, and does not ask enough questions to obtain a thorough occupational history from the patient (Arizona, 1990).

(4) The incident must be reported to the correct recordkeeping system and be recorded as being pesticide-related. It is well documented that occupational diseases in general are more likely to be under-reported than occupational injuries. A 1991 study of farmworker health and safety in the State of Washington says: "Frequently, occupational diseases simply do not appear in workers' compensation records, even when clear-cut. This is due to reporting disincentives and inherent difficulties in health care providers recognizing conditions as work-related." (Washington, 1991) In addition, a 1988 survey of farm workers in British Columbia, California, Louisiana, and Ohio found that most workers do not receive workers compensation benefits even if the illness is diagnosed as work-related (Moses, 1988). And another 1988 survey of Washington State farm workers who indicated past health problems associated with pesticide exposure found that only 4 percent filed for workers compensation (Gerstle, 1989).

Sometimes pesticide-related poisoning incidents are not reported, because diagnosis and treatment occurs in a state or country where reporting is not required, even though the

exposure occurred in a state where reporting such incidents is mandatory. For example, the report by the Arizona OAG found: "When farmworkers do seek medical care, some visit doctors in Mexico because costs are lower and language and cultural barriers are removed." (Arizona, 1990) Such incidents are unlikely to be recorded in any U.S. reporting system.

Sometimes the incident is reported to the correct record-keeping system, but it is not recorded as being pesticide-related. For example, 318 incidents involving vineyard worker dermatitis were classified by California Department of Food and Agriculture as "Insufficient" in 1986. The report states: "In previous years investigations of vineyard dermatitis cases included an application history from the last field worked prior to visiting a physician. This method assumes no latency period between exposure and onset of symptoms and/or the worker immediately visited a physician at the onset of symptoms. . . It was determined that most vineyard workers do not visit a physician for at least three and often as long as 10 days after the onset of their rash. They often cannot remember the exact field location associated with the rash. Thus identification of fields and causative agent(s) involved in dermatitis outbreaks could not be determined" (Calif. Dept. of Food and Ag., 1987b). Subsequent information, however, indicates that the dermatitis was probably pesticide related. The California investigators found that increasing the reentry-interval length for two key vineyard pesticides, sulfur and propargite, has greatly decreased the incidence of dermatitis in vineyard workers (Edmiston, 1992). These researchers also indicated that fieldworkers' delay in seeking treatment and the resultant difficulty in determining the field location associated with the onset of poisoning symptoms is one of the principal reasons why fieldworkers poisoning incidents are often classified as "Possible" rather than "Definite" or "Probable."

Finally, there may be disincentives for medical personnel to report suspected pesticide poisoning incidents to a state reporting system. The Arizona OAG report found: "[S]ome physicians and healthcare officials suggest that cases may not be reported because healthcare professionals fear becoming involved in a lawsuit or occupational injury claim in which they might have to defend an uncertain diagnosis in court. Our review of literature on the subject corroborated this statement" (Arizona, 1990).

d. Nonphysician-diagnosed acute poisoning incidents

EPA believes that many incidents of acute and allergic pesticide effects on agricultural workers and pesticide handlers are not diagnosed as such by a physician. Such incidents may vary in severity from skin irritations and headaches to life-threatening cases. The distribution of such effects is unknown, although, on average, such incidents would be expected to be less severe than those for which medical care is obtained.

The Agency has identified three principal reasons for such nondiagnosis:

1. Workers/handlers fail to perceive they have treatable symptoms,
2. Workers/handlers fail to seek medical attention,
3. Medical personnel fail to diagnose the symptoms as being both pesticide-related and occupationally related.

There is considerable uncertainty about the number of such incidents. The available studies which address this issue often suffer from a number of limitations, including reliance on recall of workers that may be affected by the questions asked, samples that are small or that may not be representative, etc. Nonetheless, the Agency believes that, with all their weaknesses with respect to this objective, existing studies, taken together, are remarkably consistent with a conclusion that undiagnosed cases of pesticide poisoning incidents among the agricultural work force subject to the WPS are likely to be significantly more numerous than those that are diagnosed.

Workers/handlers must perceive they have treatable symptoms. The Agency is not aware of studies that estimate how many agricultural workers or pesticide handlers perceive that the symptoms they are experiencing may be related to pesticide exposure. In order for workers/handlers to have such a perception they would need to be both aware they were being exposed to pesticides and aware of the typical signs and symptoms of pesticide poisoning. The Agency believes that many workers and handlers do not know the typical signs and symptoms of pesticide poisoning and that many workers do not know if and when they are exposed to pesticide residues.

Workers/handlers must seek medical treatment. The Agency is aware of a few studies that offer an indication of how often agricultural workers and pesticide handlers seek medical attention when they perceive they have a pesticide-related illness or injury.

One survey of 460 farmworkers in Washington state found that among those workers exposed to spray or drift who reported bad effects (99 workers), only 8% (8) sought medical treatment (Mentzer and Villalba, 1988). Among affected workers who had been exposed by entering fields within 2 days of treatment (91 workers), only 10% (9) sought treatment. Among affected handlers who had been exposed through mixing and applying pesticides (40 workers), only 15% (6) sought treatment. The design of this study limited its usefulness for the purposes of this analysis. It was a survey that relied on the memory of the cohorts and the perceived bad effects were not necessarily due to pesticide exposure. Furthermore, this study would not capture those workers who were unaware they were exposed to pesticides or unaware that the signs and symptoms of illness or injury might be due to pesticide exposures.

A survey of 1,811 Florida citrus field workers identified 29 field workers who reported poisoning symptoms due to pesticides (Griffith et al., 1985). However, only 31% (9 out of 29) of the total cases reported seeking medical attention. All nine of the physician-attended cases were mixer/loader/applicators. (There was a total of 11 mixer/loader/applicators.) Of these nine, 22% (2 out of 9) reported that the poisoning incident required hospitalization. No non-mixer/loader/applicators reported seeking medical treatment. A range of symptoms were reported. Approximately 36% (4 out of 11) of the mixer/loader/applicators and 11% (2 out of 18) of the field workers reported symptoms of systemic poisoning, whereas the remaining 64% and 89% respectively reported symptoms of skin and/or eye effects (irritation, burning, swelling, etc.). Again, the design of this study limited its usefulness for the purposes of this analysis. It was a survey that relied on the memory of the cohorts and the possible incidents were not necessarily due to pesticide exposure. For example, 7 of the field worker incidents were limited to skin irritant effects and the survey's authors indicated that such an effect was equally likely to be caused by citrus dermatitis. Furthermore, this study would not capture those workers who were unaware they were exposed to pesticides or unaware that the signs and symptoms of illness or injury might be due to pesticide exposures.

A study in Nebraska measured plasma cholinesterase levels of 91 farmers and 7 commercial applicators known to use organophosphate or carbamate pesticides (Spigiel et al., 1981). Thirty percent of the subjects were found to have a reduction of cholinesterase from their baseline levels of 20% or more--strong evidence of exposure. Most relevant to this analysis, 22% of the subjects reported having symptoms which are common in mild organophosphate poisoning, including weakness, headache, excessive sweating, nausea or vomiting, excessive salivation, or diarrhea. None of these workers sought medical attention for their symptoms. Again, the design of this study limited its usefulness for the purposes of this analysis. It is not clear from the recruiting procedure how representative the 98 subjects were of farmers or applicators in Nebraska or nationwide, or of the entire agricultural work force at risk from pesticides. In addition, it is unclear whether the frequency or severity of the reported symptoms were different from those expected through ordinary experience. Furthermore, this study would not capture those workers who were unaware they were exposed to pesticides or unaware that the signs and symptoms of illness or injury might be due to pesticide exposures.

Medical personnel must diagnose incident as being both pesticide-related and occupationally related. When medical treatment is sought, the treating medical personnel may not specifically diagnose the illness or injury as being caused by an occupational exposure to pesticides. Many signs and symptoms of such poisoning may be treated symptomatically or an occupational connection may not be drawn. The Agency is aware of only one study that provides any indication of how often a physician treating pesticide poisoning illness and injuries to agricultural workers and pesticide handlers actually diagnoses the condition as such. The San Francisco Bay Area Regional Poison Control Center surveyed all occupational illnesses reported to them in a 6 month period in 1986 (Blanc et al., 1989). There were 41 apparent occupational poisonings due to pesticides. However, only 7 of these or 17% were reported to the California Department of Food and Agriculture. California requires physicians to report all occupational pesticide poisoning incidents. This study is also imperfect. It is not clear how representative the poison control center was of poison control centers in California or nationwide. It is also unclear as to what percent of the physician-treated occupational pesticide poisoning incidents in this study were reported to the California Department of Food and Agriculture. Furthermore, this study would not capture many

persons who do not perceive their symptoms are related to pesticide exposure or do not seek professional advice concerning their symptoms.

Conclusion. The limited and imperfect available data are consistent with the Agency's expectation, based on the stoicism of the agricultural work force and the fact that medical care is comparatively difficult to obtain for many members of this population at risk, that only a small fraction of the symptoms of pesticide poisoning are likely to lead to medical attention and possible diagnosis.

2. Delayed effects

In addition to acute and allergic adverse health effects, pesticides are known to cause delayed adverse health effects. Some of the delayed effects caused by pesticides include:

- Chronic effects, including tumors, cancer, and genetic changes.
- Developmental and reproductive effects, including birth defects, miscarriages, stillbirths, infertility, sterility, and impotence.
- Systemic effects, including toxic effects on the heart and circulatory system, brain and nerve system, skin, lungs and respiratory system, liver, and kidneys.

Unlike acute and allergic effects, where the symptoms usually appear soon after the causal exposure, evidence of delayed adverse effects from pesticide exposures almost always emerges long after the causal exposure(s). This, coupled with the fact that symptoms of pesticide-caused delayed adverse effects are not unique, results in a predictable lack of hard data as to the extent and magnitude of pesticide-caused delayed adverse effects.

Delayed effects are almost never recorded by pesticide incident reporting systems. A 1991 Washington State Department of Labor and Industries report states: "[W]orker's compensation claims data do not usually count work-related chronic disease, including cancer." Maddy and Edmiston report: "Chronic illnesses or conditions with a long latency

period are rarely reported to the CDFA [California Department of Food and Agriculture] through reporting mechanisms currently established."

At this time, EPA has elected not to attempt to quantify risks, from all agricultural-plant pesticides, for most types of delayed adverse health effects. There are, however, four types of delayed effects for which the Agency has some data:

- carcinogenic effects,
- serious developmental defects,
- stillbirths, and
- neurotoxic effects.

These available data still fall far short of enabling EPA to quantify risks with the desired level of precision. The Agency uses these data in this regulatory impact analysis to provide a representation of the plausible incidence of delayed adverse effects in the agricultural population to which this final rule applies. However, the Agency remains convinced that these and other types of delayed adverse effects are occurring and can be, to a great extent, ameliorated with the protections provided in this final rule.

a. Carcinogenic (cancer) effects

EPA has received and reviewed the required studies for predicting oncogenic effects for numerous pesticide active ingredients. About 90 of these active ingredients (about one-third of the pesticides evaluated so far) have been shown to be, at some level, oncogenic in the study animals (Engler, 1992). As more oncogenic effects studies are received and evaluated by the Agency during the reregistration process, it is expected that additional pesticide active ingredients will exhibit oncogenic effects.

In addition, the Council of Scientific Affairs of the American Medical Association reviewed 53 pesticides and categorized 2 as definite, 13 as probable, and 16 as possible carcinogens

(Am. Med. Assn., 1988). The registration for many of these pesticides has been canceled or narrowed in use.

Based on these two estimates of the fraction of pesticides that may be carcinogenic, the Agency expects that among the over 400 pesticide active ingredients used in the production of agricultural plants, approximately 120 pesticides may exhibit positive oncogenic effects.

For more than a decade, EPA has quantified pesticide handlers' risk of cancer resulting from exposures to individual pesticide's active ingredient(s), typically in the context of regulating that active ingredient's use on a single crop. (It is clear, however, that most pesticide handlers are exposed to multiple pesticides used on multiple crops.) The magnitude of risk estimated in each such case depends upon the oncogenic potential of the pesticide and use-specific exposure factors. A range of risks has been calculated for the lifetime probability that excess cancers will develop in pesticide handlers exposed to specific carcinogenic pesticides, with 10^{-4} as a typical risk for high exposure application activities (EPA, 1983; EPA, 1983; EPA, 1987).

Fieldworkers engaged in a range of harvesting activities have been documented to experience hourly dermal exposures to pesticides at about the same magnitude as pesticide handlers (Zweig et al., 1983; Nigg et al., 1984). However, since fieldworkers are typically not as geographically stable a workforce as are pesticide handlers, it is extremely difficult to estimate the hours worked on various activities over the course of a lifetime. This is required to quantify cancer risks. However, fieldworkers nearly always work in multiple crops treated with multiple pesticides, several of which may be carcinogenic. The Agency did quantify cancer risks for fieldworkers on one occasion for a single active ingredient, with the resulting cancer risks in the same range as that for pesticide handlers (EPA, 1985). The Agency therefore concludes that a 10^{-4} value for individual lifetime cancer risks is appropriate to use for all agricultural workers and pesticide handlers covered by the revised final rule and may be an underestimate.

EPA has not attempted to quantify cancer risks from pesticide handlers' or agricultural workers' exposures to multiple pesticide active ingredients, either through simultaneous exposures to two or more combined active ingredients, or through exposures to multiple pesticides over a lifetime. The Agency has also not attempted to assess the additive, synergistic, or antagonistic effects that may result from such multiple exposures. Any such data are, by their nature, extremely difficult to obtain and verify.

Estimating the number of cancer cases caused by occupational exposures to all agricultural-plant pesticides is therefore unprecedented. However, if EPA, for example, applies an estimate of lifetime risk of 10^{-4} to all workers and handlers covered by this rule, then six cancer cases (3.9 mil. X $10^{-4} \div 70$) can be expected annually as the result of occupational exposures to agricultural-plant pesticides.

The Agency notes, however, that this estimate may be on the low side. A case study of one type of cancer, non-Hodgkins lymphoma (NHL), is illustrative. A report by the National Cancer Institute describes a case-controlled study of white men who develop NHL as adults in Kansas (Hoar, 1986). This study indicates a statistically significant increase in risk of NHL for white men who lived or worked on farmland as adults. The study further estimates that 11 percent of the NHL cases in the Nebraska population may be explained by exposures to herbicides. The national incidence of deaths due to NHL in the agricultural population is estimated to be 1,637 deaths annually (Blair, 1992). Estimating from the Nebraska population to adults who lived or worked on a farm, then 220 annual NHL cancer deaths could be attributed to occupational exposures to agricultural-plant phenoxy herbicides. In addition, a recently released article in Cancer Research shows evidence linking insecticide exposure to NHL in the agricultural population (Cantor et al., 1992). The Agency has just received all of the data from these studies and is convening a panel to review the data and advise the Agency on the weight of evidence as to the likelihood there exists an unacceptable risk of cancer due to agricultural exposures to phenoxy herbicides, specifically 2,4-D.

b. Developmental and reproductive effects

In the United States, it is estimated that about 35 percent of conceptions do not result in live births (Wilcox et al., 1985). The number of such occurrences due to occupational exposures to pesticides is unknown, but there are indications that such exposures could be responsible for a substantial number. There are several types of developmental and reproductive effects that are thought to occur as the result of exposure to pesticides. These include: infant mortality, developmental defects, stillbirths, and spontaneous abortions. Of these EPA has the most data about pesticide-related stillbirths and serious developmental defects.

Serious developmental defects

Exposing laboratory animals to certain pesticides is known to cause developmental defects in the progeny produced by those animals. On the basis of developmental toxicity studies already received and reviewed, EPA has determined that more than 100 pesticide active ingredients cause developmental toxicity in laboratory animals at some level of exposure. This represents approximately one-third of the active ingredients evaluated so far. As more developmental toxicity studies are received and evaluated by the Agency during the reregistration process, it is expected that additional pesticide active ingredients will exhibit a developmental toxicity effect.

Based on this estimate of the fraction of pesticides that may cause developmental defects, the Agency expects that among the over 400 pesticide active ingredients used in the production of agricultural plants, approximately 120 pesticides will exhibit developmental toxicity effects. Furthermore, the California Environmental Protection Agency has placed 11 pesticides on its list of developmental toxins to be regulated under Proposition 65 (Calif. EPA, 1992).

Developmental toxicity differs from carcinogenic toxicity in that developmental defects may result from a single exposure, whereas it is thought that carcinogenic effects are increasingly likely to occur as exposure accumulates over a lifetime. As a result, the risks of adverse developmental effects are calculated on the basis of a single exposure-day, rather than on the

basis of amortized lifetime exposure, as cancer risks are calculated. Developmental toxicity is calculated for the aggregate male and female population at risk, because it can originate from either sex.

An attempt has been made to quantify the risks of severe developmental defects resulting from pesticide handlers' and agricultural workers' exposures to individual pesticide active ingredients. The magnitude of risk in each case depends on the level of developmental-toxicant hazard and use-specific exposure factors.

No attempt has been made to quantify the risks of severe developmental defects resulting from pesticide handlers' or agricultural workers' exposures to multiple pesticide active ingredients, either from simultaneous exposures to two or more combined active ingredients, or from exposures to multiple pesticides over a lifetime. Furthermore, no attempt has been made to assess the additive, synergistic, or antagonistic effects that may result from such multiple exposures. Any such data are, by their nature, extremely difficult to obtain and verify.

Estimating the number of serious developmental defects caused by exposures to agricultural-plant pesticides is extremely difficult. However, the total number of serious developmental defects that might be expected to occur among the population of agricultural workers and pesticide handlers who are occupationally exposed to these pesticides can be approximated.

The annual national rate for developmental defects in the United States thought to be serious by EPA is approximately 3 percent at birth and, with increasing age and the detection of certain functional changes, increases to 6 percent or 7 percent (Shepard, 1986). EPA is aware of two different reports that estimate what fraction of those serious developmental defects are from unknown causes. One study estimates that 70 percent of the severe developmental defects are from unknown causes, while the other study estimates 43 percent (Wilson, 1977) (Nelson and Holmes, 1989). If those estimates are averaged (56.5 percent) and applied to the national (6 percent) rate, it yields an estimate of an annual rate of 3.4 percent of live births that exhibit serious developmental defects from unknown causes. The total number of live

births (3.8 million live births annually in the United States)(Ventura et al., 1988) and the percent (3.4) of those births that exhibit serious developmental defects from unknown causes may be apportioned to the population to which this rule applies (4 million agricultural workers and pesticide handlers). From this calculation, approximately 2,000 live births with serious developmental defects of unknown cause would be predicted to occur annually to this population.

If, for example, it is assumed that only 1 percent of those cases of serious developmental defects that result from unknown causes is attributed to occupational exposures to agricultural-plant pesticides in the population to which the protections of this rule apply, then 20 births with serious developmental defects attributable to such a cause would occur annually.

EPA believes this estimate of 20 may be conservative, however. A case study by McDonald et al. is illustrative. Workers with agricultural and horticultural occupations may be at higher risk than those in the general population. A study published in the British Journal of Industrial Medicine in 1988 found that the rate of congenital defects in births to workers in agricultural and horticultural occupations was 2.6 times that of the general population (McDonald et al., 1988). In addition, individual case studies of women poisoned by pesticides during their first trimester of pregnancy indicate that serious birth defects can result from such poisoning (Romero et al., 1989). As is characteristic of epidemiological studies, the McDonald et al. study is not without flaws. It did not consider alcohol, or the occupation of the fathers as possible factors. However, it did consider educational level, ethnicity, and smoking and found that even after adjustment for these factors, their findings of significant risks associated with pesticides persisted. They concluded: "We do not think it likely that the risks in specific occupational groups presented [in this study] would be importantly changed if allowances were formally made for non-occupational confounding variables."

If the Agency used the rate of congenital defects estimated by the study reported in the British Journal of Industrial Medicine to estimate for this population the total number of serious developmental defects that result from unknown causes, the total number would be

5,200 rather than the 2,000 estimate. If only 1 percent of these incidents were attributed to exposures to agricultural-plant pesticides, the estimated number would be 52 rather than 20. Moreover, the fact that the rate for agricultural occupations exceeds that of the general population suggests that the attribution of only 1 percent to pesticides could be far too low.

Illustrative Case History: The agricultural-plant pesticide dinoseb was widely used for a number of years on several agricultural crops, including crops where hand labor activities are common. In 1986, EPA determined that dinoseb was potentially a serious developmental toxicant. Based on the EPA analyses for dinoseb, the Agency estimated that over 100 serious developmental defects could result annually among occupationally exposed women if dinoseb use continued. Dinoseb registration was suspended on an emergency basis and subsequently canceled. However, once the Agency receives and reviews data on developmental toxicity for the remaining two-thirds of the pesticides to be evaluated for developmental effects during reregistration, other existing pesticides at similar risk levels may be identified.

Stillbirths

A case-control analysis based on 9,941 live births and 6,386 stillbirths found that maternal exposure to pesticides at work and in and around residences was associated with an increased risk of stillbirth at a rate approximately one and one-half times the control population (Savitz et al., 1989). This rate was significant for exposure to pesticides on the job, in the home, or in the area of the residence. In addition, paternal exposures to pesticides in these locations was also associated with increased risk of stillbirths at a rate above the control population. A generic problem with all epidemiology studies that rely to some degree on the cohorts' memory is the potential errors in subject's recall and the potential bias that may be introduced in surveys by how the questions may have been structured. This epidemiological study depended on the subjects' memory as to their exposure to pesticides in the 12 months before the birth. The correlation between exposure to pesticides and stillbirths in this study is not necessarily a direct correlation with agricultural pesticide exposures; it may include exposures to non-agricultural pesticides also.

The annual stillbirth rate for the United States is 7.5 stillbirths per 1,000 life births per year (Nat. Center for Health Stat., 1988). The total number of live births per year in the United States is approximately 3.8 million (Ventura et al., 1988). If only those cases of stillbirths that may be expected to **exceed** the base rate for the general population based on the odds ratio of 1.5 are considered, the excess stillbirths among the agricultural workforce would be 222 per year.

$$[11.25/1000 - 7.5/1000] \text{ X } 3.8 \text{ mil. X } [3.9 \text{ mil} \div 250.0 \text{ mil}] = 222$$

Even if, for example, it is assumed that only 25 percent of those excess cases are attributed to occupational pesticide exposures, an estimated 56 stillbirths may be attributable to such occupational exposures in the population to which the protections of this rule apply.

$$25\% \text{ X } 222 = 56$$

c. Persistent neurotoxic effects

Increasing evidence indicates that risks of neurotoxic health effects are related to exposures to organophosphate pesticides. The World Health Organization suggests that 5 percent of occupational poisonings due to organophosphates result in adverse neurotoxic effects (United Nations, 1990). A 1990 report to Congress by the Office of Technology Assessment states:

> The pesticides parathion, mevinphos (Phosdrin), and malathion are frequently reported as causing health problems. Case reports and studies of acute poisonings of agricultural and other workers indicate that 4 to 9 percent of the acutely poisoned individuals experienced delayed or persistent neurological and psychiatric effects. . . [These effects include] irritability, depression, mood swings, anxiety, fatigue, lethargy, difficulty concentrating, and short-term memory loss (U.S. Congress, 1990).

Two case-controlled studies and several case-series reports indicate that these symptoms may persist for months or years after the initial exposure (Savage et al., 1988; Rosenstock et al., 1991; Echobichon et al., 1990; Karalliedde and Senanayake, 1989; Eskenazi and Maizlish, 1988). The population studied was persons who had been poisoned by organophosphate pesticides. The development of the neurotoxic effects subsequent to the poisoning incident suggests that this range of percent affected is the excess above the background level.

Approximately 50 percent of the physician-diagnosed acute pesticide poisoning incidents reported by California are systemic illnesses (Mehler, 1991). Of those systemic illnesses, approximately 45 percent are caused by exposures to organophosphates. If this 22.5 percent rate is applied to the national estimate (10,300 to 20,450) of physician-diagnosed acute pesticide poisoning incidents, an estimated 2,300 to 4,600 physician-diagnosed systemic organophosphate-caused incidents occur annually. If EPA takes a midpoint of the Office of Technology Assessment's reported range (4 to 9 percent) of such acute poisoning cases that lead to mid- to long-term neurotoxic effects, approximately 150 to 300 cases of mid- to long-term neurotoxic effects may occur annually to agricultural workers and pesticide handlers poisoned by agricultural-plant pesticides.

3. Cost comparison to estimated cases avoided

Summary of costs and benefits

EPA believes that the benefits that will accrue to agricultural workers and handlers from implementation of the WPS include the reduction in lost time from the workforce, reduced medical expenses, and increased well-being and productivity through being less affected by pesticide poisoning. These and any related benefits cannot be adequately quantified with available data. The Agency is convinced that the benefits to society from avoided incidents of acute, allergic, and delayed adverse effects from occupational exposures to agricultural-plant pesticides exceed the costs attributable to this final rule.

EPA estimates that the incremental costs of this final rule will be about $95 million in the first year and about $50 million annually thereafter. To facilitate comparison with other regulations, EPA has also calculated the costs by annualizing them over ten years at several illustrative interest rates. Using 3% and 10%, the annualized costs of this final rule would be about $54 and $56 million per year respectively. The annual cost of the rule is therefore expected to be $50 to $60 million dollars, while the estimated annual benefits of this final rule include avoiding 8,000 to 16,000 physician-diagnosed (nonhospitalized) acute and allergic pesticide poisoning incidents, avoiding about 300 hospitalized acute and allergic pesticide poisoning incidents, and avoiding potentially important numbers of cancer cases, serious developmental defects, stillbirths, persistent neurotoxic effects, and nondiagnosed acute and allergic poisoning incidents.

EPA has not attempted in these analyses to develop specific estimates of anticipated adverse effects for which the aggregate occupational data that the Agency is aware of is more limited, although there is some evidence that these effects may occur. Studies have demonstrated that many pesticides cause adverse effects in animals, and some pesticides have been observed to have adverse effects on humans. Most pesticides have not yet been adequately tested for these effects, however. Nor is it yet certain, in most cases, how animal responses to various doses of pesticides compare with the response of agricultural workers/ pesticide handlers encountering expected occupational exposure levels. However, the level of current knowledge is sufficient to cause EPA to conclude that some or all of these effects may be occurring to agricultural workers and pesticide handlers as a result of their occupational exposure to agricultural pesticides. These adverse effects may include:

(1) Spontaneous abortions and infant mortality,

(2) Sterility, infertility, and impotence,

(3) Delayed-onset systemic effects to the heart and circulatory system, skin, lungs and respiratory system, liver, and kidneys.

However, as discussed in the previous sections, EPA has developed specific estimates for two categories of acute adverse effects based on human incidence data, and for four types of delayed-onset adverse effects based, of necessity, on more theoretical approaches.

80% efficacy of the WPS

The Agency assumes that compliance with the comprehensive protections provided in this final rule will reduce the incidence of each of these adverse effects by approximately 80 percent. This assumption is based on the following rationale.

1. Handlers: Studies indicate that under ideal use situations, personal protective equipment (PPE) or engineering controls (enclosed cabs/closed systems) can reduce exposures by at least 95 percent. However, pesticide-handling conditions are not ideal--hoses break, spills occur, PPE is torn, handlers remove their PPE or accidentally contaminate the inside of it, PPE is incorrectly or incompletely decontaminated or maintained, etc. Therefore, in spite of the WPS provisions for handler training and special instructions, decontamination sites, and routine inspection and maintenance of PPE, the Agency projects that the handler protections of the WPS may have an efficacy rate of only about 80 percent.

2. Workers Protected During Application and During Restricted-Entry Intervals: The WPS excludes workers from areas being treated or remaining under an REI, except under special circumstances. Such an exclusion would be close to 100 percent efficacious if total compliance were achieved. However, the WPS does allow workers in treated areas during REIs for short-term activities and for emergency activities. Such entries are accompanied by handler-like protections, but would still not be expected to achieve 100 percent protection. Furthermore, noncompliance with the exclusion of workers during applications and REIs may occur--drift from application onto nearby workers may occur and notification to workers of treated areas may be insufficient, incorrect, or ignored. Therefore, EPA projects that the WPS provisions for protecting workers during application and the REI may have an efficacy rate of only 80 percent.

3. Workers Protected After REI: The WPS provides workers with training and decontamination facilities if they will be working in treated areas within 30 days of

the REI. In addition, workers are notified about any nearby areas where pesticides are to be applied or where a restricted-entry interval is in effect.

The benefits of training as a mechanism for reducing worker illnesses and injuries have been documented in manufacturing settings and it is reasonable to expect that such programs would also be effective in agricultural settings. A 1985 study by ICF, Inc. to assess the possible benefits from increased supervision, notification, and training requirements of the Worker Protection Standard states: "the percentage of pesticide poisoning prevented by improved information flows to workers might be assumed to range between 25 and 75 percent" (ICF, 1985). While this study only considered increased handler training, it is reasonable to assume that the extension of training to workers in this final rule would result in increased benefits.

The importance of frequent and thorough washing as a means of reducing dermal exposure to pesticides, which constitutes as much as 98 percent of the exposure of field workers to pesticide residues, is also well documented. Two experts, Dr. Jesse S. Ortiz of the School of Public Health at the University of Massachusetts and Dr. Eugene J. Gangarosa of the Public Health Program at Emory University School of Medicine, have estimated that if adequate handwashing facilities were available, pesticide-related illness could be reduced by 65 percent and pesticide-related skin rashes could be reduced 35 to 97 percent (U.S. DOL, 1987).

The WPS protections for these workers are not independent of one another. Training should reinforce workers' recognition of the need to heed warnings about areas that are unsafe to enter, as well as their attention to such warnings. Training should reinforce workers' use of decontamination facilities by informing them of the importance of washing thoroughly and often, even when the presence of residues cannot be readily detected. The Agency believes that these combined protections would achieve an 80 percent efficacy in reducing pesticide-related illnesses and injuries for this segment of the worker population.

Cases avoided

For the purposes of this analysis, EPA estimates that, in the WPS-covered workforce, the following pesticide poisoning cases attributed to occupational exposures to agricultural-plant pesticides could be largely avoided through compliance with the WPS:

- a range of 300 to 450 for the annual hospitalized acute pesticide poisoning cases and a range of 10,000 to 20,000 annual physician-diagnosed (not hospitalized) acute pesticide poisoning cases that could be attributed to occupational exposures to agricultural-plant pesticides, using the most complete and reliable pesticide poisoning data available. An 80% reduction in these cases would avoid 240 to 360 hospitalized acute cases and 8,000 to 16,000 acute physician-diagnosed cases annually.

- a significant number of annual acute pesticide poisoning incidents for which medical treatment is not sought or for which medical treatment is symptomatic (no causal diagnosis is attempted) or for which no occupational connection is made. Since the Agency has not attempted to estimate the rate of such poisoning incidents in this analysis, no specific estimate of cases avoided through WPS compliance is included, although the Agency believes the number is very likely to be large.

Given the expected effectiveness of the rule, EPA believes that the delayed-onset adverse effects that would be avoided through compliance with the rule will include potentially important numbers of cancer cases, serious developmental defects, stillbirths, and persistent neurotoxic effects. Discussions of these estimates appear earlier in this section. In addition, as discussed earlier, other potential adverse effects may be avoided through compliance with this final rule.

The Agency recognizes the inherent difficulty in assigning costs of the rule among six disparate adverse effects and among the many adverse effects for which no specific estimates were attempted. One possible method would arbitrarily distribute the costs of the rule equally among the six specifically estimated adverse effects and compute a cost per case avoided for each such effect. Such an allocation of costs would be arbitrary. In addition, the approach disregards the anticipated health effects for which quantitative estimates have not been made.

Another method would compare all of the costs of the rule to one adverse effect in an attempt to provide some basis for evaluating the rule's cost-effectiveness. Using this method, the Agency might base the calculation on the category of health effect for which the best data are thought to be available--annual physician-diagnosed (including hospitalized) acute pesticide poisoning cases that could be attributed to occupational exposures to agricultural-plant pesticides (10,300 - 20,450). With an 80 percent reduction of such cases through compliance with the final rule, the estimate of the number of such cases that would be avoided by implementation of this final rule would be 8,240 - 16,360. This range of estimates would then be compared to the costs of the final rule. This result is, however, highly incomplete since it fails to incorporate all six types of adverse effects for which EPA attempted quantification, as well as the numerous effects for which no specific estimates were made.

Note that these analyses are an attempt to quantify overall risks, across all pesticides to which the population is typically exposed, for several different adverse effects. They do not attempt to take into account the possibility of currently unrecognized highly significant risks that may be associated with individual pesticides. When any such highly significant risks are discovered, they will be dealt with by the Agency on a case-by-case basis.

4. Support for regulation

EPA issued an Advanced Notice of Proposed Rulemaking in 1984 that announced its decision to revise part 170 and solicited public comment. Most comments favored revising part 170, but they expressed wide differences in opinion about the revisions needed. In 1988, EPA issued a Notice of Proposed Rulemaking (NPRM) and held more than 15 public meetings to explain the proposed rules and to answer questions. In response to the NPRM, the Agency received 380 comments totaling more than 3,000 pages. Of the comments, the overwhelming majority supported issuance of a new rule, including many federal and state agencies, universities, agricultural worker organizations and advocates, growers and grower/commodity organizations, and pesticide registrants. As would be expected in a rule of this scope and

complexity, there were a number of comments and suggestions specific to the various provisions.

In addition to the comments received during the rulemaking process, EPA has received support for this rule from a number of other sources, including EPA's own Science Advisory Board, a U.S. General Accounting Office report to Congress, and the Council of Scientific Affairs of the American Medical Association.

In 1990, EPA's Science Advisory Board identified agricultural worker exposures to chemicals as a relatively high human health risk due to the large number of workers directly exposed to a range of highly toxic chemicals (U.S. EPA, 1990). They stated: "[A]gricultural workers are exposed to many toxic substances in the workplace. Such exposures can cause cancer and a wide range of non-cancer health effects."

A 1992 United States General Accounting Office (GAO) study concluded that farmworkers and their children are routinely exposed to pesticides and that the health and well-being of farmworkers are inadequately protected by federal laws and regulations (U.S. GAO, 1992). The report states: "Federal laws and regulations give hired farmworkers exposed to pesticides inadequate protection, which increases the risk of pesticide poisonings." GAO's recommendations to reduce farmworkers' health risks included the following (all of which are addressed in this final rule):

(1) Access to labeling information, and specific information about pesticides to which the workers may be exposed.

(2) Oral and written warnings or notification of pesticide use.

(3) Greater restrictions on entering pesticide-treated areas, including a minimum reentry period of 12 hours and increased level of personal protective equipment.

(4) Widespread availability of sanitation facilities, including handwashing facilities.

GAO concludes: "EPA's modified [worker protection] standards, some of which will be effective in 1992, should increase protection to these farmworkers" (U.S. GAO, 1992).

In 1988 the Council of Scientific Affairs of the American Medical Association (AMA) recommended that the AMA: "Urge the EPA and other responsible state and federal regulatory agencies to continue their efforts at safeguarding human and environmental health, especially the health of agricultural workers who may be exposed to pesticides" (AMA, 1988).

Another indicator of the need for such regulation, and of its apparent benefits, is that key states have developed similar worker protection regulations. The major agricultural states of California, Texas, Arizona, and Ohio have already promulgated regulations that contain provisions similar to those in this final rule. Several other states, including New Jersey and Washington, are developing such regulations.

B. Benefits to Users

Agricultural-plant pesticide users are the owner/operators and supervisors of agricultural establishments and commercial pesticide handling establishments that use pesticides in the production of agricultural plants on farms, forests, nurseries, and greenhouses. These users will benefit in many ways from the revision of the WPS.

The primary goal of the revised final rule is to mitigate occupational exposures of fieldworkers and pesticide handlers to agricultural-plant pesticide products and their residues. The mitigation of such exposures should provide specific benefits to agricultural-plant pesticide users by:

(1) reducing time lost from the workforce by agricultural workers and handlers, including users themselves,

(2) reducing medical expenses and insurance premiums for themselves and as employers of hired workers and handlers,

(3) decreasing liability concerns, expenses, and insurance, and

(4) increased overall productivity from having a workforce less at risk of adverse health effects (acute, allergic, and delayed) from occupational exposures to agricultural-plant pesticides.

Sufficient data are not available to allow the quantification of the value of these benefits. The Agency, however, believes these benefits are substantial.

Pesticide users will also benefit from having a single standardized set of duties rather than myriad label-specified duties that may vary considerably from product to product. Over the past several years, many of the requirements similar to those contained in this revised rule have been placed on a number of individual specific products' labels by the Agency. These include: prohibiting early entry, specifying increased personal protective equipment and exceptions to personal protective requirements, and establishing 24-, 48-hour, and longer reentry intervals accompanied with various restrictions and exceptions. This final rule will allow users to become informed, in general, about only one set of duties and requirements pertaining to worker safety, rather than having to interpret and comply with duties that vary from product to product.

The revised final rule benefits pesticide users by: (1) allowing them options as to the means of fulfilling some of the requirements, and (2) creating exceptions to some of the requirements when employees would not be likely to benefit from the protection. In fact, the complexity of the WPS is, in large part, due to the number of exceptions and options that the Agency has built in for many of the key provisions. The exceptions and options allow employers to choose, for their individual situation, the least burdensome means of meeting a requirement.

Finally, pesticide users will benefit from having a trained and informed workforce. Studies indicate a high correlation between safety training and increased cooperation by employees in safety programs designed for their benefit. Such a workforce is more likely to follow safety precautions to protect themselves and others, thus reducing the likelihood that pesticide users will experience enforcement actions, liability suits, and pesticide-related emergencies.

C. Benefits to Registrants

The revised final rule will require registrants of agricultural-plant pesticide products to alter their product labeling to add a standardized WPS reference statement and to include product-specific requirements pertaining to personal protective equipment, restricted-entry intervals, and notification to workers. Registrants will benefit from many aspects of the implementation of the WPS, especially from the standardization of labeling statements.

Registrants are incorporating the entire WPS into each pesticide product's labeling by adding a three-sentence reference statement to the product labeling, rather than by adding the entire text of the rule into supplemental labeling which would then accompany each product at sale. This reference-statement innovation will benefit registrants by greatly reducing labeling length and complexity and, thus, reducing printing and distribution costs for labeling.

Registrants will also benefit from the standardization of labeling statements and terminology pertaining to personal protective equipment, restricted-entry intervals, and notification to workers. Their users will be better able to interpret the standardized labeling statements and requirements and thus, presumably, will be able to use the pesticide with increased safety to themselves, others, and the environment. Such increased safety in the use of their pesticides would benefit registrants through decreased liability, decreased insurance rates, and improved public image.

Furthermore, EPA has been establishing interim requirements regarding entry and personal protective equipment on a product-by-product basis for more than a decade. Since that time some registrants may have been at a competitive disadvantage if, for example, a registration standard establishing a reentry interval were issued for their product before one was issued for their competitors' products. This rule will eliminate that competitive disadvantage by establishing the same requirements and use limitations for products with similar toxicity, formulation, and use patterns.

By standardizing the exceptions concerning personal protective equipment, restricted-entry intervals, and notification to workers, the WPS makes these statements universally applicable. Registrants benefit by being able to remove verbiage regarding such exceptions from their pesticide product labeling, thereby reducing labeling complexity, lowering printing costs, and freeing label space for other crucial use directions.

Registrants may benefit from the promulgation of this final rule, because its issuance is likely to reduce pressure for states to adopt state-specific worker protection regulations. Registrants will save considerable costs if fewer state-specific regulations are enacted, through avoidance of having to supply supplemental use directions on a state-specific basis.

Finally, registrants will benefit from having users who: (1) are better trained and informed, (2) are equipped with appropriate personal protective equipment, and (3) have access to wash water for routine and emergency decontamination. Such users are likely to handle pesticides more safely and experience adverse health effects far less often. Such an outcome will benefit registrants through decreased liability, decreased insurance rates, and improved public image.

D. Benefits to States, Tribes, and Territories

The revision of the Worker Protection Standard is expected to obviate the need for agricultural worker protection regulations in many states.* Many states would no longer need to consider legislation or regulation in this area. EPA is aware of states that are delaying promulgation of their own worker protection regulations in anticipation of the issuance of this final rule. While there is no reliable way to know how often this will occur, there is ample evidence that states have been moving toward more stringent regulations with respect to pesticides and worker protection. Arizona, California, Texas, and Ohio are examples of states with significant regulations designed to reduce agricultural worker and pesticide handler exposures to pesticides. Washington and New Jersey, among others, are known to be

* Term "states," as used here, includes tribes and territories.

developing such regulations at this time, and it is likely that pressure exists in many other states to follow suit.

In general, states enforce federal pesticide regulations, including the original WPS. One of the primary rationales for revising the original WPS was the difficulty state and federal officials had in enforcing its requirements, mainly because it failed to make clear who was responsible for providing the required protections to agricultural workers. The revised final rule is designed to clarify and make more enforceable the WPS provisions, thus simplifying the efforts of compliance monitoring officials and, in some respects, easing their burden.

States will benefit from increased standardization of pesticide use directions and related requirements. The standardization of labeling statements regarding personal protective equipment, restricted-entry intervals, and notification will allow state training and compliance monitoring personnel to more easily interpret and enforce those requirements. Instead of requiring states to train users about or enforce requirements that vary greatly from product to product, the WPS will establish standardized terminology and statements that, in general, are applicable to all agricultural-plant pesticides. In addition, the WPS sections on personal protective equipment, restricted-entry intervals, and notification standardize and clarify the exceptions to these requirements for all affected products. The need for special enforcement policy statements and label-specific language on these exceptions will be eliminated.

EPA has set aside special monies for states to fund WPS-related special projects. In fiscal years 1990 through 1992, $500,000 was available annually to states desiring to develop WPS initiatives. The states have benefitted from this WPS Special Project funding by being able to develop WPS-specific projects and to explore innovative means of implementing and enforcing the WPS. Beginning in fiscal year 1990, EPA has also provided states with WPS-specific compliance monies. The states have benefitted from those monies by using them to strengthen the worker-protection compliance, information, and education components of their programs.

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VI. IMPACTS ON SMALL ENTITIES

The Regulatory Flexibility Act (RFA) (P.L. 96-354) requires governmental regulators to make a conscious effort to lighten the regulatory burden of their actions on the "small entities" within regulated communities. Regulatory options must be considered in an attempt to avoid "a significant economic impact on a substantial number of small entities."

The following analysis responds to the RFA requirements, presents the rationale for the Agency's regulatory actions, and assesses the relative economic impacts on small entities within the proposed regulatory community. It provides a preliminary assessment on whether the proposed action causes "a significant economic impact on a substantial number of small entities." While this is a subjective criteria, the following analysis indicates that the rule has avoided or mitigated, to the extent feasible, potential disproportionate burdens on small entities and is structured to provide a nearly equitable burden on both small and large entities.

This revised Worker Protection Standard (WPS) impacts those agricultural establishments - farms, forests, nurseries, and greenhouses — that use pesticides and are primarily involved in the production of agricultural plants. EPA estimates that there are approximately 570,000 such establishments nationwide. Nearly all these establishments would be classified as small businesses based on conventional size-classifications for U.S. businesses. Because of their unique characteristics, however, agricultural businesses are often classified using other criteria than those used for conventional businesses. For this analysis, two forms of classifying small versus large farms were used to consider if "significant economic impacts" occurred "on a substantial number of small entities. They were:

(1) Impacts on family-operated establishments, in comparison with impacts on hired-labor agricultural establishments, and

(2) Impacts on hired-labor agricultural establishments that have 1 hired employee, in comparison with establishments that have 10 hired employees.

Overall, EPA has attempted in several ways to relieve the regulatory burden of this final rule on small entities. Family-operated agricultural establishments will be exempt from many of the provisions in the rule. In addition, the rule allows employers considerable flexibility in the ways that they may fulfill the requirements. In some circumstances, it allows them to bypass requirements altogether when no employees would be likely to benefit from the protection. The extent of the economic burden or relief to small entities from these actions is detailed below.

A. Impacts on Family-Operated Establishments

The revised rule exempts owners of agricultural establishments and members of their immediate family from the provisions pertaining to safety training and information, decontamination facilities, notification of pesticide treatments, and emergency assistance. EPA presumes that owners and family members will provide themselves and each other with these protections, but has chosen not to regulate such behavior. This decision represents a significant exemption for small entities, since about 45 percent (250,000 of 570,000) of the agricultural establishments within the scope of the WPS do not hire labor and are, therefore, exempt from all but a few of the final rule's requirements. These establishments use only unpaid employees who, presumably, are the owners and their family members.

In terms of acres per establishment, family-operated agricultural establishments (those without paid employees) have an economic base that is one-third to one-sixth the size of agricultural establishments that employ paid workers. The size varies according to the primary crop produced (Table III-1). For example, family-operated feed and grain farms average 213 acres per farm, while those with hired employees average 607 acres per farm. For cotton farms, the ratio is 133 acres to 806 acres respectively, and for fruit/vegetable/nut farms the ratio is 16 acres to 121 acres respectively for those without and with hired employees.

Recognizing the need to minimize burdens on small family-operated establishments, EPA has reduced the requirements — and therefore the costs — for this sector, which represents approximately 45 percent of the regulated establishments. This analysis reveals that family-

operated agricultural establishments will bear a low cost-burden as compared to agricultural establishments with hired labor. The annual incremental out year costs averaged across all family-operated establishments are about $15 per establishment, whereas the annual costs averaged across all hired-labor agricultural establishments are about $140 per establishment. Family-operated feed and grain farms, which make up the largest crop segment, will incur yearly incremental out year costs averaging nearly $10 per farm. Feed and grain farms with hired employees will incur annual incremental out year costs averaging almost $55 per farm (Table VI-1).

B. Impacts on Hired-Labor Establishments According to Number of Hired Employees

This Regulatory Impact Analysis also has considered the impacts of this final rule on hired-labor agricultural establishments that have one hired employee, in comparison with establishments that have ten hired employees (Note: the mean number of hired employees on establishments with hired labor is 4.8). None of the provisions of the regulation provide a direct efficiency of size to establishments with many employees. Most of the provisions are totally or mostly variable (per worker) costs. However, the cost of familiarization with the rule is considered a per-establishment cost. Also, two provisions that contain some fixed (per establishment) cost elements are training and notification. Even these provisions are not directly efficiency-of-size cost factors, due to: (1) the diverse and sporadic nature of pesticide-use and labor-use practices, and (2) the exceptions and options in the rule that allow employers to select the most cost-effective option for their particular circumstance. The variability in the cost-factors due to these exceptions and options is difficult to quantify. Therefore, this estimate of the impact on one-worker agricultural establishments versus the impact on ten-worker agricultural establishments is a "worst-case" analysis that assumes that all costs of training and notification are fixed rather than variable. This results in an over-estimate of the impact of this rule to one-worker agricultural establishments and an underestimation of the impact to ten-worker establishments. However, results indicate that the burden is not unreasonably higher for such small establishments.

Table VI-1. Worker Protection Standard costs for small (without hired employees) versus large (with hired employees) crop production establishments, 1991 dollars.

Crop Segment	Incremental Compliance Cost 1/				Regulated agricultural establishments 2/		Average size of agricultural establishment 3/		Annual Compliance Costs Per Establishment 4/			
	Small establishments (without hired employees)		Large establishments (with hired employees)						Small establishments (without hired employees)		Large establishments (with hired employees)	
	1st year	Out year	1st year	Out year	Small	Large	Small	Large	1st year	Out year	1st year	Out year
	($1,000)				(1,000 Farms)		(Acres)		($/Farm)			
Feed & Grain	4,321	1,841	16,906	7,254	168	133	213	607	25.72	10.96	127.11	54.54
Cotton	149	68	2,617	1,203	5	16	133	806	29.80	13.60	163.56	75.19
Tobacco	231	106	6,395	2,689	8	51	19	69	28.88	13.25	125.39	52.73
Other Field	738	303	7,677	2,763	37	34	47	264	19.95	8.19	225.79	81.26
Veg/Fruit/Nut	1,906	1,544	32,899	26,610	21	58	16	121	90.76	73.52	567.22	458.79
Nursery/ Greenhouse	407	208	5,604	3,133	13	19	6	35	31.31	16.00	294.95	164.89
Commercial Application	0	0	2,143	1,517	0	9	n.a.	n.a.	n.a.	n.a.	238.11	168.56
TOTAL	$7,751	$4,070	$74,241	$45,169	252	320	136	362	$30.76	$16.15	$232.00	$141.15

1/ Appendix Table RF-1.
2/ Those agricultural-plant establishments that use pesticides (Table III-3).
3/ Table III-1.
4/ Some farms in some states may be in compliance with some requirements of the Worker Protection Standard due to existing state regulations. No attempt was made to net out these farms as it should be proportional across all farms. This would underestimate state actual averages for all farms but the extent is unknown.

The revised rule allows employers options in the means of fulfilling some of the requirements and also creates exceptions to some of the requirements when employees would not be likely to benefit from the protection. In fact, the complexity of the WPS is due in large part to the number of exceptions and options that the Agency has built in for many of the key provisions.

The rule provides options to employers by allowing them to choose the least burdensome means of meeting a requirement for their situation. For example, the rule requires that employers notify hired workers of treated areas on farms, forests, and nurseries, but allows employers to choose (except with the most highly toxic pesticides) whether to notify orally or by posting signs at entrances to treated areas. On many small establishments with only a few workers, an oral warning probably would take less than a minute per pesticide application, as opposed to posting warning signs at entrances to the treated fields. On small establishments where a large variety of crops are grown in a small area, such as herb farms or potted-plant nurseries, posting a warning sign next to treated plants probably would take less than a minute per pesticide application, as opposed to orally warning employees about all the different applications taking place.

The rule also provides exceptions to several key provisions. For example, employers need not notify workers if (1) the workers will not be in or within 1/4 mile of the treated area during the pesticide application or the restricted-entry interval, or (2) the workers applied or supervised the application for which the notification is being given and therefore know the information that an oral notification would convey. On farms with a small number of employees working only in one area, employers would not have to warn those employees — either orally or by posting signs — if the application or area under a restricted-entry interval was located in another part of the farm. If a farm had only one or two employees, and those employees performed the pesticide applications, the employer would have no notification duties.

The rule also provides exceptions to the decontamination and training provisions for employees working in areas where pesticides have not been recently applied. Training and

decontamination facilities are required only within 30 days of a pesticide application or a restricted-entry interval. For example, a feed and grain farm that applies a pesticide only at planting and hires no workers until harvest would not have to provide those workers with any protections under this rule.

All the workers who are on an establishment when training is held can be trained at one time, so that the labor cost for the trainer could be incurred only once. On establishments with many employees, however, worker turnover is common. USDA has advised EPA that 1,000-percent turnover within labor-intensive agricultural work groups is not unusual. Workers not trained during the initial training would have to be trained on another occasion, if they have not been trained before their employment on that establishment.

Notification costs also could be strictly per-establishment costs but, in reality, probably will not be. As noted earlier, only those workers who will be within 1/4 mile of a treated area need be notified about an pesticide application. Establishments with only one hired worker may have no notification costs, while establishments with more than one crew of workers may have to notify each crew separately, depending on which treated areas each will be within 1/4 mile of.

The decontamination provision might be expected to contain fixed (per establishment) costs for purchase of the water container and the labor required to rinse and fill the container, but such is not the case. The size of the container needed and the amount of time needed to rinse and fill it are directly related to the number of workers for whom the decontamination facility is being provided. For example, establishments with only one worker would need to obtain and fill only a one-gallon container (such as a plastic milk jug). Establishments with 10 workers would need to obtain and fill either 10 one-gallon containers or one or more larger containers. Therefore, in the main, this analysis figures the decontamination provision as a variable (per worker) cost.

As stated earlier, quantifying these options and exceptions to determine a direct efficiency-of-size impact is difficult. Therefore, EPA completed a sensitivity analysis and considered

effects on costs if direct efficiencies of size related to the training and notification requirements of the WPS and the cost of familiarization with the rule were realized, and how costs for establishments would vary depending on the number of hired employees (one, ten, or average number). This would be a worst-case analysis in terms of relative per-employee costs for small establishments. To analyze the per-employee cost for agricultural establishments with between 1 and 10 hired employees, EPA separated the cost elements of the WPS into those which are mainly fixed (per-establishment) — training, notification, and rule familiarization — and those which are mainly variable (per-employee) costs. Table VI-2, which was derived from Appendix Table RF-1, summarizes the results. The assessment of relative burden is shown with two sample cases: feed and grain farms, which represent the crop sector with the most entities affected, and vegetable/fruit/nut farms, which represent the crop sector with the highest cost impacts, both total and per establishment.

Even with impacts for one-worker establishments being exaggerated, the results indicate the burden is not unreasonably higher for establishments with only 1 hired employee than for those with 10 hired employees (Table VI-2 and Figure VI-1). The average incremental out year cost for a feed and grain farm with one hired employee is about $25 per year (or $25 per employee). For a feed and grain farm with 10 hired employees, it is about $115 per year (or $10 per employee). For vegetable/fruit/nut establishments with 1 hired employee, the average incremental out year cost is almost $95 per establishment (or $95 per employee). The cost is nearly $650 (or $65 per employee) for a vegetable/fruit/nut establishment with 10 hired employees.

C. Impacts on Other Small Entities

This regulation should not cause any significant burden on any forms of small entities other than farms, nursery/greenhouses, and commercial handlers.

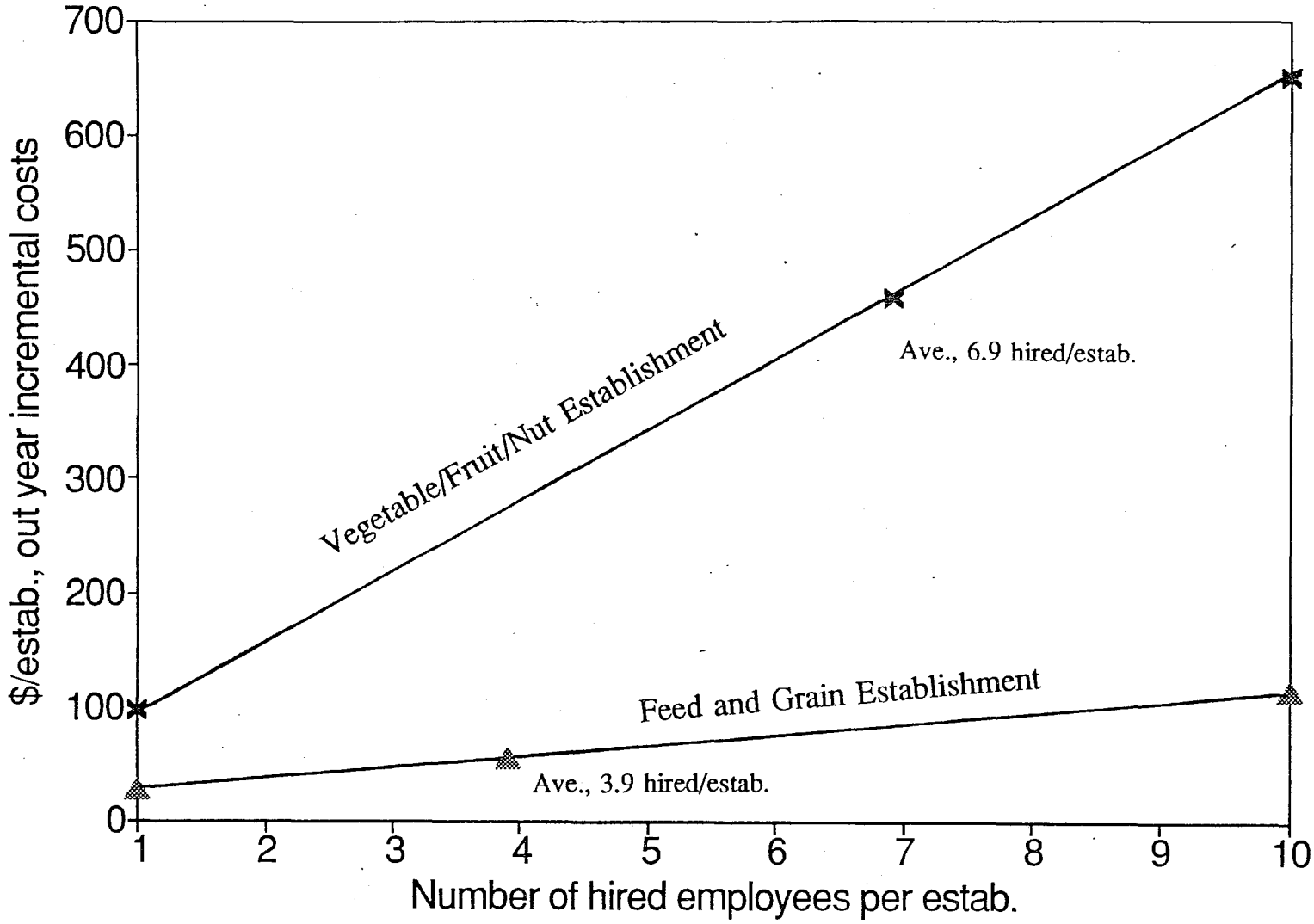
No provisions of this rule will require implementation support or compliance from typical small cities, counties, towns, villages, school districts, not-for-profit enterprises, or other similar public or private institutions.

Table VI-2. Incremental costs of compliance per year, for representative establishments with different levels of hired employees

Compliance cost category	Costs Per Establishment Per Year (Out Year)					
	Size of feed and grain establishments with hired employees			Size of fruit and vegetable establishments with hired employees		
	Average (3.87 hired)	One Hired	Ten Hired	Average (6.9 hired)	One Hired	Ten Hired
	($/Establishment)					
Variable Worker Protection Requirements (restricted entry, decontamination, personal protective equipment, emergency response)	38.12	9.85	98.50	424.80	61.57	615.65
Fixed or Potentially Fixed Worker Protection Requirements (training, notification, rule familiarization)	16.41	16.41	16.41	33.96	33.96	33.96
TOTAL -- Per Farm	$54.53	$26.26	$114.91	$458.76	$95.93	$649.61
Per Hired Employee	$14.09	$26.26	$11.49	$66.49	$95.93	$64.96

Source: Calculated from out year incremental costs by cost factor from Appendix Table RF-1 and number of regulated farms from Table VI-1.

Figure VI-1. Incremental costs of compliance for different establishment sizes and number of employees



VII. LIMITS OF THE ANALYSIS

A. Need for Additional Data

Several data deficiencies were identified during the completion of the WPS regulatory impact analysis, both in terms of the cost to and benefit of the regulation. Throughout the WPS compliance analysis, EPA relies on USDA data approximating 1.6 million hired farmworkers in the U.S. work on agricultural-plant establishments (Oliveira and Cox, 1989). Other estimates of the number of hired farmworkers vary widely, and the estimates of both the costs and benefits rely on this number. The revised RIA also relies on USDA estimates of the number of hired (paid) and nonhired (unpaid) agricultural farmworkers by crop sector. However, no data were available on how many of the hired or unpaid farmworkers were pesticide handlers.

A significant portion of the calculations and assumptions relied on pesticide usage data by agricultural crop sector and restricted-entry interval to help determine cost estimates. The pesticide usage data utilized in this study was from a single proprietary source for the year 1989.

Another limitation of the analysis was the lack of data available on the quantitative impacts of restricted-entry intervals on the yields and quality of fruit and vegetable crops. Only one study could be found that addressed this concern to any degree (DPRA, 1985). The DPRA study found that several hand-labor-intensive crops would be primarily affected around harvest time if restricted-entry intervals were 24- or 48-hours after a pesticide application. However, the study did not estimate REI impacts on a quantitative basis. In the revised WPS RIA, average per acre cost impacts were estimated to those crops identified in the earlier DPRA study to incur none - minor, minor - potentially significant, and potentially significant impacts from 48-hour REI's. EPA has created two additional impact categories--significant and major--to describe the impacts that are probable to the cut flower and cut fern industries in the event that an early-entry exception is not granted.

The lack of data on the distribution of agricultural-plant establishments by the number of hired employees was an additional limitation of the revised RIA. This information would allow more precise estimation of impacts of the regulation on small entities and the relative efficiency of the regulation. Due to the lack of agricultural establishment distribution data by hired employee numbers, the revised RIA considers three sizes of establishments: establishments with no hired employees, establishments with one hired employee, and those with 10 hired employees.

The benefit analysis of the revised WPS RIA also had data limitations on occupationally caused pesticide poisonings. Pesticide exposures can result in acute adverse effects and delayed adverse effects.

Acute effects: Reliable estimates of the numbers of acute pesticide poisonings among agricultural workers are difficult to obtain for several reasons including:

- the nature of agricultural labor, as well as economic and social factors, hamper data collection;
- the geographic and seasonal heterogeneity of the population under scrutiny makes estimates of the number of workers at risk elusive;
- agricultural workers adversely affected by pesticides often do not seek medical attention; and
- pesticide poisoning incidents often are treated symptomatically without being diagnosed as pesticide-related and may not be reported as such.

Delayed effects: Unlike acute and allergic effects, where the symptoms usually appear soon after the causal exposure, evidence of delayed adverse effects from pesticide exposures almost always emerges long after the causal exposure(s). This, coupled with the fact that symptoms of pesticide-caused delayed adverse effects are not unique, results in a predictable lack of hard data as to the extent and magnitude of pesticide-caused delayed adverse effects.

The available data fall far short of enabling EPA to quantify risks with a desired level of precision. The Agency uses the available data in this regulatory impact analysis to provide a

representation of the plausible incidence of delayed adverse effects in the agricultural population to which this final rule applies.

B. Potentially Overestimated Compliance Costs

The EPA, in consultation with knowledgeable persons from the agricultural community, found it necessary at times, to supplement published data with proprietary data and estimates. Often, a range of estimates was acquired over several sources. In many instances, estimates at the higher end of the range were used in the analysis that eventually caused higher compliance costs than might be warranted. In addition, certain "what if" scenarios could affect the cost of compliance to the regulated community, however, quantifying these situations was not feasible. For example, the WPS generally has more restrictive, and thus, more costly provisions for pesticides with higher acute toxicities. Agricultural operators may choose less toxic or even non-chemical pesticide control methods to help reduce compliance costs associated with the regulation. The following section describes some of the major potential overestimates of the WPS by cost factor, for the forestry sector, and for the cost of labeling changes to registrants.

1. Restricted-Entry Interval (REI)

The WPS sets a 72-hour REI into fields after application of organophosphate (OPs) or N-methyl carbamate pesticides in arid areas. Due to limited state acreage data on vegetable and fruit crops, EPA estimated the percent of fruit and vegetable acreage that is treated with OPs or carbamates in arid areas to be five percent of the total U.S. acreage of the seven vegetable and six fruit crops identified as being affected by REIs. This is likely an overestimate of the number of acres affected by the 72-hour REI. While arid areas (defined as areas that receive less than 25 inches of precipitation per year) are predominately restricted to certain portions of the country (California, Arizona, Texas, Colorado, etc.), many of the affected crops are also grown nationwide and are not located in arid areas.

Probably the most significant overestimate of expenses due to REIs of the WPS are out year total and out year incremental costs. EPA believes that some vegetable and fruit operator/owners will switch from the more toxic pesticides to the less toxic pesticides or to non-chemical pest control methods, to lessen the impacts of the longer REIs for the more toxic pesticides, especially with time-sensitive crops. Not only will this decrease yield/quality losses associated with time-sensitive harvesting concerns, but it will have the additional benefits of lessening the exposure to handlers and workers of highly toxic pesticides, along with reducing several other cost factors associated with the WPS (PPE, notification, and emergency assistance).

2. Personal Protective Equipment (PPE)

PPE costs vary directly with the toxicity of the pesticide being applied--toxicity I and II pesticides have greater PPE needs, and hence higher costs, than toxicity III-IV pesticides. It is likely that there are some commercial handlers that never handle toxicity I-II pesticides in a given year whether due to crop-specific pesticide requirements, reduced pest infestations, personal preference, or liability concerns. However, determining the actual percentage of commercial pesticide handlers that never handle toxicity I-II pesticides in a given year is difficult. Therefore, the revised RIA estimates the cost of PPE assuming that 100 percent of all commercial handlers handle toxicity I-II pesticides at some time during the year.

3. Notification

Oral notification cost calculations are based on several factors including the number and toxicity of pesticide treatments, the probability that workers are within 1/4 mile of treated fields, the wage rate of workers and supervisors, and the amount of time it takes to orally notify workers of pesticide treatments. Wage rates and notification time comprise the greatest percentage of oral notification costs--both workers and supervisors are paid for their time during notification. The costs estimated for oral notification assume that it takes five minutes to orally notify workers of any pesticide treatments. This is probably an overestimate of the time needed, as in all likelihood it would take less than one minute for a supervisor to tell

workers to "Stay out of the beans today and tomorrow because we're going to apply a pesticide today".

4. Training

The revised Rule exempts certified pesticide handlers from the training requirements of the WPS. However, published data on the number of certified agricultural-plant pesticide handlers is not useful for this analysis in its current aggregated form. Therefore, estimated compliance costs for training is based on the assumption that none of the hired handlers are certified. This is very likely an underestimate of the number of certified hired handlers, which in turn, overestimates the cost of the training component of the WPS.

The training provision of the WPS requires that hired agricultural workers and pesticide handlers receive pesticide safety training. Due to lack of detailed data on agricultural hiring practices, the training cost computation assumes that agricultural employees are hired singularly and will receiving training on a one-on-one basis with the trainer. This is likely an underestimate of the number of employees that are hired at once, especially on vegetable/fruit/nut establishments, where crews of workers are often hired at one time. Several employees can be trained at one time with one trainer, substantially reducing the costs of training.

5. Decontamination

There are several costs associated with decontamination requirements. Containers that hold wash water and the labor necessary to rinse and refill them, account for approximately 75 percent of total decontamination costs. The revised RIA assumes that all hired handlers and hired workers and all commercial handlers use a container to hold the decontamination water. EPA believes this is an overestimate of the number of containers necessary because it is likely that most greenhouses and nurseries and mix/load sites, and some farm and forestry application sites already have running water immediately available.

6. Emergency Assistance

While the cost of emergency assistance is relatively small when compared to other cost factors of the WPS, EPA believes that the numbers may be reduced even further in out years. As stated in the earlier section on overestimates of the costs of REI's, it is likely that some agricultural operator/owners may switch to less toxic or non-chemical pest control methods after the implementation of the WPS. With a decrease in the use of the more toxic pesticides on agricultural establishments, a decrease in the number of occupationally related poisonings among pesticide handlers and workers can be expected. Likewise, with a decrease in the number of poisonings, comes a decrease in costs associated with the emergency assistance provision of the WPS. Furthermore, some poisonings, especially skin rashes and ulcerations, may not require emergency transportation, i.e., the victim may provide for their own transportation.

7. Forestry

Due to the relatively insignificant impacts of the WPS on the forestry sector (about $145,000 incremental out year costs), the costs of the six compliance factors were averaged across the six types of agricultural establishments (feed and grain, cotton, tobacco, other field crops, vegetable/fruit/nut, and nursery/greenhouse) to determine compliance expenses to forestry. Pesticide usage (both amount and toxicity), days that pesticides are handled, days working in the field within the 30-day period following a pesticides's REI, and the probability that workers are within 1/4 mile of fields during a pesticide application and a REI are likely to be more similar to "other field crops" than to the average agricultural establishments. For this reason, EPA believes that the compliance costs of the WPS are overestimated to the forestry sector.

8. Pesticide Labeling Changes

The one-time cost of changing all pesticide product labels which are registered for agricultural uses has been estimated. The Agency is aware that many labels require amendments during

the course of a year for other reasons. Registrants which are revising labels for other reasons would incur less cost to include revisions necessary for WPS compliance. However, the Agency had no basis from which to project the portion of applicable product labels which would require amendment during the course of a typical year. Therefore, no costs were subtracted from estimated total costs and, as such, incremental costs of label changes are overestimated.

In summary, when data "gaps" presented estimation problems that necessitated the use of rational assumptions, EPA attempted to err on the high side, or to overestimate compliance costs associated with the rule rather than to underestimate costs.

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APPENDIX A

Compliance Cost Calculations and Documentation
By Cost Factor

Section 1
Restricted-Entry Interval

Appendix Table REI-1. Revised WPS compliance costs for restricted-entry interval, by sector

Sector	Compliance Costs: Total First Year (1)	Compliance Costs: Total Out Year * (2)	Compliance Costs: Incremental First Year (3)	Compliance Costs: Incremental Out Year * (4)	Number of Establishments That Use Pesticides (5)	Incremental Costs per Establishment That Uses Pesticides: First Year (6)	Incremental Costs per Establishment That Uses Pesticides: Out Year * (7)
	($)		($)		(Number)	($)	
Feed & Grain	NOT SIGNIFICANT						
Cotton	NOT SIGNIFICANT						
Tobacco	NOT SIGNIFICANT						
Other Field 8/	NOT SIGNIFICANT						
Vegetable & Fruit 9/	38,759,410	38,759,410	20,711,251	20,711,251	79,050	262.00	262.00
Nursery & Greenhouse	604,124	491,266	434,837	434,837	31,450	13.83	13.83
Total	$39,363,534	$39,250,676	$21,146,088	$21,146,088	110,500		

* First and out year costs are estimated to be the same, though out year cost are likely to be overestimated. It is expected that some agricultural operators will switch to less toxic or non-chemical control methods in out years to reduce restricted entry, which will in turn, reduce yield/quality losses associated with time sensitive, hand-labor intensive crops.

SOURCES:

(1),(2); DPRA, Inc. Analysis of Proposed Reentry Interval Regulations Under FIFRA. 1985.: for feed & grain, cotton, tobacco, and other field sectors. Appendix tables REI-2 and REI-7 for vegetable & fruit sector; REI-11 for nursery/greenhouse sector.

(3),(4); DPRA, Inc. Analysis of Proposed Reentry Interval Regulations Under FIFRA. 1985.: for feed & grain, cotton, tobacco, and other field sectors. Appendix tables REI-4 and REI-9 for vegetable & fruit sector; REI-11 for nursery/greenhouse sector.

(5); Table III-2, column (1)-(4).

(6); Calculated, (3)/(5).

(7); Calculated, (4)/(5).

8/ There may be some costs associated with the seed corn industry, however, data on acreage and value could not be found.

9/ Out year costs are likely overestimated, as some operators may switch to less toxic pesticides or to non-chemical pest control methods causing lesser impacts. However, any deductions from first year costs due to the use of less toxic pesticides or non-chemical methods of pesticide control could not be quantified.

Appendix Table REI-2. Total first year and total out year restricted entry interval (REI) costs to vegetable crops

Affected Vegetable Crops (1)	Percent of Base Acreage Treated with 48 Hr REI Pesticides (2)	Percent of Base Acreage Treated with 72 Hr REI Organophosphates in Arid Areas (3)	Base Acreage Treated with Any Pesticide (1988-90 ave) (4)	Average per Acre Impact from 48 hr REI (% yield/ quality loss) (5)	Average per Acre Impact from 72 hr REI--OPs in arid areas (% yield/ quality loss) (6)	Per Acre Crop Value (1988-90 ave) (7) ($/Acre)	Per Acre Income Loss due to (5) (8) ($/Acre)	Per Acre Income Loss due to (6) (9) ($/Acre)	Aggregate Income Loss (10) ($)
Artichokes	95%	5%	10,244	0.5%	1.0%	3,212	15.26	1.61	172,768
Cauliflower	95%	5%	60,526	0.5%	1.0%	2,734	12.99	1.37	868,694
Snap Beans	95%	5%	34,564	0.5%	1.0%	1,578	7.50	0.79	286,396
Tomatoes	95%	5%	128,029	0.5%	1.0%	7,428	35.28	3.71	4,992,976
Cucumbers	95%	5%	110,547	1.50%	3.0%	1,714	24.43	2.57	2,984,787
Melons	95%	5%	242,813	1.50%	3.0%	1,353	19.28	2.03	5,173,310
Squash	95%	5%	20,021	3.50%	7.0%	2,902	96.50	10.16	2,135,391
						Total First & Out Year Costs of REI			$16,614,321

Note: Assumes there are no price effects.

SOURCES:

(1); DPRA, Inc. Analysis of Proposed Reentry Interval Regulations Under FIFRA. 1985.

(2); Estimate based on acre treatments of Toxicity I pesticides as reported by:

--U.S. Department of Agriculture. Agricultural Chemical Usage 1990 Vegetables Summary. 1991 (June).

--Oregon State University Extension Service. Oregon Pesticide Use Estimated for 1987. 1989 (August).

--State of California, Department of Food and Agriculture. Pesticide Use Report by Commodity. 1988.

(3); Estimated by DPRA, Inc. California produces the majority of affected vegetable crops that are grown in arid areas. However, base acreage is estimated assuming 5% of total U.S. vegetable (7 crops) acreage is affected. Therefore, the percentage of affected acreage is likely overstated.

(4); Derived from total crop acreages in Appendix Table REI-3 times 92.5% (represents the percentage of total crop acres that are treated with pesticides). 92.5% was derived by dividing column (3) in Table III-2 (15% for veg) by 50%. Assumes that the establishments that don't use pesticides are smaller operations and untreated acreage is proportionately one-half as much as the number of farms not using pesticides.

(5); Estimated by DPRA, Inc. and EPA based upon (1), consultation with industry experts, and general knowledge.

Crop Impact	Range of Yield Loss	Average Yield Loss
None - Minor	0.00 - 1.00	.5
Minor - Potentially Significant	1.00 - 2.00	1.50
Potentially Significant	2.00 - 5.00	3.50
Significant	5.00 - 7.00	6.00
Major	7.00 - 15.00	11.00

(6); Estimated by DPRA (double the impact of (5)).

(7); Appendix Table REI-3.

(8); Calculated, [(2)X(4)X(5)X(7)]/(4).

(9); Calculated, [(3)X(4)X(6)X(7)]/(4).

(10); Calculated, (4)X[(8)+(9)].

Appendix Table REI-3. VEGETABLE CROPS -- With impacts from 48 hr. restricted entry interval *

Crop	Acres 1/ Harvested (3-year ave)	Total value 1/ of Production (3-year ave) ($1,000)	Per Acre Crop Value ($)
Squash 2/	21,644	62,817	2,902
Cucumbers 3/	119,510	204,876	1,714
Melons 4/	262,500	355,096	1,353
Tomatoes (fresh)	138,410	1,028,155	7,428
Artichokes	11,075	35,576	3,212
Snap Beans 5/	37,367	58,975	1,578
Cauliflower	65,433	178,882	2,734
Total of affected crops	655,939	1,924,377	

* Crops included are based on DPRA's 1985 report, "Analysis of Proposed Reentry Interval Regulations Under FIFRA".

1/ Unless otherwise noted, from USDA Vegetables and Specialties Yearbook, 1991 (Dec). 3-year average=1988-90.

2/ Squash Stats:

	Acres Harvested	Value ($1,000)
Florida	13,117	37,567
Calif	7,979	23,905
Arizona	549	1,346
Total	21,644	62,817

Note: Florida data from 1988-90, Calif from 88-89, Arizona data from 1988-90. Texas data NA.
Source: Florida & Arizona Ag Stats and USDA Veggies and Specialties Yearbook

3/ Processing cucumbers only, 88-90

4/ Melon Stats:

	Acres Harvested	Value of Prod ($1,000)
Honeydew	30,550	73,020
Watermelon *	127,200	83,812
Cantaloupe **	104,750	198,264
Total	262,500	$355,096

*Watermelon-'90 only--harvested acres

California	14,600
Arizona	4,600
Texas	55,000
Florida	53,000
Total	127,200

**Cantalope--harvested acres

	89	90
California	84,000	90,200
Arizona	7,600	8,700
Texas	NA	19,000
Total	91,600	117,900

2 yr ave harvest 104,750

5/ Snap beans for fresh market

	Acres Planted	Value ($1,000)	Value per Acre ($)
Florida	27,833	49,274	1,770
Michigan	2,500	3,330	1,332
N.Carolina	6,833	6,105	893
Arizona	200	266	1,332
Total	37,367	$58,975	

Note: Florida and N.C. data from 1988-90, Michigan & Ariz. only 1990.
Note: Mich. & Ariz. Value figures derived from the average value of Florida & N.C. snap beans.
Source: Florida, N.C. state ag stats; Mich. & Ariz. from USDA Ag. Chemical Usage.

Appendix Table REI-4. Incremental first year and incremental out year restricted-entry interval (REI) costs to vegetable crops

Affected vegetable crops (1)	Percent of Base Acreage Treated with 48 Hour REI Pesticides (2)	Percent of Base Acreage Treated With 72 Hr REI Organophosphates in Arid Areas (3)	Base Acreage-- Removing Acres Currently Affected by state REIs (4)	Percent of Base Acreage Currently Incurring Losses Due to Label REIs, PHIs, or PPE Requirement (5)	Base Acreage Affected by the WPS REIs (6)	Average per Acre Impact from 48 hr REIs (% yield/ quality loss) (7)	Average per Acre Impact from 72 hr REIs-- OPs in arid areas (% yield/ quality loss) (8)	Per Acre Crop Value (1988-90 ave) (9)	Per Impacted Acre: Income Loss due to (7) (10)	Per Impacted Acre: Income Loss due to (8) (11)	Aggregate Income Loss (12)
								($/Acre)	($/Acre)	($/Acre)	($)
Artichokes	95%	5%	5,634	0%	5,634	0.5%	1.0%	3,212	15.26	1.61	95,021
Cauliflower	95%	5%	34,783	0%	34,783	0.5%	1.0%	2,439	11.58	1.22	445,350
Snap Beans	95%	5%	34,472	0%	34,472	0.5%	1.0%	1,577	7.49	0.79	285,425
Tomatoes	95%	5%	108,714	0%	108,714	0.5%	1.0%	7,520	35.72	3.76	4,291,770
Cucumbers	95%	5%	109,050	20%	87,240	1.50%	3.0%	1,686	24.02	2.53	2,316,009
Melons	95%	5%	189,707	10%	170,736	1.50%	3.0%	1,445	20.59	2.17	3,884,631
Squash	95%	5%	16,446	25%	12,334	3.50%	7.0%	2,756	91.63	9.65	1,249,192
							Incremental first & out year costs of REI				$12,567,399

Note: Assumes there are no price effects.

SOURCES:

(1); DPRA. Analysis of Proposed Reentry Interval Regulations Under FIFRA. 1985.

(2); Estimate based on acre treatments of Toxicity I pesticides as reported by:

--U.S. Department of Agriculture. Agricultural Chemical Usage 1990 Vegetables Summary. 1991 (June).

--Oregon State University Extension Service. Oregon Pesticide Use Estimated for 1987. 1989 (August).

--State of California, Department of Food and Agriculture. Pesticide Use Report by Commodity. 1988.

(3); Estimated by DPRA, Inc.

(4); Derives from total crop acreages in Appendix Table REI-5 times 92.5% (represents the percentage of total crop acres that are treated with pesticides). 92.5% was derived by dividing column (3) in Table III-2 (15% for veg) by 50%. Assumes that the establishments that don't use pesticides are smaller operations and untreated acreage is proportionately one-half as much as the number of farms not using pesticides.

(5); Two of the most commonly used Tox I pesticides on cucumbers (methomyl & oxamyl), melons (methomyl & methyl parathion), and squash (methomy & oxamyl) either have a 2 day pre-harvest interval or require full PPE including a respirator for early re-entry. Because field workers need to re-enter fields primarily to harvest, and harvest is forbidden for 2 days after application, and because the cost of full PPE including a respirator would be economically discourging, it is estimated that a percentage of the cost of cucumber, melon, and squash yield loss is already being incurred due to the use of the aforementioned pesticides.

(6); Calculated, (4)-[(4)X(5)].

(7); See Appendix Table REI-2, Source (5).

(8); Estimated by DPRA (double the impact of (7)).

(9); Appendix Table REI-5.

(10); Calculated, (2)X(7)X(9).

(11); Calculated, (3)X(8)X(9).

(12); Calculated, (6)X[(10)+(11)].

Appendix Table REI-5. VEGETABLE CROPS - - With impacts from 48 hour REI, removing acreage from states with WPS equivalent REIs already in effect.

Crop	Acres 1/ Harvested (3-year ave)	Total Value 1/ of Production (3-year ave) ($1,000)	Per Acre Crop Value ($)
Squash 2/	17,779	48,997	2,756
Cucumbers 3/	117,892	198,714	1,686
Melons 4/	205,088	296,268	1,445
Tomatoes (fresh)	117,528	883,762	7,520
Artichokes	6,091	19,567	3,212
Snap Beans 5/	37,267	58,775	1,577
Cauliflower	37,803	91,706	2,439
Total of affected crops	539,249	1,597,789	

SOURCES:

1/ USDA Vegetables and Specialties Yearbook, 1991 (Dec), unless otherwise noted.

California has REIs in effect for several of the most common Toxicity I pesticides (Appendix Table REI-6). Nearly half of the pesticides listed in Appendix Table REI-6 have REIs as lengthy as those proposed by the WPS. Therefore, 45% of the California acreage of 6 of the 7 vegetable crops from Appendix Table REI-3 has been removed to determine incremental costs of the restricted-entry intervals posed by the WPS.

Arizona likewise has REI's in effect for Tox I and II organophosphates and carbamates that are just as lengthy as those posed by the WPS. It was assumed that 50% of the squash, melon, and snap bean acreage in Arizona is treated with OPs or carbamates and therefore was removed to determine incremental costs.

2/ Squash Stats:

	Acres Harvested	Value ($1,000)
Florida	13,117	37,567
45% Calif	4,388	10,757
50% Ariz	274	673
Total	17,779	48,997

Note: Florida data from 1988-90, Calif from 88-89, Arizona data from 1988-90. Texas data NA.
Source: Florida & Arizona Ag Stats and USDA Veggies and Specialties Yearbook.

3/ Processing cucumbers only, 88-90

4/ Melon Stats:

	Acres Harvested	Value of Prod ($1,000)
Honeydew	25,278	60,708
Watermelon *	118,330	78,513
Cantaloupe **	61,480	157,047
Total	205,088	$296,268

*Watermelon-'90 only--harvest

45% Calif	8,030
50% Arizona	2,300
Texas	55,000
Florida	53,000
Total	118,330

**Cantalope--harvested acres

	89	90
45% Calif	46,200	49,810
50% Arizona	3,800	4,360
Texas	NA	19,000
Total	50,000	72,980

2 yr ave harvest 61,480

5/ Snap beans for fresh market:

	Acres Planted	Value ($1,000)	Value per Acre ($)
Florida	27,833	49,274	1,770
Michigan	2,500	3,330	1,332
N.Carolina	6,833	6,105	893
50% Arizona	100	67	668
Total	37,267	$58,775	

Note: Florida and N.C. data from 1988-90, Michigan & Ariz. only 1990.
Note: Mich. & Ariz. Value figures derived from the average value of Florida & N.C. snap beans.
Source: Florida, N.C. state ag stats; Mich. & Ariz. from USDA Ag. Chemical Usage.

Appendix Table REI-6. Restricted entry intervals for the most commonly used Toxicity I pesticides in California by selected vegetable and fruit crops.

WPS Toxicity I Pesticide	Artichokes	Cauliflower	Snap Beans	Tomatoes	Cucumbers	Melons	Squash	Strawberries	Peaches	Plums	Cherries
	Hours										
Endosulfan	48	48	48	48	48	48	48	48	48	48	48
Methomyl	--	--	--	--	--	--	--	--	48	--	--
Mevinphos	48	48	48	48	48	48	48	48	96	48	48
Oxamyl	--	--	--	--	--	--	--	--	48	--	--
Captan	--	--	--	--	--	--	--	--	--	--	--
Methyl parathion	14 days	14 days	14 days	14 days	14 days	14 days	14 days	14 days	21 days	14 days	14 days
Azinphos-methyl	24	24	24	24	24	24	24	24	7-14 days	24	24
Methidathion	48	48	48	48	48	48	48	48	48	48	48
Methamidophos	48	48	48	48	48	48	48	48	--	48	48
All Toxicity I Pesticides	24	24	24	24	24	24	24	24	24	24	24

Source: Barclays California Code of Regulations.

Appendix Table REI-7. Total first year and total out year restricted-entry interval (REI) costs to fruit crops

Affected Fruit Crops (1)	Percent of Base Acreage Treated with 48 Hr REI Pesticides (2)	Percent of Base Acreage Treated with 72 Hr REI Organophosphates in Arid Areas (3)	Base Acreage Treated with Any Pesticide (1988-90 ave) (4)	Average per Acre Impact from 48 hr REIs (% yield/ quality loss) (5)	Average per Acre Impact from 72 hr REI --OPs in Arid Areas (% yield/ quality loss) (6)	Per Acre Crop Value (1988-90 ave) (7)	Per Acre Income Loss due to (5) (8)	Per Acre Income Loss due to (6) (9)	Aggregate Income Loss (10)
							($/Acre)		($)
Blackberries	95%	5%	4,061	0.5%	1.0%	2,495	11.85	1.25	53,191
Cherries (Sweet)	95%	5%	44,801	0.5%	1.0%	2,753	13.08	1.38	647,513
Peaches	95%	5%	171,063	0.5%	1.0%	1,998	9.49	1.00	1,794,366
Plums	95%	5%	38,573	0.5%	1.0%	2,659	12.63	1.33	538,462
Raspberries	95%	5%	9,016	0.5%	1.0%	2,586	12.28	1.29	122,405
Strawberries	95%	5%	42,682	3.5%	7.0%	12,106	403	42.37	18,989,152
						Total First & Out Year Costs of REI			$22,145,089

Note: Assumes there are no price effects.

SOURCES:

(1); DPRA, Inc. Analysis of Proposed Reentry Interval Regulations Under FIFRA. 1985.

(2); Estimate based on acre treatments of Toxicity I pesticides as reported by:

--U.S. Department of Agriculture. Agricultural Chemical Usage 1990 Vegetables Summary. 1991 (June).

--Oregon State University Extension Service. Oregon Pesticide Use Estimated for 1987. 1989 (August).

--State of California, Department of Food and Agriculture. Pesticide Use Report by Commodity. 1988.

(3); Estimated by DPRA, Inc. California produces the majority of affected fruit crops that are grown in arid areas. However, base acreage is estimated assuming 5% of total U.S. fruit (6 crops) acreage is affected. Therefore, the percentage of affected acreage is likely overestimated.

(4); Based on total crop acreages in Appendix Table REI-8 times 92.5% (represents the percentage of total crop acres that are treated with pesticides). 92.5% was derived by dividing column (3) in Table III-2 (15% for fruit) by 50%. Assumes the establishments that don't use pesticides are smaller operations and untreated acreage is proportionately one-half as much as the number of farms not using pesticides.

(5); Estimated by DPRA, Inc. and EPA based upon (1), consultation with industry experts, and general knowledge.

Crop Impact	Range of Yield Loss	Average Yield Loss
None - Minor	0.00 - 1.00	0.5
Minor - Potentially Significant	1.00 - 2.00	1.50
Potentially Significant	2.00 - 5.00	3.50
Significant	5.00 - 7.00	6.00
Major	7.00 - 15.00	11.00

(6); Estimated by DPRA (double the impact of (5)).

(7); Appendix Table REI-8.

(8); Calculated, [(2)X(4)X(5)X(7)]/(4).

(9); Calculated, [(3)X(4)X(6)X(7)]/(4).

(10); Calculated, (4)X[(8)+(9)].

Appendix Table REI-8. FRUIT CROPS - - With impacts from 48 hr restricted-entry interval *

Crop		Acres 1/ Harvested (3-year ave)		Total value 1/ of Production (3-year ave) ($1,000)	Per Acre Crop Value ($)
Blackberries					
Oregon	4,250		10,586		
Washington	140		366		
Total		4,390		10,952	2,495
Cherries (sweet)		48,433		133,348	2,753
Peaches		184,933		369,459	1,998
Plums		41,700		110,870	2,659
Raspberries 2/					
Oregon	5,400		12,365		
Washington	4,347		12,838		
Total		9,747		25,203	2,586
Strawberries		46,143		558,591	12,106
Total of affected crops		335,347		1,208,423	

* Crops included are based on DPRA's 1985 report, "Analysis of Proposed Re-entry interval Regulations Under FIFRA".

1/ Fruit and Tree Nuts Yearbook, USDA, 1991 (August). 3-yr ave=1988-90.

2/ Raspberries includes both black and red:

	Acres Harvested		Value of Prod. ($1,000)	
	OR	WA	OR	WA
Black	1,433	80	1,811	54
Red	3,967	4,267	10,555	12784
Total	5,400	4,347	12,365	12,838

Note: Data on Wash. black raspberries was only available for 1988

Appendix Table REI-9. Incremental first year and incremental out year restricted-entry interval (REI) costs to fruit crops

Affected Fruit Crops (1)	Percent of Base Acreage Treated with 48 Hr REI Pesticides (2)	Percent of Base Acreage Treated with 72 Hr REI Organophosphates in Arid Areas (3)	Base Acreage Receiving Acres Currently Affected by State REIs (4)	Percent of Base Acreage Currently Incurring Losses Due to Label REIs, PHIs, or PPE Requirements (5)	Base Acreage Affected by the WPS REIs (6)	Average per Acre Impact from 48 hr REIs (% yield/ quality lost) (7)	Average per Acre Impact from 72 hr REIs--OP's in Arid Areas (% yield/ quality lost) (8)	Per Acre Crop Value (1988-90 ave) (9)	Per Impacted Acre Income Loss due to (7) (10)	Per Impacted Acre Income Loss due to (8) (11)	Aggregate Income Loss (12)
								($/Acre)			($)
Blackberries	95%	5%	4,061	0%	4,061	0.5%	1.0%	2,495	11.85	1.25	53,183
Cherries (Sweet)	95%	5%	39,629	0%	39,629	0.5%	1.0%	2,838	13.48	1.42	590,531
Peaches	95%	5%	143,540	0%	143,540	0.5%	1.0%	1,725	8.19	0.86	1,299,749
Plums	95%	5%	21,215	0%	21,215	0.5%	1.0%	2,659	12.63	1.33	296,128
Raspberries	95%	5%	9,016	0%	9,016	0.5%	1.0%	2,586	12.28	1.29	122,394
Strawberries	95%	5%	32,864	50%	16,432	3.5%	7.0%	9,575	318.36	33.51	5,781,868
							Incremental first & out year costs of REI				$8,143,852

Note: Assumes there are no price effects.

SOURCES:

(1); DPRA. Analysis of Proposed Reentry Interval Regulations Under FIFRA. 1985.

(2); Estimate based on acre treatments of Toxicity I pesticides as reported by:
–U.S. Department of Agriculture. Agricultural Chemical Usage 1990 Vegetables Summary. 1991 (June).
–Oregon State University Extension Service. Oregon Pesticide Use Estimated for 1987. 1989 (August).
–State of California, Department of Food and Agriculture. Pesticide Use Report by Commodity. 1988.

(3); Estimated by DPRA, Inc.

(4); Derived from total crop acreages in Appendix Table REI-10 times 92.5% (represents the percentage of total crop acres that are treated with pesticides). 92.5% was derived by dividing column (3) in Table III-2 (15% for fruit) by 50%. Assumes the establishments that don't use pesticides are smaller operations and untreated acreage is proportionately one-half as much as the number of farms not using pesticides.

(5); One of the four most commonly used pesticides on strawberries (Captan) already requires chemical resistant gloves to be worn if workers re-enter the fields within 4 days of an application. In this case it is likely that chemical resistant gloves would be enough of a hindrance to picking, that supervisors are likely to wait until the expiration of the 4 day REI before sending harvesting crews into the strawberry fields.
Another commonly used pesticide on strawberries (Methomyl) already has a 3 day pre-harvest interval. Because field workers need to re-enter fields primarily to harvest, and harvest is forbidden for 3 days after application, none of the costs of the 48 hour REI for methomyl use on strawberries is due to the WPS.

(6); Calculated, (4)-[(4)X(5)].

(7); See Appendix Table REI-7, Source (5).

(8); Estimated by DPRA (double the impact of (7)).

(9); Appendix Table REI-10.

(10); Calculated, (2)X(7)X(9).

(11); Calculated, (3)X(8)X(9).

(12); Calculated, (6)X[(10)+(11)].

Appendix Table REI-10. FRUIT CROPS - - With impacts from 48 hr restricted-entry intervals, removing acreage from states with WPS equivalent REIs already in effect

Crop		Acres 1/ Harvested (3-year ave)		Total value 1/ of Production (3-year ave) ($1,000)	Per Acre Value ($)
Blackberries					
Oregon	4,250		10,586		
Washington	140		366		
Total		4,390		10,952	2,495
Cherries (sweet)		42,842		121,602	2,838
Peaches		155,178		267,645	1,725
Plums		22,935		60,979	2,659
Raspberries 2/					
Oregon	5,400		12,365		
Washington	4,347		12,838		
Total		9,747		25,203	2,586
Strawberries		35,528		340,172	9,575
Total of affected crops		270,620		826,553	

SOURCES:

1/ Fruit and Tree Nuts Yearbook, USDA, 1991 (August). 3-yr ave=1988-90.

California has REIs in effect for several of the most common Toxicity I pesticides (Appendix Table REI-6). Nearly half of the pesticides listed in Appendix Table REI-6 have REIs as lengthy as those proposed by the WPS. Therefore, 45% of the California acreage of four of the six fruit crops from Appendix Table REI-8 has been removed to determine incremental costs of the restricted-entry intervals posed by the WPS.

2/ Raspberries includes both black and red.

	Acres Harvested		Value of Prod. ($1,000)	
	OR	WA	OR	WA
Black	1,433	80	1,811	54
Red	3,967	4,267	10,555	12784
Total	5,400	4,347	$12,365	$12,838

Note: Data on Washington black raspberries was only available for 1988.

Appendix Table REI-11. Total and incremental first and out year restricted-entry interval (REI) costs to greenhouse establishments, per worker and for the total sector*

Item	Total		Incremental	
	First	Out	First	Out
	($/worker)			
Personal 1/ Protective Equipment (PPE)	57.85	22.35	4.60	4.60
PPE Cleaning 2/	100.00	100.00	100.00	100.00
Decontamination 3/	8.75	8.75	8.75	8.75
Instruction 4/	23.43	23.43	23.43	23.43
Total per Worker	$190	$155	$137	$137
	($)			
Total Cost for 5/ All Greenhouses	$604,124	$491,266	$434,837	$434,837

* These costs are due to PPE, decontamination, and early entry instructions that are required for early entry workers on those establishments where early entry is allowed (cut flowers and cut ferns). EPA believes these costs are greatly overestimated because the majority of early entry workers on cut flower establishments are owner/operators who are exempt from early-entry PPE cleaning, decontamination, and instruction.

1/ First year PPE costs per worker were based on the following:

– One pair of cotton coveralls	30.00
– Two pair of nitrile gloves	4.60
– One pair of safety glasses	4.00
– Protective headwear (one hat or hood)	8.25
– One pair of water proof boots	11.00
Total first year costs per worker	$57.85

Out year PPE costs per worker were based on the following:

– All PPE items with the exception of nitrile gloves last three years.	
Total out year costs per worker	$22.35

First and out year incremental costs per worker were based on the following:

– Early entry workers on cut flower or fern establishments are assumed to be handlers (stable, trusted, permanent employees or owner/operators).	
– These handlers are already trained and already have a set of PPE due to the WPS.	
– However, it is assumed that these handlers will need two extra pair of gloves for early entry duties ($4.60 for 2 pair).	
Incremental first and out year costs per worker for PPE	$4.60

Footnotes continued . . .

Footnotes for Appendix Table REI-11 continued . . .

2/ Total and incremental first and out year PPE washing costs per worker were based on the following:
- It takes 12 minutes to wash all PPE items.
- Person doing the washing is employer with a wage rate of $10 per hour.
  (12/60) X $10 = $2.00 labor cost per washing per worker
- 33% of the 50 total pesticide applications in greenhouse's are of pesticides with 48 hour REI's, 33% are of 24 hour REI's, and 33% are of 12 hour REI's.
- One early entry day per application of a 24 hour REI pesticide will be necessary.
- Two early entry day per application of a 48 hour REI pesticide will be necessary.
- The total number of early entry days per early entry worker per year =
  (33% are 48 hr REI X 50 apps. X 2 days) + (33% are 24 hr REI X 50 apps. X 1 day) = 50

Total and incremental first and out year costs per worker = $2.00 X 50 = $100.00

3/ Total and incremental first and out year decontamination costs per worker were based on the following:
- 2 oz. of soap is needed per early entry day. Soap costs $0.96 for 32 oz.
  [(2 oz X 50 early entry days) / 32 oz] X $0.96 = $3.00
- 16 paper towels are needed per early entry day. Paper towels cost $0.69 for 96 towels.
  [(16 towels X 50 early entry days) / 96 towels] X $0.69 = $5.75

Total and incremental first and out year costs per worker = $3.00 + 5.75 = $8.75

4/ Total and incremental first and out year instruction costs per worker were based on the following:
- It takes 5 minutes for employer to instruct early entry worker for each early entry episode (i.e., 1 episode during a 24 hr REI and 2 episodes during a 48 hr REI). Early entry workers would receive instructions at the same time.
  [(5 min./60 min.) X ($7 worker wage + $10 employer wage)] / 2 early entry workers = $0.71
- There are 33 early entry episodes per cut-flower or fern establishment.
  16.5 48 hour REI's + 16.5 24 hour REI's = 33 early entry episodes

Total and incremental first and out year costs per worker = $0.71 X 33 = $23.43

Note: It is assumed that no early entry workers can read well enough to instruct themselves. However, those capable of reading and understanding English would not need an instructor for the labeling instructions. Therefore, early entry instruction costs are likely overestimated.

5/ Calculated, cost per worker X 3,179 workers.
3,179 early entry cut-flower workers was derived by:

18,613	Nursery/greenhouse establishments that hire labor and use pesticides (Table III-2)
61%	Are greenhouses and greenhouse-like nurseries (U.S. Dept. of Commerce, 1987 Census of Horticulture Specialties, 1989)
11,354	Greenhouses
14%	of greenhouses are primarily cut flower establishments (U.S. Dept of Commerce, 1987 Census of Horticulture Specialties, 1989)
1,590	Cut flower establishments
2	Early entry workers per establishment (EPA estimate).
3,179	Potential early entry workers on cut flower establishments

No Early-Entry Exception for Cut Flowers/Ferns

Information that the Agency received from the cut flower and cut fern industry during the comment period for this rulemaking has persuaded EPA that there could be substantial economic repercussions in this industry if routine hand labor tasks were prohibited during the restricted-entry interval. The Agency has reviewed the information received on the subject and is inclined to grant an exception to such a prohibition for this industry, because, in light of the economic benefits and new conditions of entry that would be imposed, the Agency believes it is likely that early entry would not pose unreasonable risks to workers in this industry. As a result, such an exception is being proposed under the exception process in the final rule. Therefore, this RIA contains cost estimates based on the premise that such an exception will be granted. The costs attributed to REIs for greenhouses and nurseries are the costs associated with permitting workers to enter during the REI. Such costs include supplying labeling-specific instructions, and decontamination soap, water, and towels, and providing, cleaning, and maintaining personal protective equipment. The incremental first year cost estimate for this is approximately $604,000 and the incremental out year cost estimate is approximately $435,000 (Appendix Table REI-11).

If the Agency receives information during the public-comment period that persuades it that granting an early-entry exception for cut flowers and cut ferns would pose unreasonable risks to workers in this industry, greenhouse and nursery employers will bear a higher cost-burden due to this final rule than is now being assumed. The Agency estimates that the incremental first and out year cost to the greenhouse and nursery industry of a prohibition of routine hand labor during REIs will be $43.7 million (Appendix Table REI-12). Therefore, if EPA is persuaded not to grant the early-entry exception for cut flowers and cut ferns, the additional continuing annual incremental cost to this industry would be $43.7 million - $0.44 million or $43.3 million.

Additional Early-Entry Exceptions. In this final rule, the Agency is offering interested persons the opportunity to submit requests for exceptions to REIs. Any exceptions granted to

the thirteen crops where the prohibition of routine early entry is reflected as a cost burden in this RIA, would substantially reduce such burden. Thus, the granting of any such exceptions would result in an overall reduction in costs attributable to the WPS.

Appendix Table REI-12. Total and incremental first and out year restricted-entry interval (REI) costs to cut flower and cut fern crops, if no exception is granted

Cut Flower and Fern Crops	Annual Wholesale Sales (1)	Average Sales Impact from REIs (% yield/ quality loss) (2)	Aggregate Income Loss (3)
	(Million $)	(%)	($)
Cut Roses	187,950	11.0%	20,675
Other Cut Flowers	293,277	6.0%	17,597
Cut Ferns	89,746	6.0%	5,385
Total & incremental first & out year costs of REI 4/			$43,655,880

Note: Assumes there are no price effects and as such aggregate income loss is likely to be an overestimate.

SOURCES:

(1); U.S. Department of Commerce. 1991 (August). "Census of Horticultural Specialties (1989)".

(2); Estimated by DPRA, Inc. and EPA based upon consultation with industry experts and general knowledge.

Crop Impact	Range in Yield Losses	Estimated Yield Loss
None - Minor	0.00 - 1.00	0.5
Minor - Potentially Significant	1.00 - 2.00	1.50
Potentially Significant	2.00 - 5.00	3.50
Significant	5.00 - 7.00	6.00
Major	7.00 - 15.00	11.00

(3); Calculated; (1) X (2).

4/ The Agency is unaware of any State imposed REIs with prohibited entry for toxicity II-IV pesticides. Due to this reason and the fact that the majority of the pesticides that are used in cut flower culture are of toxicity II-IV, incremental compliance costs are the same as total compliance costs (i.e. no reduction for state imposed REIs or other current compliance).

Section 2
Personal Protective Equipment

Appendix Table PPE-1. Revised Worker Protection Standard compliance costs for personal protective equipment in 1991 dollars, by sector.

Sector	Compliance Costs: Total First Year (1)	Compliance Costs: Total Out Year (2)	Compliance Costs: Incremental First Year (3)	Compliance Costs: Incremental Out Year (4)	Number of Establishments That Use Pesticides (5)	Incremental Costs per Establishment That Hire Labor & Use Pesticides: First Year (6)	Incremental Costs per Establishment That Hire Labor & Use Pesticides: Out Year (7)
	($)		($)			($)	
Feed & Grain	35,996,985	17,016,750	8,498,202	4,444,864	300,820	28.25	14.78
Cotton	4,716,802	2,415,899	814,424	441,217	20,680	39.38	21.34
Tobacco	8,774,493	4,154,564	2,535,653	1,382,541	57,000	44.49	24.26
Other Field	5,522,438	2,772,573	1,702,249	929,080	71,340	23.86	13.02
Vegetable & Fruit	17,282,620	7,527,909	3,244,038	1,732,142	79,050	41.04	21.91
Nursery & Greenhouse	6,451,315	3,545,578	1,059,045	564,632	31,500	33.62	17.92
Commercial Handlers	6,155,884	3,684,384	1,575,908	1,081,608	8,500	185.40	127.25
Total	$84,900,536	$41,117,658	$19,429,519	$10,576,083	568,890	$34.15	$18.59

Note: For hired handler PPE cleaning, costs were apportioned by multiplying total cleaning costs by the percentage of hired handlers in each crop sector (Table III-2). A similar proceedure was used for apportioning incremental PPE costs: total incremental PPE costs were multiplied by the percentage of hired and family member handlers in each crop group (Tables III-2 and III-5).

SOURCES:

(1); Appendix Tables PPE-2, PPE-5, PPE-9, and PPE-10.

(2); Appendix Tables PPE-5, PPE-6, PPE-10, and PPE-13.

(3); Appendix Tables PPE-7 and PPE-14.

(4); Appendix Tables PPE-8 and PPE-15.

(5); Table III-2, column (1) "Total Number of Establishments" minus column (4) "Establishments that Don't Use Pesticides".

(6); Calculated, (3)/(5).

(7); Calculated, (4)/(5).

Appendix Table PPE-2. Total first year PPE costs for hired and family member handlers by crop sector.

Crop	Coveralls 1/	Chemical 2/ Resistant Gloves	Chemical 1/ Resistant Footwear	Eye 1/ Protection	Respiratory 1/ Protection	Chemical 1/ Resistant Apron	Protective 1/ Headwear	Handler 3/ Monitoring	Total PPE Costs
Feed & Grain	7,018,164	3,587,062	2,573,327	2,210,722	15,206,022	1,871,510	1,929,995	150,487	34,547,289
Cotton	57,463	330,275	631,831	542,800	1,400,081	459,514	473,873	85,229	3,981,067
Tobacco	88,748	1,020,464	976,096	838,555	4,325,880	709,888	732,072	6,717	8,698,420
Other Field	44,633	684,227	490,859	421,692	2,900,528	356,988	368,144	30,779	5,297,848
Veg/Fruit	261,805	1,337,974	2,879,554	2,473,798	5,671,848	2,094,221	2,159,665	41,064	16,919,929
Nursery/G.H.	47,574	437,538	523,144	449,428	1,854,782	760,936	784,715	170,025	5,028,141
Totals	$7,518,386	$7,397,541	$8,074,810	$6,936,996	$31,359,140	$6,253,057	$6,448,465	$484,301	$74,956,995

Notes: All costs are in 1991 dollars.

We assume that all hired and family member handlers mix, load, and apply pesticides. Therefore, we must outfit hired and family member handlers with the PPE requirements for SUPPORT, because they have the greatest protective requirements (Appendix Table PPE-3).

1/ With the exception of respiratory protection, all individual costs are calculated by:
Per handler cost of PPE item (Appendix Table PPE-4) X the number of hired and family member handlers by crop category (Tables III-2 and III-4)
X the percentage of hired handlers that will handle Tox I or Tox II pesticides in any one year (percentages by crop group follow):
- In any one year, 30% of hired handlers on feed & grain farms will handle Tox I or Tox II pesticides (EPA estimate).
- In any one year, 80% of hired handlers on cotton farms will handle Tox I or Tox II pesticides (EPA estimate).
- In any one year, 40% of hired handlers on tobacco farms will handle Tox I or Tox II pesticides (EPA estimate).
- In any one year, 30% of hired handlers on other field farms will handle Tox I or Tox II pesticides (EPA estimate).
- In any one year, 90% of hired handlers on veg/fruit/nut farms will handle Tox I or Tox II pesticides (EPA estimate).
- In any one year, 50% of hired handlers on nursery/greenhouse establishments will handle Tox I or Tox II pesticides (EPA estimate).

2/ Gloves are required for most pesticide applications, therefore, it is assumed that all hired and family member handlers will need gloves.

3/ The costs of monitoring handlers while applying pesticides with 48 hour REIs is calculated by:
Days per year that one hired handler applies pesticides by crop group (Table III-6, footnote 6) X percentage of all acre treatments are of pesticides with 48 hr REIs by crop group (Table III-8) X 3 monitoring periods per treatment (one every 2 hours) X supervisors labor cost ((1 minute to make contact with handler/60 minutes) X $7/hr wage rate) X the number of hired handlers (Table III-2).

Appendix Table PPE-3. Personal Protective Equipment Required for Hired and Family Member Handlers, by Type of Pesticide Handling Activity and Pesticide Toxicity Category

Type of Pesticide 1/ Handling Activity	Coveralls		Gloves		Chemical Resistant Footware		Eye Protection		Respiratory Protection		Chemical Resistant Apron		Protective Headwear	
	Tox I-II*	Tox III-IV	Tox I-III*	Tox IV	Tox I-II*	Tox III-IV	Tox I-II+	Tox III-IV	Tox I-II@	Tox III-IV	Tox I-II#	Tox III-IV	Tox I-II**	Tox III-IV
GROUND APPLICATION	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	No	No	Yes	No
SUPPORT (Mixing & Loading)	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	No	No

* For dermal toxicity or skin irritation potential.

\+ For eye irritation potential.

@ For inhalation toxicity.

\# For dermal toxicity or skin irritation potential while performing mix/load or equipment cleaning tasks.

** For dermal toxicity or skin irritation potential with overhead exposure.

1/ We assume that none of the hired & family member handlers apply pesticides by aerial methods. If any do apply aerially, only chemical-resistant gloves would be required.

Appendix Table PPE-4. Personal protective equipment costs for hired and family member handlers

Item	Per Handler Cost 1/
Coveralls 2/	30.00
Gloves 3/	4.60
Waterproof 4/ Boots	11.00
Eye Protection 5/	9.45
Respiratory Protection 6/	19.50
Chemical 7/ Resistant Apron	8.00
Protective Headwear 8/	8.25
Total Cost	$90.80

SOURCES:

1/ Prices are from current (1991), personal and environmental safety supply catalogs.

2/ Based on one pair of cotton coveralls per handler ($30 per pair).

3/ Based on two pair of nitrile gloves per handler ($2.30 per pair).

4/ Based on one pair of waterproof boots per handler ($11 per pair).

5/ Based on the assumption that one-third of the handlers wear goggles ($4.50), one-third wear a face shield ($19.85), and one-third wear safety glasses ($4). (4.50 + 19.85 + 4)/3 = $9.45.

6/ Based on the following:

- Hired and family member handlers handle pesticides an average of 13 days per year (Table III-6).
- On average, 15% (EPA estimate) of the 13 days handling will require respiratory protection: 13 X 15% = 2 days.
- Half the handlers use a non-disposable respirator that costs $22. Cartridges cost $6 each and must be replaced 2 times per year: $22 + ($6 X 2) = $34.00.
- Half the handlers use a disposable dust/mist cup-style respirator that costs $2.50 each and must also be replaced 2 times per year: $2.50 X 2 = $5.00.

Average cost per hired and family member handler for respiratory protection:

($34 + $5) / 2 = $19.50

7/ Based on one heavy-duty neoprene apron per handler ($8).

8/ Based on the assumption that half of the handlers wear a hat ($15), and half wear a hood ($1.50).

* Protective headwear cost = ($15 + $1.50)/2 = $8.25.

Appendix Table PPE-5. Total first and out year cleaning costs for hired handlers by crop sector *

Crop	Toxicity I-II PPE Equipment Cleaning Cost (1)	Toxicity III-IV PPE Equipment Cleaning Cost (2)	Total Cleaning Cost (3)	Number of Handling Days Per Year Per Handler (4)	Per Handler Total Cleaning Cost (5)	Number of Hired Handlers (6)	Total PPE Cleaning Cost (7)
	($/handler/day)			(Number)	($/handler/year)	(Number)	($)
Feed & Grain	0.57	0.34	0.91	6	5.46	265,410	1,449,696
Cotton	0.93	0.19	1.12	21	23.48	31,340	735,735
Tobacco	0.45	0.30	0.75	1	0.75	101,000	76,073
Other Field	0.89	0.21	1.10	3	3.29	68,170	224,589
Veg/Fruit/Nut	0.81	0.24	1.05	3	3.15	115,025	362,691
Nursery/G.H.	1.26	0.06	1.32	29	38.23	37,225	1,423,174
					Total first and out year PPE cleaning costs		$4,271,958

*Note: Family member handlers are exempt from the PPE cleaning requirements of the regulation.

SOURCES:

(1); Based on the following:
It takes 12 minutes to wash all PPE (all PPE required for Tox I-II pesticides) and the employer is responsible for the cleaning at $7 an hour: 12 min/60 min X $7 = $1.40
Calculated, $1.40 X the % of acre treatments of pesticides that are Tox I-II by crop group (Table III-8).

(2); Based on the following:
It takes 5 minutes to wash a pair of gloves (the only PPE required for Tox III-IV pesticides) and the employer is responsible for the cleaning at $7 an hour: 5 min/60 min X $7 = $0.58
Calculated, $0.58 X the % of acre treatments of pesticides that are Tox III-IV by crop group (Table III-8).

(3); Calculated, (1) + (2).
(4); Table III-6.
(5); Calculated, (3) X (4).
(6); Table III-2.
(7); Calculated, (5) X (6).

Total first year PPE and Cleaning Costs	$79,228,953

Appendix Table PPE-6. Total out year PPE costs for hired and family member handlers by crop sector.

Crop	Coveralls 1/	Chemical 1/ Resistant Gloves	Chemical 1/ Resistant Footware	Eye 1/ Protection	Respiratory 1/ Protection	Chemical 1/ Resistant Apron	Protective 1/ Headwear	Handler 2/ Monitoring	Total PPE Costs
Feed & Grain	2,339,388	3,587,062	857,776	736,907	6,628,266	623,837	643,332	150,487	15,567,054
Cotton	19,154	330,275	210,610	180,933	610,292	153,171	157,958	17,770	1,680,164
Tobacco	29,583	1,020,464	325,365	279,518	1,885,640	236,629	244,024	57,267	4,078,491
Other Field	14,878	684,227	163,620	140,564	1,264,333	118,996	122,715	38,652	2,547,984
Veg/Fruit	87,268	1,337,974	959,851	824,599	2,472,344	698,074	719,888	65,219	7,165,218
Nursery/G.H.	15,858	437,538	174,381	149,809	808,495	253,645	261,572	21,107	2,122,405
Totals	$2,506,129	$7,397,541	$2,691,603	$2,312,332	$13,669,369	$2,084,352	$2,149,488	$350,502	$33,161,316

Note: all costs are in 1991 dollars.

1/ Out year costs are based upon Appendix Table PPE-2 and the following assumptions:
- --Non-disposable respirator bodies last indefinitely
- --Gloves are replaced annually
- --Respirator cartridges and dust/mist respirators are replaced after each day of use.
- --All other PPE items are replaced every three years

2/ Total out year costs are estimated to be the same as first year costs. However, due to the possibility of agricultural operators switching to less toxic pesticides and thus the decreased need for monitoring, out year estimates are likely overestimated.

Total out year cleaning costs are the same as total first year costs $4,271,958

Total out year PPE Costs (PPE + Cleaning) $37,433,274

Appendix Table PPE-7. Incremental first year total PPE costs for hired and family member handl

Total first year PPE costs 1/ =	74,956,995	
- Percentage of PPE costs already required on labels 2/	80%	
Incremental first year PPE costs		$14,991,399
Total first year cleaning costs 3/=	4,271,958	
- Percentage of cleaning costs currently incurred 4/	33%	
Incremental first year cleaning costs		$2,862,212
Total incremental first year PPE and cleaning costs (in 1991 dollars)		$17,853,611

SOURCES:

1/ Appendix Table PPE-2.

2/ About 80 percent of the volume of all pesticides used have been reviewed under EPA's Registration Standards program. Chemicals reviewed to date have had specific requirements for PPE established.

3/ Appendix Table PPE-5.

4/ EPA estimates that hired handlers are currently cleaning their PPE items at least every third handling day (33% of the time).

Appendix Table PPE-8. Incremental out year total PPE costs for hired and family member handle

Total out year PPE costs 1/ =	33,161,316	
- Percentage of PPE costs already required on labels 2/	80%	
Incremental out year PPE costs		$6,632,263
Total out year cleaning costs 3/=	4,271,958	
- Percentage of cleaning costs currently incurred 4/	33%	
Incremental out year cleaning costs		$2,862,212
Total incremental out year PPE and cleaning costs (in 1991 dollars)		$9,494,475

SOURCES:

1/ Appendix Table PPE-6.

2/ About 80 percent of the volume of all pesticides used have been reviewed under EPA's Registration Standards program. Chemicals reviewed to date have had specific requirements for PPE established.

3/ Appendix Table PPE-5.

4/ EPA estimates that hired handlers are currently cleaning their PPE items at least every third handling day (33% of the time).

Appendix Table PPE-9. Total first year PPE costs for commercial handlers

Type of Pesticide Handling Activity 1/	Coveralls 4/	Chemical 4/ Resistant Gloves	Chemical 4/ Resistant Footwear	Eye 4/ Protection	Respiratory 4/ Protection	Chemical 4/ Resistant Apron	Protective 4/ Headwear	Total
				($)				
GROUND APPLICATION 2/	780,000	59,800	286,000	120,250	419,250		107,250	1,772,550
AERIAL APPLICATION 3/		27,600						27,600
SUPPORT (Mixing & Loading)	1,140,000	87,400	418,000	175,750	612,750	152,000		2,585,900
Subtotals	$1,920,000	$174,800	$704,000	$296,000	$1,032,000	$152,000	$107,250	$4,386,050
Cost of monitoring handlers 5/								$620,730
TOTAL COSTS								$5,006,780

SOURCES: Appendix Table PPE-12 and Table III-5.

Note: All costs are in 1991 dollars.

1/ It is assumed that all commercial applicators and support personnel handle Toxicity I pesticides at some time during the year. This is probably an overestimate.

2/ Applicators in enclosed cabs do not have to wear PPE, but they must have all necessary PPE available in the event that they must leave the cab. Therefore, all ground applicators (in both open and enclosed cabs) must have all necessary PPE (Appendix Table PPE-11).

3/ It is assumed that all aerial applicators have enclosed cockpits. Applicators in enclosed cockpits only need chemical resistant gloves (and only have to wear them when leaving a plane contaminated with pesticides).

4/ All individual costs are calculated by:
Cost of PPE item (Appendix Table PPE-12) X The number of commercial handlers in each category (Table III-5)
Example: Coveralls for ground applicators = $60 X 13,000 = $780,000

5/ Includes the cost of monitoring handlers while they apply pesticides with 48 hr REIs, calculated as follows:
Average of 33 days per year that one commercial handler applies pesticides (Table III-6, footnote 4) X 75% of those days are applying pesticides with 48 hr REIs (EPA estimate) X 3 monitoring periods per day (one every 2 hours) X supervisor's labor cost ((1 minute to make contact with handler/60 minutes) X $13 wage rate) X 38,000 commercial handlers (Table III-5) = $620,730.

Appendix Table PPE-10. Total first and out year cleaning costs for commercial handlers

	Ground & Support	Aerial	
Per handler cost of washing PPE, per treatment day	0.98 1/	0.58 2/	
X Number of treatment days per year 3/	33	33	
= Per handler washing cost per year	$32.32	$19.14	
X Number of ground & support 4/	32,000	6,000	
Total washing cost for ground & support	$1,034,264	$114,840	
Grand total first & out year cost of washing PPE (1991 dollars)			$1,149,104

1/ It takes 12 minutes to wash all PPE (all PPE required for Tox I-II pesticides), 48.5% of all pesticide applications are of Tox I-II (Table III-8) and the employer is responsible for the cleaning at a wage rate of $7 an hour:
12 min/60 min X $7 = $1.40
It takes 5 minutes to wash a pair of gloves (the only PPE required for Tox III-IV pesticides), 51.5% of all pesticide applications are of Toxicity III-IV and the employer is responsible for the cleaning at a wage rate of $7 an hour:
5 min/60 min X $7 = $0.58
Calculated: ((12 min/60 min) X $7 hr.) X 48.5% + ((5 min/60 min) X $7 hr.) X 51.5% = $0.98.

2/ Aerial applicators only need gloves. See Footnote 1/ for the calculation of glove washing costs.

3/ Table III-6.

4/ Table III-5.

Total First Year PPE Costs (PPE + Cleaning) $6,155,884

Appendix Table PPE-11. Personal protective equipment required for commercial handlers, by type of pesticide handling activity and pesticide toxicity category

Type of Pesticide Handling Activity	Coveralls		Gloves		Chemical Resistant Footware		Eye Protection		Respiratory Protection		Chemical Resistant Apron		Protective Headwear	
	Tox I-II*	Tox III-IV	Tox I-III*	Tox IV	Tox I-II*	Tox III-IV	Tox I-II+	Tox III-IV	Tox I-II@	Tox III-IV	Tox I-II#	Tox III-IV	Tox I-II**	Tox III-IV
GROUND APPLICATION	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	No	No	Yes	No
AERIAL APPLICATION	No	No	Yes	No	No	No	No	No	No	No	No	No	No	No
SUPPORT (Mixing & Loading)	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	No	No

* For dermal toxicity or skin irritation potential.

\+ For eye irritation potential.

@ For inhalation toxicity.

\# For dermal toxicity or skin irritation potential while performing mix/load or equipment cleaning tasks.

** For dermal toxicity or skin irritation potential with overhead exposure.

Appendix Table PPE-12. Personal protective equipment costs for commercial handlers.

Item	Per Handler Cost 1/
Coveralls 2/	60.00
Gloves 3/	4.60
Chemical 4/ Resistant Footware	22.00
Eye Protection 5/	9.25
Respiratory Protection 6/	32.25
Chemical 7/ Resistant Apron	8.00
Protective Headwear 8/	8.25
Total Cost	$144.35

SOURCES:

1/ Prices are from current (1991), personal and environmental safety supply catalogs.

2/ Based on two pair of cotton coveralls per handler ($30 per pair).

3/ Based on two pair of nitrile gloves per handler ($2.30 per pair).

4/ Based on one pair of heavy rubber boots per handler ($22 per pair).

5/ Based on the assumption that one-third of the handlers wear goggles ($4.50), one-third wear a face shield ($19.85), and one-third wear safety glasses ($4). (4.50 + 19.85 + 4)/3 = $9.25.

6/ Based on the following:

- Commercial handlers handle pesticides 33 days per year (Table III-6).
- On average, 15% of the 33 days handling will require respiratory protection: 33 X 15% = 5 days.
- Half the handlers use a non-disposable respirator that costs $22. Cartridges cost $6 each and must be replaced 5 times per year: $22 + ($6 X 5) = $52.
- Half the handlers use a disposable dust/mist cup-stype respirator that costs $2.50 each and must also be replaced 5 times per year: $2.50 X 5 = $12.50.

Average cost per commercial handler for respiratory protection:

($52 + $12.50) / 2 = $32.25.

7/ Based on one heavy-duty neoprene apron per handler ($8).

8/ Based on the assumption that half of the handlers wear a hat ($15), and half wear a hood ($1.50).

Protective headwear cost = (15 + 1.50)/2 = $8.25.

Appendix Table PPE-13. Total out year PPE costs for commercial handlers

Type of Pesticide Handling Activity	Coveralls 1/	Chemical 1/ Resistant Gloves	Chemical 1/ Resistant Footware	Eye 1/ Protection	Respiratory 1/ Protection	Chemical 1/ Resistant Apron	Protective 1/ Headwear	Total
GROUND APPLICATION	260,000	59,800	95,333	40,083	276,250		35,750	767,217
AERIAL APPLICATION		27,600						27,600
SUPPORT (Mixing & Loading)	380,000	87,400	139,333	58,583	403,750	50,667		1,119,733
Subtotal	$640,000	$174,800	$234,667	$98,667	$680,000	$50,667	$35,750	$1,914,550
Cost of monitoring handlers								$620,730
Total cost								$2,535,280

Note: All costs are in 1991 dollars.

1/ Out year costs are based upon Appendix Table PPE-9 and the following assumptions:

- –Non-disposable respirator bodies last indefinitely
- –Gloves are replaced annually
- –Respirator cartridges and dust/mist respirators are replaced after each day of use.
- –All other PPE items are replaced every three years

Total out year cleaning costs are the same as total first year costs $1,149,104

Total Out Year PPE Costs (PPE + Cleaning) $3,684,384

Appendix Table PPE-14. Incremental first year total PPE costs for commercial handlers

Total first year PPE costs 1/ =	5,006,780	
- Percentage of PPE costs already required on labels 2/	80%	
Incremental first year PPE costs		$1,001,356
Total first year cleaning costs 3/ =	1,149,104	
- Percentage of cleaning costs currently incurred 4/	50%	
Incremental first year cleaning costs		$574,552
Total incremental first year PPE and cleaning costs (in 1991 dollars)		$1,575,908

1/ Appendix Table PPE-9.

2/ About 80 percent of the volume of all pesticides used have been reviewed under EPA's Registration Standards program. Chemicals reviewed to date have had specific requirements for PPE established.

3/ Appendix Table PPE-10.

4/ EPA estimates that commercial handlers are currently cleaning their PPE items at least every other handling day (50% of the time).

Appendix Table PPE-15. Incremental out year total PPE costs for commercial handlers

Total out year PPE costs 1/ =	2,535,280	
- Percentage of PPE costs already required on labels 2/	80%	
Incremental out year PPE costs		$507,056
Total out year cleaning costs 3/ =	1,149,104	
- Percentage of cleaning costs currently incurred 4/	50%	
Incremental out year cleaning costs		$574,552
Total incremental out year PPE and cleaning costs (in 1991 dollars)		$1,081,608

1/ Appendix Table PPE-13.

2/ About 80 percent of the volume of all pesticides used have been reviewed under EPA's Registration Standards program. Chemicals reviewed to date have had specific requirements for PPE established.

3/ Appendix Table PPE-10.

4/ EPA estimates that commercial handlers are currently cleaning their PPE items at least every other handling day (50% of the time).

Section 3
Notification/Posting

Appendix Table NP-1. Revised WPS compliance costs for notification in 1991 dollars, by sector

Sector	Compliance Costs: Total First Year (1)	Compliance Costs: Total Out Year (2)	Compliance Costs: Incremental First Year (3)	Compliance Costs: Incremental Out Year (4)	Number of Establishments With Hired Labor That Use Pesticides (5)	Incremental Costs per Establishment That Hire Labor & Use Pesticides: First Year (6)	Incremental Costs per Establishment That Hire Labor & Use Pesticides: Out Year (7)
	($)		($)			($)	
Feed & Grain	3,374,102	1,100,423	3,280,806	1,007,127	132,705	24.72	7.59
Cotton	699,902	264,067	672,216	236,381	15,670	42.90	15.08
Tobacco	1,313,970	336,964	1,287,644	310,637	50,500	25.50	6.15
Other Field	3,780,297	868,529	3,755,689	843,921	34,085	110.19	24.76
Vegetable & Fruit	4,700,325	2,056,456	3,898,355	1,254,487	57,513	67.78	21.81
Nursery & Greenhouse	2,894,371	1,488,219	2,680,026	1,273,876	18,613	143.99	68.44
Total	$16,762,967	$6,114,658	$15,574,737	$4,926,430	309,086	$50.39	$15.94

SOURCES:
(1); Appendix Table NP-2.
(2); Appendix Table NP-4.
(3); Appendix Table NP-5.
(4); Appendix Table NP-7.
(5); Table III-2, column (7).
(6); Calculated; (3)/(5).
(7); Calculated; (4)/(5).

Appendix Table NP-2. Total first year notification costs for agricultural establishments that hire labor and use pesticides.

Crop Grouping	Safety Poster (1)	Central Notification (2)	Oral Notification (3)	Treated Area Posting (4)	Total Notification Costs
			($)		
Feed & Grain	188,441	479,812	17,181	2,688,669	3,374,102
Cotton	22,251	117,406	26,558	533,686	699,902
Tobacco	71,710	49,557	17,076	1,175,627	1,313,970
Other Field	48,401	119,575	10,529	3,601,792	3,780,297
Veg/Fruit/Nuts	81,668	474,231	713,449	3,431,976	4,700,325
Nursery	10,308	161,858	229,794	1,481,229	1,883,188
Greenhouse	16,123	664,205	47,006	283,850	1,011,183
Total	$438,902	$2,066,644	$1,061,592	$13,195,828	$16,762,967 (in 1991 dollars)

(1) Based on the following assumptions:

--One safety poster per establishment that hires labor.
--Posters cost $0.25 each.
--Employer or supervisor receives $7.00 per hour for labor.
--Writing the name, address and phone number of medical facility takes 5 minutes of employer's or supervisor's time.
Thus the cost of labor would be $7 per hour X 5 minutes/60 minutes = $0.58 per poster.
--Posting the safety poster takes 5 minutes of employer's or supervisor's time
Thus the cost of labor would be $7 per hour X 5 minutes/60 minutes = $0.58 per poster.
--Total per establishment cost for the sign and labor = $.25 + $1.17 = $1.42.

Calculated; Establishments with hired labor that use pesticides (Table III-2) X $1.42.

Footnotes continued ...

pendix Table NP-2 footnotes continued...

Based on the following assumptions:

--One centrally posted notice per pesticide treatment per establishment that hires labor.
--Paper or form cost for notification is negligible.
--Employer or supervisor receives $7.00 per hour for labor.
--Posting the notice takes 10 minutes of employer's or supervisor's time.
Thus the cost of labor per treatment would be $7 per hour X 10 minutes/60 minutes = $1.17 per posted notice.

alculated; Establishments with hired labor that use pesticides (Table III-2) X $1.17 X Average number of all treatments applied per acre, per year, / crop group (Appendix Table NP-3).

Based on the following assumptions:

--Employer's have the choice of either orally notifying hired workers of any pesticide treatments or posting fields that have been treated.
--With the exception of greenhouses, it is assumed that all hired workers will be orally notified instead of posted notification.
--One oral notification is necessary for each pesticide treatment, when hired workers will be within 1/4 mile of a treated field and the pesticide treatment is within the restricted entry interval.
--The expected probabilities that hired workers will be within 1/4 mile of a field after a 48/24/12 hour REI pesticide application, is given in Table III-7.
--An average of one oral notification per pesticide application is derived by averaging applications with 12-hour REI's (Tox III-IV), where no oral notification is probably required, with applications with 48-hour and longer REI's (Tox I), where more than one oral notification may be required due to new hires.
--Oral notification of any pesticide treatment is given by an employer or supervisor; wage rate is $7.00 per hour; oral notification takes 5 minutes.
5 minutes/60 minutes X $7.00 = $0.58 per notification
--Oral notification of any pesticide treatment is received by all hired workers on the farm; wage rate is $5.00 per hour; oral notification takes 5 minutes.
5 minutes/60 minutes X $5.00 = $0.42 per notification per worker
--Oral notification of any commercially applied pesticide treatment is also received by hired handlers when they are working in fields; wage rate is $7.00 per hour; oral notification takes 5 minutes.
5 minutes/60 minutes X $7.00 = $0.58 per notification per handler working in fields.
--5% of all pesticide applications in greenhouses are of Toxicity I pesticides for dermal or eye irritation potential and must have double notification.

Footnote (3) continued . . .

l) continued . . .

Calculation for feed & grain farms (all other crop groups would be the same procedure except greenhouses):
{[(3.1 treatments applied per acre (Appendix Table NP-3, column (7)) X 27% of all acre treatments are of 48 hr. REI pesticides (Table III-8) X 5% probability that hired workers are within 1/4 mile of field after a 48 hr REI pesticide application (Table III-7)) + (3.1 treatments per acre X 13.4% are of 24 hr REI's X 5% probability) + (3.1 treatments per acre X 59.1% are of 12 hr REI's X 0% probability)] X [$0.58 employer's wage + ((1.9 workers per establishment (Appendix Table NP-3) X $0.42 worker's wage)]} + {[(1.9 treatments applied commercially per acre (Appendix Table NP-3, column (8)) X 27% of all acre treatments are of 48 hr. REI pesticides (Table III-8) X 5% probability that hired handlers working in fields are within 1/4 mile of field after a 48 hr REI pesticide application (Table III-7)) + (1.9 treatments per acre X 13.4% are of 24 hr REI's X 5% probability) + (1.9 treatments per acre X 59.1% are of 12 hr REI's X 0% probability)] X [(2 handlers per establishment working in fields (Appendix Table NP-3) X $0.58 handler's wage)]} = $0.13 per feed & grain farm for oral notification X 132,705 feed and grain farms that hire labor and use pesticides.

Calculation for greenhouses (hired handlers that are working in the greenhouse do not need oral notification because they applied the pesticide):
[(50 treatments applied by hired handlers per greenhouse (Appendix Table NP-3) X 5% of all treatments are of Tox I pesticides for dermal toxicity or skin irritation potential X 90% probability that hired workers will be returning to the greenhouse within the 48 hr REI (Table III-7)] X [$0.58 employer's wage + (3 workers per establishment (Appendix Table NP-3) X $0.42 worker's wage) = $4.14 per greenhouse for oral notification X 11,354 greenhouses that hire labor and use pesticides.

4) Based on the following assumptions:

--Only pesticide applications of Toxicity I dermal toxicity or skin irritation potential require treated area posting (with the exception of greenhouses).

--Number of treatments requiring posting = % of Tox I treatments (Table III-8) X % of Tox I treatments that are also Tox I for dermal toxicity or skin irritation potential (III-8) X % of treatments requiring notification (Table III-7, column (1)) X average number of all treatments applied per acre, per year, per crop group (Appendix Table NP-3).

Example for feed & grain: 27% of all acre treatments are Tox I X 18.6% of all Tox I treatments are Tox I dermal/skin X 5% of treatments require notif. X 3.1 treatments applied per acre, per yr = .01 treatments per acre (or per establishment) require posting.

--There are 300 acres per feed & grain farm field; 240 per cotton field; 30 per tobacco field; 25 per other field; and 22 per veg/fruit/nut field (Appendix Table NP-3).

--There are 2 feed & grain fields per farm; 3.4 per cotton farm; 2.3 per tobacco farm, 10.6 per other field farm; and 5.6 per veg/fruit/nut farm (Appendix Table NP-3).

--Two signs will be needed per field; 50 signs are needed per greenhouse establishment.

--Signs for greenhouses cost $0.50, all other establishments' signs cost $5.00.

--A pesticide handler-employee would post and remove signs with a wage rate of $7.00 per hour.

--Posting & removal would take an average of 30 minutes per field (10 minutes to post, handler on site, + 20 minutes to remove which may require special trip to field).

Footnote (4) continued . . .

ntinued . . .

--Labor costs to post & remove signs = $7.00 per hour X 30 minutes/60 minutes = $3.50 per field.
--Labor costs to post and remove signs on greenhouses would be negligible because handlers are always present.

lculation example for feed & grain farms (cotton, tobacco, other field, veg/fruit, and nursery would be the same):
elds per farm X 2 signs per field X $5 per sign] + [.01 treatments require posting X $3.50 labor costs] X 132,705 establishments.

:ulation for greenhouses:
treatment sites per estab. X 1 sign per treatment site X $0.50 per sign] + $0 labor costs X 11,354 greenhouse establishments.

Appendix Table NP-3. Supplemental data used for calculating notification costs.

Crop Grouping	Million Acres Planted or Grown (1)	Percent of Acres not Treated with Pesticides (2)	Million Acres Planted or Grown That Have Pesticides Applied (3)	Million Acre Treatments of Pesticides (4)	Percent of Acre Treatments Applied by Commercial Handlers (5)	Million Acre Treatments of Pesticides Applied Commercially (6)	Average No. of ALL Treatments Applied per Acre, per Yr. (7)	Average No. of Treatments Applied Commercially Per Acre, Per Yr. (8)	Average No. of Hired Workers per Estab (9)	Average No. of Hired Handlers per Estab (10)	Acres per Establishment W/ Hired Labor (11)	Average No. of Acres per Field (12)	Average No. of Fields Per Estab. (13)
Feed & Grain	128.0	5.5%	121.0	373.8	60%	224.3	3.1	1.9	1.9	2	607	300	2.0
Cotton	13.7	3.0%	13.3	85.1	60%	51.1	6.4	3.8	4.6	2	808	240	3.4
Tobacco	4.2	12.0%	3.7	3.1	60%	1.9	0.8	0.5	0.5	2	69	30	2.3
Other Field	16.0	21.0%	12.6	37.9	60%	22.7	3.0	1.8	4.7	2	264	25	10.6
Veg/Fruit/Nuts	7.9	7.5%	7.3	51.5	60%	30.9	7.0	4.2	4.9	2	121	21.5	5.6
Nursery	0.3	7.5%	0.3	5.5	60%	3.3	19.1	11.4	3	2	50		20.0
Greenhouse	0.5	7.5%	0.5	5.5	0%	0.0	50	0.0	3	2	20		
Total	170.6		158.6	562.4		334.1							

(1); Table III-1. 61% of all nursery/greenhouses are greenhouses and greenhouse-like nurseries; 39% are farm-like nurseries (U.S. Department of Commerce. 1987 Census of Horticultural Specialties. 1989).
(2); Calculated, Table III-2, column (3) divided by 50%. Assumes the establishments that don't use pesticides are smaller operations and untreated acreage is proportionately 1/2 as much as the number of farms not using pesticides.
(3); Calculated: (1) X (100% - (2)).
(4); Table III-8.
(5); Estimated by DPRA, Inc. and Chris Myrick, National Agri-Chemicals Retailers Association.
(6); Calculated, (4) X (5).
(7); Calculated, (4)/(3).
(8); Calculated, (6)/(3).
(9); Table III-2, column (9) - 2.
(10); Table III-2, source 10.
(11); Table III-1.
(12); ICF, Inc. "Analysis of Proposed Farmworker Supervision, Training, and Warning Regulations Under FIFRA". 1985 (August). Page 3-3.
(13); Calculated, (10)/(11). The number of fields per nursery was estimated by DPRA.

Appendix Table NP-4. Total out year notification costs for agricultural establishments that hire labor and use pesticides.

Crop Grouping	Safety Poster (1)	Central Notification (2)	Oral Notification (2)	Treated Area Posting (3)	Total Notification Costs
			($)		
Feed & Grain	62,814	479,812	17,181	540,617	1,100,423
Cotton	7,417	117,406	26,558	112,685	264,067
Tobacco	23,903	49,557	17,076	246,427	336,964
Other Field	16,134	119,575	10,529	722,291	868,529
Veg/Fruit/Nuts	27,223	474,231	713,449	841,553	2,056,456
Nursery	3,436	161,858	229,794	319,777	714,864
Greenhouse	5,374	664,205	47,006	56,770	773,354
Total	$146,301	$2,066,644	$1,061,592	$2,840,121 (in 1991 dollars)	$6,114,658

SOURCES:
(1) Appendix Table NP-2 and the assumption that safety posters last 3 years.
(2) Appendix Table NP-2.
(3) Appendix Table NP-2 and the assumption that treated area signs last 5 years (labor costs remain the same as first year costs since signs must be posted and removed).

Appendix Table NP-5. Incremental first year notification costs for agricultural establishments that hire labor and use pesticides.

Crop Grouping	Safety Poster (1)	Central Notification (2)	Oral Notification (3)	Treated Area Posting (4)	Total Notification Costs
			($)		
Feed & Grain	188,441	390,249	13,447	2,688,669	3,280,806
Cotton	22,251	95,491	20,787	533,686	672,216
Tobacco	71,710	40,307	0	1,175,627	1,287,644
Other Field	48,401	97,255	8,241	3,601,792	3,755,689
Veg/Fruit/Nuts	81,668	385,711	0	3,430,976	3,898,355
Nursery	10,308	131,645	179,859	1,481,229	1,803,041
Greenhouse	16,123	540,224	36,791	283,848	876,986
Total	$438,902	$1,680,882	$259,126	$13,195,827 (in 1991 dollars)	$15,574,737

SOURCES:

(1) Incremental first year costs for safety posters are the same as total first year costs.

(2) Calculated by reducing total first year costs (Appendix Table NP-2) by 19%. Five states already require central notification on agricultural establishments (Appendix Table NP-6) and their percentage of U.S. farms = 19%.

(3) Calculated by reducing total first year oral notification costs (Appendix Table NP-2) by 22%. Eight states already require oral notification on agricultural establishments (Appendix Table NP-6) and their combined percentage of U.S. farms = 22%. Additionally, pesticides that are used on labor intensive crops are currently required to have oral notification statements on their labels. Therefore the cost of oral notification is already being incurred by those establishments with labor intensive crops (tobacco and veg/fruit/nuts).

(4) Incremental first year costs for treated area posting are the same as total first year costs.

Appendix Table NP-6. Calculation of WPS Notification Costs Attributable to State Regulations

	State Worker Protection Standards Currently in Effect*					
	(1)	(2)	(3)	(4)	(5)	(6)
States with notification requirements	States' % of U.S. Farms	Requires Central Notification	Requires Oral Notification	Requires Treated Area Posting	Does Posting Apply to all Applications	Specific Examples to (5)
Alaska	0.0%	X	X			
Arizona	0.4%		X	X	No	48 hr or > REI on 11 specific crops (mainly fruit & veg)
California	4.0%	X	X	X	No	If label specifies posting or has 48 hr or > REI on LIC
Florida	1.9%		X			
Michigan	2.5%		X			
Minnesota	3.7%			X	No	If a reentry interval is stated on the label
New Jersey	0.4%		X			
Ohio 7/	3.9%	X	X			
Texas	8.7%	X	X			
Virginia	2.1%	X				
Washington	1.7%			X	No	>24 hr reentry interval on labor intensive crops (LIC)
Wisconsin	3.7%			X	No	If a reentry interval is stated on the label
Total	33.0%	19%	22%	13%		

* Results of an EPA WPS questionaire from each state.

(1); Source: U.S. Department of Agriculture. Agricultural Statistics, 1990.

Survey questions corresponding to table column titles:

(2); 1. State HCS "Requires posting a list of pesticides used and the reentry interval in effect".

(3); 3.(b). "Must workers be orally informed about where and when pesticides are being applied and how long to stay out of treated areas".

(4); 3.(c). "Is posting of treated areas required".

(5); 3.(c). "Does the posting apply to all pesticide applications".

(6); 3.(c). "If posting is required for only certain applications, what are examples".

7/ Ohio's regulation applies to migrant labor only. Ohio requires either oral notification or posting.

Appendix Table NP-7. Incremental out year notification costs for agricultural establishments that hire labor and use pesticides.

Crop Grouping	Safety Poster (1)	Central Notification (2)	Oral Notification (2)	Treated Area Posting (3)	Total Notification Costs
			($)		
Feed & Grain	62,814	390,249	13,447	540,617	1,007,127
Cotton	7,417	95,491	20,787	112,685	236,381
Tobacco	23,903	40,307	0	246,427	310,637
Other Field	16,134	97,255	8,241	722,291	843,921
Veg/Fruit/Nuts	27,223	385,711	0	841,553	1,254,487
Nursery	3,436	131,645	179,859	319,777	634,718
Greenhouse	5,374	540,224	36,791	56,770	639,159
Total	$146,301	$1,680,882	$259,126	$2,840,121 (in 1991 dollars)	$4,926,430

SOURCES:

(1) Appendix Table NP-5. Based on the assumption that safety posters will last 3 years.

(2) Incremental out year central and oral notification costs are the same as first year incremental costs.

(3) Appendix Table NP-5. Based on the assumption that treated area signs last 5 years (labor costs remain the same as first year costs since signs must be posted and removed).

Section 4
Training

Appendix Table TR-1. Revised WPS compliance costs for training, by sector

Sector	Compliance Costs: Total First Year (1)	Compliance Costs: Total Out Year (2)	Compliance Costs: Incremental First Year (3)	Compliance Costs: Incremental Out Year (4)	Number of Establishments With Hired Labor That Use Pesticides (5)	Incremental Costs per Establishment With Hired Labor That Use Pesticides: First Year (6)	Incremental Costs per Establishment With Hired Labor That Use Pesticides: Out Year (7)
	($)		($)			($)	
Feed & Grain	4,138,343	1,392,581	2,624,899	866,030	132,705	19.78	6.53
Cotton	732,081	261,806	436,530	152,893	15,670	27.86	9.76
Tobacco	1,140,751	356,310	773,172	239,276	50,500	15.31	4.74
Other Field	1,629,043	584,129	968,581	340,191	34,085	28.42	9.98
Vegetable & Fruit	2,785,302	1,000,246	1,653,331	581,620	57,513	28.75	10.11
Nursery & Greenhouse	692,479	240,139	426,424	144,773	18,613	22.91	7.78
Commercial Handlers	490,200	147,060	61,275	55,148	8,500	7.21	6.49
Total	$11,608,197	$3,982,271	$6,944,212	$2,379,931	317,586	$21.87	$7.49

Note: Costs were apportioned by multiplying total first year training costs for workers by the percentage of workers in each crop sector and adding that to total first year training costs for handlers multiplied by the percentage of handlers in each crop sector.
This proceedure was repeated for total out year costs, and incremental first and out year costs.

SOURCES:
(1); Appendix Table TR-2.
(2); Appendix Table TR-3.
(3); Appendix Table TR-4.
(4); Appendix Table TR-6.
(5); Table III-2, column (7) and Table III-5.
(6); Calculated, (3)/(5).
(7); Calculated, (4)/(5).

Appendix Table TR-2. Total first year training costs for agricultural workers, handlers, and commercial pesticide handlers.

Employee Type	Length of Training (1) (Hours)	Average Employee Wage Rate (2) ($/hr)	Average Trainer Wage Rate (3) ($/hr)	Training Costs (4) ($/Employee)	Material Costs (5) ($/Employee)	Total Training & Material Costs (6) ($/Employee)	Number of Hired Employees (7) (Number)	Total First Year WPS Training Costs (8) ($)
Workers	0.50	5.00	6.50	5.75	0.15	5.90	847,138	4,998,114
Handlers	0.75	6.00	7.00	9.75	0.15	9.90	618,170	6,119,883
Commercial Handlers	0.75	7.00	10.00	12.75	0.15	12.90	38,000	490,200
Total							1,503,308	$11,608,197

SOURCES:
(1); EPA estimate.
(2); Worker wage rates from U.S. Department of Labor. Handbook of Labor Statistics. 1989 (August). Handler and commercial handler wage rate is an EPA estimate.
(3); For workers: calculated by assuming half of training is from employer ($7/hr, source:(2)) and half from hired handler ($6/hr, midway of worker and employer wage rate). Handler and commercial handler trainer wage rates are EPA estimates.
(4); Calculated, (1)X(2)+(1)X(3).
(5); EPA estimate.
(6); Calculated, (4)+(5).
(7); Workers and handlers from Table III-2, commercial handlers from Table III-5.
(8); Calculated, (6)X(7).

Appendix Table TR-3. Total out year training costs for agricultural workers, handlers, and commercial pesticide handlers

Employee Type	Number of Hired Employees (1) (Number)	Average Annual Employee Turnover Rate (2) (%)	Average Annual Employee Renewal Rate (3)	Total Average Annual Percent of Employees Requiring Training (4)	Number of Out Year Hired Employees (5) (Number)	Total Training & Material Costs (6) ($/Employee)	Total Out Year WPS Training Costs (7) ($)
Workers	847,138	20%	20%	40%	338,855	5.90	1,999,246
Handlers	618,170	10%	20%	30%	185,451	9.90	1,835,965
Commercial Handlers	38,000	10%	20%	30%	11,400	12.90	147,060
Total	1,503,308				535,706		$3,982,271

SOURCES:
(1),(6); From Appendix Table TR-2.
(2); EPA estimate based on an average career in agriculture of 5 years for workers and 10 years for handlers and commercial handlers.
(3); Employees are to receive retraining every 5 years, therefore, in any one year 20% of the employees will receive retraining.
(4); Calculated, (2) + (3).
(5); Calculated, (1) X (4).
(7); Calculated, (5) X (6).

Appendix Table TR-4. Incremental first year training costs for agricultural workers, handlers, and commercial pesticide handlers

Employee Type	Number of Hired Employees (1)	Number of Hired Employees Already Certified as Handlers (2)	Hired Employees Requiring Training (Uncertified) (3)	Percent Reduction in Employees Requiring Full Training Due to OSHA-HCS & State Regulations (4)	Number of Employees Receiving Training Due to OSHA-HCS & State Regs (5)	Number of Employees Requiring Full WPS Training (6)	Total Per Employee Training & Material Cost For WPS Full Training (7)	Total First Year Cost For WPS Full Training (8)	Supplemental Per Employee Training & Material Costs For Employees Trained Under HCS & State Regs (9)	First Year Supplemental Cost for Employees Trained Under HCS & State Regulations (10)	Total First Year Incremental WPS Training Costs (11)
	(Number)			(%)	(Number)		($/Employee)	($)	($/Employee)	($)	
Workers	847,138	0	847,138	60%	508,283	338,855	5.90	1,999,246	1.18	599,774	2,599,019
Handlers	618,170	0	618,170	60%	370,902	247,268	9.90	2,447,953	4.95	1,835,965	4,283,918
Commerical Handlers	38,000	28,500	9,500	100%	9,500	0	12.90	0	6.45	61,275	61,275
Total	1,503,308	28,500	1,474,808		888,685	586,123		4,447,199		2,497,014	$6,944,212

SOURCES:

(1),(7); Appendix Table TR-2.

(2); Table III-5. Due to lack of data, no handlers are assumed to be certified pesticide handlers. EPA believes this is an underestimate of the number of certified handlers which in turn, overestimates the cost of training due to the WPS.

(3); Calculated, (1)-(2).

(4); OSHA's Hazard Communication Standard applies to farm workers and handlers that are employed on farms with 11 or more employees. Thirty-six percent (36%) of all field workers are covered by the HCS (Federal Register. Vol. 52, No. 84. 1987 (May 1)), Page 16094. Additionally, nine states currently require some training for pesticide handlers or workers that could be exposed to pesticides, on establishments with 10 or less employees (Appendix Table TR-5). The nine states' percentage of U.S. hired farm labor expenses = 34%, which was used as a proxy for reducing the number of workers and handlers that require WPS training. Commercial handlers are covered by HCS and by state regulations.

(5); Calculated; (3)X(4).

(6); Calculated; (3)-(5).

(8); Calculated, (6)X(7).

(9); Calculated; (7)X20% for workers and (7)X50% for handlers (EPA est.). Costs account for more stringent training requirements under the WPS.

(10); Calculated; (5)X(9).

(11); Calculated; (8)+(10).

Appendix Table TR-5. Calculation of Worker Protection Standards Training Costs Attributable to State Regulations

States with training requirements	(1) States' % of U.S. Hired Farm Labor Expenses	State Worker Protection Standards Currently in Effect* (2) Applies to All Farms	(3) Worker Trainees: Subtract Worker Wages	(4) Worker Trainees: Subtract Worker-Trainer Wages	(5) Worker Trainees: Subtract Material Costs	(6) Handler Trainees: Subtract Handler Wages	(7) Handler Trainees: Subtract Handler-Trainer Wages
Alaska	0.0%	X		X	X	X	
California	22.0%	X	X		X	X	
Maine	0.5%	X	X	X	X	X	
Massachusetts	0.8%	X	X		X		
Michigan	2.2%	X	X				
Minnesota	2.2%					X	
New Hampshire	0.2%			X		X	
New Jersey	0.8%			X			X
Ohio	2.0%				X		
Oregon	2.4%	X	X	X	X	X	
Pennsylvania	2.7%	X		X		X	
Rhode Island	0.1%	X	X		X		
Texas	5.8%				X		
Virginia	1.3%				X		
Washington	3.9%	X	X				
Total	47%	34%	32%	7%	35%	30%	1%

* Results of an EPA WPS questionaire from each state.

(1); Source: U.S. Department of Commerce. 1987 Census of Agriculture. 1989 (November). Bureau of the Census.
Survey questions corresponding to table column titles:
(2); 1. "Does the State have a "Right-to-Know" or Hazard Communication law/regulation that is more stringent than the Federal HCS in any of the following ways:
Applies to farms with 10 or less employees".
(3); 1. "Requires pesticide-specific training".
(4); 4.(c). "Is an instructor/trainer required".
(5); 1. "Requires fact sheets on pesticides be made available to workers".
(6); 4.(a). "Is training required for noncertified pesticide handlers".
(7); 4.(c). "If an instructor/trainer is required, they must meet certain qualifications".

Appendix Table TR-6. Incremental out year training costs for agricultural workers, handlers, and commercial pesticide handlers

Employee Type	Number of Hired Employees (1)	Number of Hired Employees Already Certified as Handlers (2)	Hired Employees Requiring Training (Uncertified) (3)	Percent Reduction in Employees Requiring Full Training Due to OSHA-HCS & State Regulations (4)	Number of Employees Receiving Training Due to OSHA-HCS & State Regs (5)	Number of Employees Requiring Full WPS Training (6)	Total Per Employee Training & Material Cost For WPS Full Training (7)	Total Out Year Cost For WPS Full Training (8)	Supplemental Per Employee Training & Material Costs For Employees Trained Under HCS & State Regs (9)	Out Year Supplemental Cost for Employees Trained Under HCS & State Regulations (10)	Total Out Year Incremental WPS Training Costs (11)
	(Number)			(%)	(Number)		($/Employee)	($)	($/Employee)	($)	
Workers	338,855	0	338,855	60%	203,313	135,542	5.90	799,698	1.18	239,909	1,039,608
Handlers	185,451	0	185,451	60%	111,271	74,180	9.90	734,386	4.95	550,789	1,285,175
Commerical Handlers	11,400	2,850	8,550	100%	8,550	0	12.90	0	6.45	55,148	55,148
Total	535,708	2,850	532,858		323,134	209,722		1,534,084		845,846	$2,379,931

SOURCES:

(1),(7); Appendix Table TR-3.

(2); Estimate based on 3,800 total out year commercial handlers multiplied by the the proportion of certified commercial handlers to all commercial handlers (75%) from Table III-5.

(3); Calculated, (1)-(2).

(4); OSHA's Hazard Communication Standard applies to farm workers and handlers that are employed on farms with 11 or more employees. Thirty-six percent (36%) of all field workers are covered by the HCS (Federal Register. Vol. 52, No. 84. 1987 (May 1)). Page 16084. Additionally, nine states currently require some training for pesticide handlers or workers that could be exposed to pesticides, on establishments with 10 or less employees (Appendix Table TR-5). The nine states' percentage of U.S. hired farm labor expenses = 34%, which was used as a proxy for reducing the number of workers and handlers that require WPS training. Commercial handlers are covered by HCS and by state regulations.

(5); Calculated, (3)X(4).

(6); Calculated, (3)X(5).

(8); Calculated, (6)X(7).

(9); Calculated, (7)X20% for workers and (7)X50% for handlers (EPA est.). Costs account for more stringent training requirements under the WPS.

(10); Calculated, (5)X(9).

(11); Calculated; (8)+(10).

Section 5
Decontamination

Appendix Table DC-1. Revised WPS compliance costs for decontamination in 1991 dollars, by sector

Sector	Compliance Costs: Total First Year (1)	Compliance Costs: Total Out Year (2)	Compliance Costs: Incremental First Year (3)	Compliance Costs: Incremental Out Year (4)	Number of Establishments With Hired Labor That Use Pesticides (5)	Incremental Costs per Establishment That Hire Labor & Use Pesticides: First Year (6)	Incremental Costs per Establishment That Hire Labor & Use Pesticides: Out Year (7)
	($)		($)			($)	
Feed & Grain	7,355,078	4,375,776	3,785,480	2,267,375	132,705	28.53	17.09
Cotton	1,040,043	662,072	587,797	397,155	15,670	37.51	25.34
Tobacco	2,984,258	1,912,289	1,267,690	734,481	50,500	25.10	14.54
Other Field	2,182,776	1,355,655	1,247,629	829,460	34,085	36.60	24.34
Vegetable & Fruit	13,866,287	12,465,703	4,347,143	3,714,044	57,513	75.59	64.58
Nursery & Greenhouse	2,808,124	2,418,602	1,058,963	864,245	18,613	56.89	46.43
Commercial Handlers	1,089,117	950,717	421,210	366,406	8,500	49.55	43.11
Total	$31,325,684	$24,140,815	$12,715,912	$9,173,166	309,086	$41.14	$29.68

Note: For hired handler decontamination, costs were apportioned by multiplying total first year decontamination costs by the percentage of hired handlers in each crop sector (Table III-2). This procedure was repeated for total out year costs, and incremental first and out year costs.

SOURCES:
(1); Appendix Tables DC-2, DC-7, DC-11, and DC-13.
(2); Appendix Tables DC-3, DC-8, DC-11, and DC-14.
(3); Appendix Tables DC-4, DC-9, DC-12, and DC-15.
(4); Appendix Tables DC-5, DC-10, DC-12, and DC-16.
(5); Table III-2, column (7) and Table III-5.
(6); Calculated, (3)/(5).
(7); Calculated, (4)/(5).

Appendix Table DC-2. Total first year decontamination costs for commercial handlers

Eyewash Dispensers:		
Ground applicators on foot 1/ =	0	
Total first year eyeflush dispenser costs	$0	
Decontamination Site:		
Tyvek coverall 2/	3.75	
Container for wash water 3/	3.08	
Soap 4/	2.97	
Towels 5/	5.69	
Labor 6/	27.50	
Total first year decontamination costs per site	$42.99	
Total number of handling sites 7/ X	25,333	
Total first year decontamination costs for commercial handlers (in 1991 dollars)		$1,089,117

All prices are from current personal and environmental safety supply catelogs.

1/ Based on the assumption that only a small number of hired handlers on foot need eyewash dispensers. These applicators and the associated eyewash dispenser costs are addressed under hired handler decontamination costs.

2/ Based on one change of clean clothing per decontamination site.

3/ Based on the assumption that aerial applicators and support crew have running water at their loading site. Calculated, (13,000 comm. ground applicators/38,000 total applicators (Table III-5)) X $9 per 3-gal container.

4/ Based on the following assumptions:
- –Each handler requires 2 oz. of soap per handling day. (EPA estimate).
- –There are 1.5 handlers per site (40% of comm. handlers work alone and 60% work together with mixers/loaders/cleaners). EPA estimate.
- –There are 33 handling days per commercial handler per year (Table III-6, footnote 4).
- –Soap costs $0.96 for 32 oz. (EPA estimate).

Calculated, ((2 oz. soap X 1.5 handlers X 33 days)/32 oz.) X $0.96.

5/ Based on the following assumptions:
- –Each handler requires 16 towels per handling day. (EPA estimate).
- –There are 1.5 handlers per site. (40% of comm. handlers work alone and 60% work together with mixers/loaders/cleaners). EPA estimate.
- –There are 33 handling days per commercial handler per year (Table III-6, footnote 4).
- –Towels cost $0.69 per 96 towel roll (EPA estimate).

Calculated, ((16 towels X 1.5 handlers X 33 days)/96 towels) X $0.69.

6/ Based on the need to rinse and refill wash water containers and the following assumptions:
- –Commercial handler's wage rate = $10.00 per hour (Appendix Table TR-2).
- –It takes 5 minutes per handling day, per site, to rinse and refill containers (EPA estimate).
- –There are 33 handling days per commercial handler per year (Table III-6, footnote 4).

Calculated, $10.00 per hour X (5 min/60 min) X 33 days.

7/ Calculated, 38,000 commercial handlers/1.5 handlers per site.

Appendix Table DC-3. Total out year decontamination costs for commercial handlers

Decontamination Site:		
Tyvek coverall 1/	0.75	
Container for wash water 1/	0.62	
Soap	2.97	
Towels	5.69	
Labor	27.50	
Total out year decontamination costs per site	$37.53	
Total number of handling sites X	25,333	
Total out year decontamination costs for commercial handlers (in 1991 dollars)		$950,717

Source: Appendix Table DC-2.

1/ Based on the assumption that coveralls and containers are replaced every 5 years.

Appendix Table DC-4. Total first year incremental decontamination costs for commercial handlers

Decontamination Site:	Percent Attributable 1/ to State Regulations	Cost Removing State Regs	Existing 2/ Voluntary Compliance	Cost After Voluntary Compliance	
Tyvek coverall	19%	3.04	50%	1.52	
Container for wash water	23%	2.37	50%	1.19	
Soap	23%	2.29	50%	1.14	
Towels	23%	4.38	50%	2.19	
Labor	23%	21.18	50%	10.59	
		Total first year incremental decontamination costs per site		$16.63	
		Total number of handling sites X		25,333	
		Total first year incremental decontamination cost for commercial handlers (in 1991 dollars)			$421,210

Source: Appendix Table DC-2.
1/ Appendix Table DC-6.
2/ EPA estimate.

Appendix Table DC-5. Total out year incremental decontamination costs for commercial handlers

Decontamination Site:	Percent Attributable 1/ to State Regulations	Cost Removing State Regs	Existing 2/ Voluntary Compliance	Cost After Voluntary Compliance	
Tyvek coverall	19%	0.61	50%	0.30	
Container for wash water	23%	0.47	50%	0.24	
Soap	23%	2.29	50%	1.14	
Towels	23%	4.38	50%	2.19	
Labor	23%	21.18	50%	10.59	
		Total out year incremental decontamination costs per site		$14.46	
		Total number of handling sites X		25,333	
		Total out year incremental decontaminstion cost for commercial handlers (in 1991 dollars)			$366,406

Source: Appendix Table DC-3.
1/ Appendix Table DC-6.
2/ EPA estimate.

Appendix Table DC-6. Calculation of Worker Protection Standards Decontamination Costs Attributable to State Regulations

	State Field Sanitation law/regulations equal to Federal Field Sanitation Standards								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
				Requires Wash Water (including soap & towels)			Requires Eyeflush Dispensers or Eyeflush Water		
States with decontamination requirements	States' % of U.S. Crop Marketings	Applies to 10 or less Employees	Requires Clean Change of Clothing for Emergencies	Handlers	Early Entry Workers	All Ag Workers	Handlers	Early Entry Workers	All Ag Workers
Alaska	0.9%	X		X	X	X			
California	16.5%	X	X	X			H2O	H2O	H2O
Florida	6.6%	X							
Indiana	9.3%	X							
Michigan	2.2%	X	X			X			
New Jersey	0.6%			X		X	X		X
Ohio	2.9%	X							
Oregon	2.1%	X				X			X
Pennsylvania	1.3%	X			X				
Texas	5.2%	X		X	X	X	X	X	X
Washington	3.2%	X				X			
Total	45%	44%	19%	23%	7%	14%	6%	5%	8%

* Source: Results of an EPA WPS questionaire from each state.

(1); U.S. Department of Agriculture. Agricultural Statistics, 1990.

Survey questions corresponding to table column titles:

(2); 2. "Applies to farms with 10 or less employees".

(3); 2. "Requires a clean change of clothing for emergencies".

(4); 5.(a). "Is wash water required for agricultural pesticide handlers".

(5); 5.(a). "Is wash water required for early entry workers".

(6); 5.(a). "Is wash water required for all agricultural workers".

(7); 5.(c). "Is eyeflush water or dispensers required for agruicultural pesticide handlers".

(8); 5.(c). "Is eyeflush water or dispensers required for early entry workers".

(9); 5.(c). "Is eyeflush water or dispensers required for all agricultural workers".

Appendix Table DC-7. Total first year decontamination costs for hired handlers

Eyewash Dispensers:				
Hired ground applicators on foot 1/ =		13,010		
Percent of pesticides that are Toxicity I-II 2/ for eye irritation potential	X	35%		
= Number of eyewash dispensers needed by hired handlers		4,554		
Cost per eyewash dispenser 3/	X	$6.00		
Total first year cost for eyewash dispensers for hired handlers			$27,321	
Decontamination Items (cost per hired handler):				
Tyvek coverall 4/		3.75		
Container for wash water 5/		9.00		
Soap 6/		0.78		
Towels 7/		1.50		
Labor 8/		7.58		
Total first year decontamination costs per hired handler		$22.61		
Number of hired handlers 9/	X	618,170		
Total first year decontamination costs for hired handlers			$13,975,793	
Grand total first year eye wash dispenser and decontamination costs for hired handlers				$14,003,115 (in 1991 dollars)

All prices are from current personal and environmental safety supply catelogs.

1/ Based on the assumption that 5% of the hired handlers on fruit/vegetable farms apply pesticides by foot [115,025 handlers (Table III-2) X 5% (EPA est.)] and that 50% of the hired handlers in nurseries do not have water immediately available and apply pesticides by foot [37,225 nursery/greenhouse handlers (Table III-2) X X 39% are nursery handlers (based on 1987 Census of Agriculture data) X 50% of hursery handlers do not have running water immediately available (EPA estimate)].

2/ EPA estimate based on the proportion of Tox I-II pesticides for eye irritation potential to all pesticides.

3/ The cost of eyewash dispenser water is negligable. Water used is drinking water from the establishment.

4/ Based on one change of clean clothing per hired handler.

5/ Based on one, three gallon carboy-type container per hired handler. EPA believes this is an overestimate of the number of water containers needed because most greenhouses and most mixing and loading sites already have running water available.

6/ Based on the following assumptions:
--Each handler requires 2 oz. of soap per handling day. (EPA estimate).
--There are an average of 13 handling days per hired handler per year. (Table III-6, footnote 6).
--Soap costs $0.96 for 32 oz. (EPA estimate).
Calculated, ((2 oz. soap X 13 days)/32 oz.) X $0.96.

7/ Based on the following assumptions:
--Each handler requires 16 towels per handling day. (EPA estimate).
--There are an average of 13 handling days per hired handler per year. (Table III-6, footnote 6).
--Towels cost $0.69 per 96 towel roll (EPA estimate).
Calculated, ((16 towels X 13 days)/96 towels) X $0.69.

8/ Based on the need to rinse and refill wash water containers and the following assumptions:
--Hired handler's wage rate = $7.00 per hour
--It takes 5 minutes per handling day, to rinse and refill carboy-type container (EPA estimate).
--There are an average of 13 handling days per hired handler per year. (Table III-6, footnote 6).
Calculated, $7.00 per hour X (5 min/60 min) X 13 days.

9/ Table III-2.

Appendix Table DC-8. Total out year decontamination costs for hired handlers

Eyewash Dispensers:					
Number of eyewash dispensers needed by hired handlers			4,554		
Cost per eyewash dispenser 1/		X	$1.20		
Total out year cost for eyewash dispensers for hired handlers				$5,464	
Decontamination Items (cost per hired handler):					
Tyvek coverall 1/			0.75		
Container for wash water 1/			1.80		
Soap			0.78		
Towels			1.50		
Labor			7.58		
Total out year decontamination costs per hired handler			$12.41		
Number of hired handlers	X		618,170		
Total out year decontamination costs for hired handlers				$7,670,459	
Grand total out year eye wash dispenser and decontamination costs for hired handlers					$7,675,924 (in 1991 dollars)

Source: Appendix Table DC-8.

1/ Based on the assumption that eyewash dispensers, coveralls, and carboy water containers are replaced every 5 years.

Appendix Table DC-9. Total first year incremental decontamination costs for hired handlers

Eyewash Dispensers:	Percent Attributable 1/ to State Regulations	Cost After Removing State Regs		Total Incremental Cost of Eye Wash Dispensers
Dispensers	2%	$26,775		$26,775
Decontamination Items (cost per hired handler):	**Percent Attributable 1/ to State Regulations**	**Cost After Removing State Regs**	**Existing 2/ Voluntary Compliance**	**Cost Removing Voluntary Compliance**
Tyvek coverall	24%	2.85	35%	1.85
Container for wash water	22%	7.02	35%	4.56
Soap	22%	0.61	35%	0.40
Towels	22%	1.17	35%	0.76
Labor	22%	5.92	35%	3.84
		Total first year incremental decontamination costs per hired handler		$11.41
		Total number of hired handlers	X	618,170
		Total first year incremental decontamination cost for hired handlers		$7,055,591
Grand total first year incremental eye wash dispenser and decontamination costs for hired handlers				$7,082,366

(in 1991 dollars)

Source: Appendix Table DC-7.
1/ Appendix Table DC-6.
2/ EPA estimate.

Appendix Table DC-10. Total out year incremental decontamination costs for hired handlers

Eyewash Dispensers:	Percent Attributable 1/ to State Regulations	Cost After Removing State Regs		Total Incremental Cost of Eye Wash Dispensers
Dispensers	2%	$5,355		$5,355
Decontamination Items (cost per hired handler):	**Percent Attributable 1/ to State Regulations**	**Cost After Removing State Regs**	**Existing 2/ Voluntary Compliance**	**Cost Removing Voluntary Compliance**
Tyvek coverall	24%	0.57	35%	0.37
Container for wash water	22%	1.40	35%	0.91
Soap	22%	0.61	35%	0.40
Towels	22%	1.17	35%	0.76
Labor	22%	5.92	35%	3.84
		Total out year incremental decontamination costs per hired handler		$6.28
		Total number of hired handlers	X	618,170
		Total out year incremental decontamination cost for hired handlers		$3,882,898
Grand total out year incremental eye wash dispenser and decontamination costs for hired handlers				$3,888,251

(in 1991 dollars)

Source: Appendix Table DC-8.
1/ Appendix Table DC-6.
2/ EPA estimate.

Appendix Table DC-11. Total first and out year decontamination costs for hired handlers when they are working in the field

Crop Sector	Water 1/ Container	Soap 2/	Towels 3/	Labor 4/	Total Cost	Total Number 5/ of Hired Handlers	Total First & Out Year Cost
			-($/hired handler)			(Number)	($)
Feed & Grain	0.00	0.48	0.92	0.00	1.40	265,410	$371,574
Cotton	0.00	0.36	0.69	2.03	3.08	31,340	$96,566
Tobacco	0.00	1.44	2.76	0.00	4.20	101,000	$424,200
Other Field	0.00	0.36	0.69	1.91	2.96	68,170	$201,904
Vegetable/Fruit	0.00	4.92	9.43	23.38	37.73	115,025	$4,339,570
Nursery/Greenhouse	0.00	5.70	10.93	0.00	16.63	37,225	$618,866
Total First Year Decontamination Cost for hired handlers when they are working in the field (1991 dollars)							$6,052,680

SOURCES:

1/ All hired handlers have been "bought" a water container for the days in which they apply pesticides. This container can also be used on the days they are working in the field.

2/ Based on the following:
- –Each handler requires 2 oz. of soap for each day working in the field (EPA estimate).
- –The number of days that handlers spend in the field within 30 days of the expiration of an REI, per year, per crop sector (Table III-6).
- –Soap costs $0.96 for 32 oz. (EPA estimate).

Calculated, ((2 oz. soap X days in field)/32 oz.) X $0.96.

3/ Based on the following:
- –Each handler requires 16 towels for each day working in the field (EPA estimate).
- –The number of days that handlers spend in the field within 30 days of the expiration of an REI, per year, per crop sector (Table III-6).
- –Towels cost $0.69 per 96 towel roll (EPA estimate).

Calculated, ((16 towels X days in field)/96 towels) X $0.69.

4/ Based on the need to rinse and refill carboy-type wash water containers and the following:
- –The handlers' supervisor's wage rate = $6.50 per hour (Appendix Table TR-2).
- –It takes 5 minutes per work day, to rinse and refill each container (EPA estimate).
- –The number of days that handlers spend in the field within 30 days of the expiration of an REI, per year, per crop sector (Table III-6).
- –Only cotton, other field, and veg/fruit establishments have greater than 5 employees and will need to use the 3-gallon carboy in addition to the 5-gallon collapsible water container.

Calculated for handlers while working in the fields on cotton establishments:
[$6.50 per hour X (5 min/60 min) X 6 days in field]/(6.6 employees per estab. - 5 employees who are using the 5 gal. water container) = $2.03.

5/ Table III-2.

Appendix Table DC-12. Incremental first and out year decontamination costs for hired handlers when they are working in the field

Crop Sector	Total Cost Per Hired Handler (1)	Cost Offset of Voluntary Compliance (2)	Cost Removing Voluntary Compliance (3)	Percent of Cost Attributable to State Regulations (4)	Per Handler Cost Removing State Regulations (5)	Total Number of Hired Handlers (6)	Number of Hired Handlers Already Covered by OSHA-FSS (7)	Number of Hired Handlers Not Covered by OSHA-FS (8)	Total Incremental First & Out Year Cost (9)
	($/hired handler)			(%)	($)	(Number)			($)
Feed & Grain	1.40	0.28	1.12	30%	0.78	256,065	0	256,065	$200,755
Cotton	3.08	0.62	2.47	30%	1.73	71,494	7,149	64,345	$111,027
Tobacco	4.20	0.84	3.36	30%	2.35	23,873	11,220	12,653	$29,759
Other Field	2.96	0.59	2.37	30%	1.66	161,722	14,555	147,167	$244,089
Vegetable/Fruit	37.73	7.55	30.18	30%	21.13	279,077	192,563	86,514	$1,827,798
Nursery/Greenhouse	16.63	3.33	13.30	30%	9.31	54,907	27,454	27,454	$255,592
Incremental First and Out Year Decontamination Cost for Hired Handlers When They are Working in the Field (1991 dollars)									$2,669,021

(1),(6); Appendix Table DC-11.
(2); Federal Register. Vol. 52, No. 84, May 1, 1987. Page 16082. OSHA offsets approximately 20% of the FSS decontamination costs from voluntary compliance.
(3); Calculated, (1)-(2).
(4); Appendix Table DC-6.
(5); Calculated, (3)-[(3)X(4)].
(7); Calculated, (6)-% covered by OSHA. Federal Register. Vol. 52, No. 84, May 1, 1987. Page 16073. OSHA estimates that 10% of hired cotton workers, 47% of tobacco, 9% of other field crop, 70% of vegetable, and 67% of hired fruit workers are covered by the FSS. EPA estimates that 50% of nursery/greenhouse workers are also covered by OSHA's FSS.
(8); Calculated, (6)-(7).
(9); Calculated, (5)X(8).

Appendix Table DC-13. Total first year decontamination costs for hired agricultural workers

Crop Sector	Water 1/ Container	Soap 2/	Towels 3/	Labor 4/	Total Cost	Total Number 5/ of Hired Workers	Total First Year Cost
	($/hired worker)					(Number)	($)
Feed & Grain	1.28	0.48	0.92	1.11	3.79	256,065	$971,296
Cotton	1.00	0.48	0.92	0.87	3.27	71,494	$233,547
Tobacco	2.00	1.44	2.76	5.20	11.40	23,873	$272,152
Other Field	1.00	0.36	0.69	0.65	2.70	161,722	$436,649
Vegetable/Fruit	1.00	5.04	9.66	9.10	24.80	279,077	$6,921,110
Nursery/Greenhouse	0.20	7.44	14.26	2.62	24.51	54,907	$1,346,018
Total First Year Decontamination Cost for Hired Agricultural Workers (1991 dollars)							$10,180,772

Footnotes on following page.

Footnotes from Appendix Table DC-13

1/ Based on the following assumptions:
--Each worker requires one gallon of wash water per work day in the field. Although OSHA requires two gallons per worker EPA estimates that one gallon is sufficient for hand washing purposes.
--Water containers cost $5 each (5 gallon collapsible with spigot, food approved). On establishments with greater than 5 employees it is assumed that the carboy-type water container that was purchased for hired handlers (who are also working in the fields), can be used in addition to the 5 gallon collapsible container.
--None of the workers in feed & grain, cotton, tobacco, other field, and vegetable/fruit fields currently have running water available within 1/4 mile.
--All greenhouse (& greenhouse-like nursery) workers have running water available, therefore they do not need a water container (Greenhouses & greenhouse-like nurseries = 61% of nursery/greenhouses, Source: 1987 Census of Agriculture).
--Half of the nursery workers have running water available (Nurseries = 39% of all nursery/greenhouses) (EPA estimate).
Feed & grain calculation: $5.00 container/3.9 employees per establishment = $1.28 per worker.
Cotton calculation: $5.00 container/5 employees using the 5 gallon collapsible container = $1.00 per worker.
Similar logic for tobacco, other field, and vegetable/fruit crops.
Nursery/greenhouse calculation: ($5.00 per container/5.0 employees per establishment) X
(39% of nursery/greenhouses are nurseries X 50% of nurseries don't have running water immediately available).

2/ Based on the following:
--Each worker requires 2 oz. of soap per work day. (EPA estimate).
--The number of days that workers spend in the field within 30 days of the expiration of an REI, per year, per crop sector (Table III-6).
--Soap costs $0.96 for 32 oz. (EPA estimate).
Calculated, ((2 oz. soap X days in field)/32 oz.) X $0.96.

3/ Based on the following:
--Each worker requires 16 towels per work day. (EPA estimate).
--The number of days that workers spend in the field within 30 days of the expiration of an REI, per year, per crop sector (Table III-6).
--Towels cost $0.69 per 96 towel roll (EPA estimate).
Calculated, ((16 towels X days in field)/96 towels) X $0.69.

4/ Based on the need to rinse and refill wash water containers and the following:
--The workers' supervisor's wage rate = $6.50 per hour (Appendix Table TR-2).
--It takes 5 minutes per work day, to rinse and refill each container (EPA estimate).
--The number of days that workers spend in the field within 30 days of the expiration of an REI, per year, per crop sector (Table III-6).
Calculated, ($6.50 per hour X (5 min/60 min) X days in field)/ Number of employees per establishment (up to 5)
Calculated for nursery/greenhouses, [($6.50 per hour X (5 min/60 min) X 124 days in field)/5.0 workers per estab.] X 39% X 50%.

5/ Table III-2.

Appendix Table DC-14. Total out year decontamination costs for hired agricultural workers

Crop Sector	Water 1/ Container	Soap	Towels	Labor	Total Cost	Total Number of Hired Workers	Total Out Year Cost
	($/hired worker)					(Number)	($)
Feed & Grain	0.26	0.48	0.92	1.11	2.77	256,065	$708,560
Cotton	0.20	0.48	0.92	0.87	2.47	71,494	$176,352
Tobacco	0.40	1.44	2.76	5.20	9.80	23,873	$233,955
Other Field	0.20	0.36	0.69	0.65	1.90	161,722	$307,272
Vegetable/Fruit	0.20	5.04	9.66	9.10	24.00	279,077	$6,697,848
Nursery/Greenhouse	0.04	7.44	14.26	2.62	24.36	54,907	$1,337,507
Total out year decontamination cost for agricultural workers (1991 dollars)							$9,461,494

Source: Appendix Table DC-13.
1/ Based on the assumption that water containers are replaced every 5 years.

Appendix Table DC-15. Incremental first year decontamination costs for hired agricultural workers

Crop Sector	Total Cost Per Hired Worker (1)	Cost Offset of Voluntary Compliance (2)	Cost Removing Voluntary Compliance (3)	Percent of Cost Attributable to State Regulations (4)	Per Worker Cost Removing State Regulations (5)	Total Number of Hired Workers (6)	Number of Hired Workers Already Covered by OSHA FSS (7)	Number of Hired Workers Not Covered by OSHA FSS (8)	Total Incremental First Year Cost (9)
	($/hired worker)			(%)	($)	(Number)			($)
Feed & Grain	3.79	0.76	3.03	30%	2.12	256,065	0	256,065	$543,926
Cotton	3.27	0.65	2.61	30%	1.83	71,494	7,149	64,345	$117,708
Tobacco	11.40	2.28	9.12	30%	6.38	23,873	11,220	12,653	$80,775
Other Field	2.70	0.54	2.16	30%	1.51	161,722	14,555	147,167	$222,517
Vegetable/Fruit	24.80	4.96	19.84	30%	13.89	279,077	192,563	86,514	$1,201,505
Nursery/Greenhouse	24.51	4.90	19.61	30%	13.73	54,907	27,454	27,454	$376,885
Incremental First Year Decontamination Cost for Hired Agricultural Workers (1991 dollars)									$2,543,314

(1),(6); Appendix Table DC-13.
(2); Federal Register. Vol. 52, No. 84, May 1, 1987. Page 16082. OSHA offsets approximately 20% of the FSS decontamination costs from voluntary compliance.
(3); Calculated, (1)-(2).
(4); Appendix Table DC-6.
(5); Calculated, (3)-[(3)X(4)].
(7); Calculated, (6)-% covered by OSHA. Federal Register. Vol. 52, No. 84, May 1, 1987. Page 16073. OSHA estimates that 10% of hired cotton workers, 47% of tobacco, 9% of other field crop, 70% of vegetable, and 67% of hired fruit workers are covered by the FSS. EPA estimates that 50% of nursery/greenhouse workers are also covered by OSHA's FSS.
(8); Calculated, (6)-(7).
(9); Calculated, (5)X(8).

Appendix Table DC-16. Incremental out year decontamination costs for hired agricultural workers

Crop Sector	Total Cost Per Hired Worker (1)	Cost Offset of Voluntary Compliance (2)	Cost Removing Voluntary Compliance (3)	Percent of Cost Attributable to State Regulations (4)	Per Worker Cost Removing State Regulations (5)	Total Number of Hired Workers (6)	Number of Hired Workers Already Covered by OSHA-FSS (7)	Number of Hired Workers Not Covered by OSHA-FSS (8)	Total Incremental Out Year Cost (9)
	($/hired worker)			(%)	($)	(Number)			($)
Feed & Grain	2.77	0.55	2.22	30%	1.55	256,065	0	256,065	$397,208
Cotton	2.47	0.49	1.98	30%	1.38	71,494	7,149	64,345	$89,001
Tobacco	9.80	1.96	7.84	30%	5.49	23,873	11,220	12,653	$69,438
Other Field	1.90	0.38	1.52	30%	1.06	161,722	14,555	147,167	$156,586
Vegetable/Fruit	24.00	4.80	19.20	30%	13.44	279,077	192,563	86,514	$1,162,746
Nursery/Greenhouse	24.38	4.87	19.49	30%	13.64	54,907	27,454	27,454	$374,510
Incremental Out Year Decontamination Cost for Hired Agricultural Workers (1991 dollars)									$2,249,489

(1),(6); Appendix Table DC-14.
(2); Federal Register. Vol. 52, No. 84, May 1, 1987. Page 16082. OSHA offsets approximately 20% of the FSS decontamination costs from voluntary compliance.
(3); Calculated, (1)-(2).
(4); Appendix Table DC-6.
(5); Calculated, (3)-[(3)X(4)].
(7); Calculated, (6)-% covered by OSHA. Federal Register. Vol. 52, No. 84, May 1, 1987. Page 16073. OSHA estimates that 10% of hired cotton workers, 47% of tobacco, 9% of other field crop, 70% of vegetable, and 67% of hired fruit workers are covered by the FSS. EPA estimates that 50% of nursery/greenhouse workers are also covered by OSHA's FSS.
(8); Calculated, (6)-(7).
(9); Calculated, (5)X(8).

Section 6
Emergency Assistance

Appendix Table EA-1. Revised WPS compliance costs for emergency assistance in 1991 dollars, by sector

Sector	Compliance Costs: Total* First Year (1)	Compliance Costs: Total* Out Year (2)	Compliance Costs: Incremental* First Year (3)	Compliance Costs: Incremental* Out Year (4)	Number of Establishments With Hired Labor That Use Pesticides (5)	Incremental Costs per Establishment That Hire Labor & Use Pesticides: First Year (6)	Incremental Costs per Establishment That Hire Labor & Use Pesticides: Out Year (7)
	($)		($)			($)	
Feed & Grain	13,746	13,746	3,385	3,385	132,705	0.03	0.03
Cotton	2,711	2,711	668	668	15,670	0.04	0.04
Tobacco	3,292	3,292	811	811	50,500	0.02	0.02
Other Field	6,060	6,060	1,492	1,492	34,085	0.04	0.04
Vegetable & Fruit	10,389	10,389	2,559	2,559	57,513	0.04	0.04
Nursery & Greenhouse	2,429	2,429	598	598	18,613	0.03	0.03
Commercial Handlers	1,002	1,002	247	247	8,500	0.03	0.03
Total	$39,628	$39,628	$9,759	$9,759	317,586	$0.03	$0.03

SOURCES:
(1),(2),(3),(4); Appendix Tables EA-2.
(5); Table III-2.
(6); Calculated; (3)/(6).
(7); Calculated; (4)/(6).

* First and out year costs are estimated to be the same, though out year costs are likely to be overestimated. It is expected that the number of poisonings will be reduced in out years due to agricultural operators switching to less toxic pesticides. However, the reductions could not be quantified.

Appendix Table EA-2. Total and incremental first and out year emergency response costs for hired handlers, commercial handlers, and hired workers

TOTAL FIRST & OUT YEAR COSTS			
Hired Ag. Employee Poisonings 1/		1,965	
Total hired employee poisonings		1,965	
1. Cost of responding to each emergency information request 2/	X	$1.17	
= Cost of responding to all emergency information requests			$2,293
2. Total hired employee poisonings		1,965	
Cost of transporting each employee to medical facility 3/	X	$19.00	
= Cost of transporting all employees to medical facilities			$37,335
Total first and out year emergency response costs (in 1991 dollars)			$39,628
INCREMENTAL FIRST & OUT YEAR COSTS			
1. Cost of responding to all emergency information requests		$2,293	
			$2,293
2. Cost of transporting all employees to medical facilities		$37,335	
Percent of transportation costs 4/ attributable to state regulations and existing voluntary compliance		80%	
Cost of transportation, removing state regulations and voluntary compliance			$7,467
Incremental first and out year emergency response costs (in 1991 dollars)			$9,759

1/ The number of physician-diagnosed poisonings for agricultural employees is 15,400. Hired agricultural handlers, commercial handlers, and agricultural workers account for 63.8% of the total agricultural work force (hired + nonhired). Therefore the number of physician-diagnosed poisionings among hired agricultural employees is 15,400 X 63.8 = 9,825. However, there should be at least an 80% reduction in the number of poisoning after the Rule is in effect. 9,825 X .20 = 1,965 physican-diagnosed poisonings for hired agricultural employees after the Rule becomes effective.

2/ Based on an employer wage rate of $7.00 per hour (U.S. Department of Labor) and the assumption that it will take 10 minutes for the employer to respond to a telephone call for emergency information.
Calculated, $7 an hour X (10 minutes / 60 minutes).

3/ Based on an employer wage rate of $7.00 per hour, a 50 mile round trip to the medical facility which will take one hour, and a vehicle depreciation rate of $0.24 per mile.
Calculated, ($7 an hour employer wage X 1 hour to transport employee to and from medical facility) + (50 miles X $0.24 per mile) = $19.00

4/ EPA estimate.

Section 7
Rule Familiarization

Worker Protection Standard Costs of Familiarization

When the Worker Protection Standard (WPS) becomes final, operators/managers of agricultural establishments and commercial pesticide handling establishments covered by the WPS must learn how to comply with the requirements of the WPS. The Agency is drafting a "How To Comply" manual, including a 2-page summary chart. The "How To Comply" manual and summary chart will serve as a far more readable document than the rule itself. EPA estimates that operators/managers on agricultural establishments with hired labor will need about 2 hours to become familiar with the WPS provisions during the first year of implementation and approximately 20 minutes per year thereafter. EPA also estimates that operators/managers of agricultural establishments without hired labor and of commercial pesticide handling establishments will need only about 1 hour in the first year to become familiar with the WPS's provisions that pertain to them and approximately 10 minutes per year thereafter.

The Agency based its estimate on the following assumptions:

1. Operators/managers of agricultural establishments with hired labor may need as much as 2 hours to read the sections of the "How To Comply" manual about the basic WPS requirements and the exceptions that may apply to their circumstances. The "How To Comply" manual is designed to facilitate familiarization with the general provisions of the WPS (through the 2-page summary chart) and provide ready access to applicable exceptions. If a feed and grain farmer, for example, has no need to send workers into a treated area before the expiration of the restricted-entry interval, that farmer need not become familiar with the exceptions to restricted-entry intervals. If a fruit/vegetable/nut farmer uses pesticides frequently while workers are present, that farmer need not become familiar with the exceptions to notification and decontamination facilities.

2. Operators/managers of establishments without hired labor or of commercial pesticide handling establishments must comply with far fewer requirements and are not expected to need more than 1 hour. The "How To Comply" manual is constructed with an

index for owners of establishments without hired labor that directs them to the provisions applicable to them. The manual also separates the requirements for pesticide handlers from those for agricultural workers, which allows operators/managers of commercial pesticide handling establishments to read only the applicable provisions.

3. As an option to becoming familiar with the content of the revised Standard on their own, many operators/managers will receive information about the WPS in their annual industry-, commodity-, or Cooperative Extension Service-sponsored meetings. EPA has already been approached by many of these organizations for information and assistance in conducting such a program and is developing a "How To Comply" slide set that will present an overview of the requirements of the WPS. As a result of such informational meetings, the operators/managers may be more efficient in reading the "How To Comply" manual due to their increased understanding of the general content of the revised Standard and the exceptions that would be most applicable to their situation.

4. EPA also plans to help reduce the time necessary for operators/managers to become familiar with the revised Standard by cooperating with certain industries and commodity organizations to develop "How To Comply" manuals specific to those industries and commodities. EPA has already held preliminary discussions about the development of such manuals with the greenhouse, nursery, and forestry industries.

5. After the first year, operators/managers would need a short time each year to remind themselves about the requirements in the WPS. However, this time is expected to be small, because most of them will have been complying with the WPS throughout the previous year and will be familiar with the requirements and exceptions in the WPS that are most applicable to their situation.

6. Time estimates are based, in part, on the comparison of the WPS "How To Comply" manual with the national core manual for pesticide applicator certification. Persons

wishing to become certified applicators must be trained about the contents of the core manual, which is approximately 5 times longer than the WPS "How To Comply" manual. The average length of training using the certification core manual is approximately 8 hours for initial certification. For recertification (usually within 3-5 years), the certified applicator must usually attend "update courses" that last, on average, about an hour each year.

Appendix Table F-1. WPS compliance costs for Rule familarization in 1991 dollars, by sector

Sector	Compliance Costs: Total First Year	Compliance Costs: Total Out Year	Compliance Costs: Incremental First Year	Compliance Costs: Incremental Out Year	Incremental Cost per Establishment That Hires Labor & Use Pesticides: First Year ($)	Incremental Cost per Establishment That Hires Labor & Use Pesticides: Out Year ($)	Incremental Cost per Establishment Without Hired Labor, but Use Pesticides: First Year ($)	Incremental Cost per Establishment Without Hired Labor, but Use Pesticides: Out Year ($)
Feed & Grain	3,034,675	505,779	3,034,675	505,779	14.00	2.33	7.00	1.17
Cotton	254,450	42,408	254,450	42,408	14.00	2.33	7.00	1.17
Tobacco	759,500	126,583	759,500	126,583	14.00	2.33	7.00	1.17
Other Field	737,975	122,996	737,975	122,996	14.00	2.33	7.00	1.17
Vegetable & Fruit	949,263	158,211	949,263	158,211	14.00	2.33	7.00	1.17
Nursery & Greenhouse	350,875	58,479	350,875	58,479	14.00	2.33	7.00	1.17
Commercial Handlers	85,000	14,167	85,000	14,167	14.00	2.33	7.00	1.17
Total	$6,171,738	$1,028,623	$6,171,738	$1,028,623	$14.00	$2.33	$7.00	$1.17

SOURCE: Appendix Table F-2.

Appendix Table F-2. Costs associated with owner/operators becoming familiar with the Worker Protection Standard

Crop Group/Type of Establishment	Establishments using pesticides 1/	Number of people requiring Rule familiarization per establish.	Annual time necessary to become familiar with Rule: First Yr.	Annual time necessary to become familiar with Rule: Out Yr.	Owner/operator wage rate 2/	Total cost to become familiar with Rule 3/: First Yr.	Total cost to become familiar with Rule 3/: Out Yr.	Per establishment cost to become familiar with Rule 4/: First Yr.	Per establishment cost to become familiar with Rule 4/: Out Yr.
	(Number)		(Hours)		($/Hour)	($)		($/Estab.)	
FEED & GRAIN									
With hired labor	132,705	1	2	0.33	7.00	1,857,870	309,645	14.00	2.33
Without hired labor	168,115	1	1	0.17	7.00	1,176,805	196,134	7.00	1.17
						3,034,675	505,779		
COTTON									
With hired labor	15,670	1	2	0.33	7.00	219,380	36,563	14.00	2.33
Without hired labor	5,010	1	1	0.17	7.00	35,070	5,845	7.00	1.17
						254,450	42,408		
TOBACCO									
With hired labor	50,500	1	2	0.33	7.00	707,000	117,833	14.00	2.33
Without hired labor	7,500	1	1	0.17	7.00	52,500	8,750	7.00	1.17
						759,500	126,583		
OTHER FIELD									
With hired labor	34,085	1	2	0.33	7.00	477,190	79,532	14.00	2.33
Without hired labor	37,255	1	1	0.17	7.00	260,785	43,464	7.00	1.17
						737,975	122,996		
VEG/FRUIT/NUTS									
With hired labor	57,513	1	2	0.33	7.00	805,182	134,197	14.00	2.33
Without hired labor	20,583	1	1	0.17	7.00	144,081	24,014	7.00	1.17
						949,263	158,211		
NURSERY/G.H.									
With hired labor	18,625	1	2	0.33	7.00	260,750	43,458	14.00	2.33
Without hired labor	12,875	1	1	0.17	7.00	90,125	15,021	7.00	1.17
						350,875	58,479		
Commercial pesticide handling	8,500	1	1	0.17	10.00	85,000	14,167	10.00	1.67
Total	568,936					$6,171,738	$1,028,623		

SOURCES:
1/ RIA Table III-3.
2/ RIA Appendix Table TR-2.
3/ Number of establishments X number of people requiring Rule familiarization per establishment X annual time necessary to become familiar with Rule X owner/operator wage rate.
4/ Total cost to become familiar with Rule / number of establishments.

APPENDIX B

Compliance Costs to Forestry

PS Cost Calculations for Forestry

	Handlers	Workers
d employees in st nurseries	282	2,538
d employees in sts	7,000	200
	7,282	2,738

emental st Year	Incremental Out Year	Cost Factor
($)		
		1. RESTRICTED-ENTRY INTERVAL
		Not Significant
		2. PERSONAL PROTECTIVE EQUIPMENT
		Total incremental first year PPE cost for hired and family member handlers on farms = $17.6 million / 1.6 million hired & family handlers = $11 per handler
80,102		7,282 hired handlers in forests X $11 = $80,102
		Total incremental out year PPE costs for hired and family member handlers on farms = $9.4 million / 1.6 million hired & family handlers = $5.88
	42,818	7,282 hired handlers in forests X $5.88 = $42,818
		3. NOTIFICATION
		Total incremental first year cost for notification per hired handler or hired worker = $15.3 million / 1.5 million hired workers & handlers = $10.20 per employee
102,204		10,020 hired handlers & workers in forests X $10.20 = $102,204
		Total incremental out year cost for notification per hired handler or hired worker = $4.7 million / 1.5 million hired workers & handlers = $3.13 per employee
	31,363	10,020 hired handlers & workers in forests X $3.13 = $31,363

Forestry costs continued . . .

Incremental First Year	Increment Out Year	
($)		
		Total incremental first year costs for training hired handlers = $4.3 million / 618,170 hired handlers = $6.93 per hired handler on farms Total incremental first year costs for training hired workers = $2.6 million / 847,138 hired workers = $3.07 per hired worker on farms 7,282 hired handlers in forests X $6.93 = $50,464
58,870		2,738 hired workers in forests X $3.07 = $8,408
		Total incremental out year costs for training hired handlers = $1,285,175 / 618,170 hired handlers = $2.08 per hired handler on farms Total incremental out year costs for training hired workers = $1,039/608 / 847,138 hired workers = $1.23 per hired worker on farms 7,282 hired handlers in forests X $2.08 = $15,147
	18,515	2,738 hired workers in forests X $1.23 = $3,368

5. DECONTAMINATION

Incremental first year costs for decontamination per hired handler on farms = $11.03
Incremental out year costs for decontamination per hired handler on farms = $5.90

Incremental first year costs for decontamination per hired worker on farms = $3.00
Incremental out year costs for decontamination per hired worker on farms = $2.65

88,534		Total incremental first year costs = (11.03 X 7,282) + (3.00 X 2,738) = $88,534
	50,220	Total incremental out year costs = (5.90 X 7,282) + (2.65 X 2,738) = $50,220

6. EMERGENCY ASSISTANCE

There were 9,825 hired employee poisonings on farms (Appendix Table EA-2) / 1,503,308 hired employees on farms = 0.6% poisoning rate among hired employees.

Incremental first and out year emergency assistance cost per poisoning = $1.17.

70	70	Incremental first and out year cost for emergency assistance for hired forestry employees = $1.17 X (10,020 forestry employees X 0.006) = $70.

7. RULE FAMILIARIZATION

First year incremental cost to farms = $6.2 million; $6.2 M / 1,194,000 farm operators = $5.17 per operator
Out year incremental cost to farms = $1.0 million; $1.0 M / 91,194,000 farm operators = $0.86 per operator
Ratio of farm operators to all ag. employees = 41.7%
7,282 forestry handlers X 41.7% = 3,036 forestry handlers that need rule familiarization

16,000		Incremental first year costs = 3,036 X $5.17 = $16,000
	3,000	Incremental out year costs = 3,036 X $0.86 = $3,000
$345,780	$145,986	TOTAL FIRST AND OUT YEAR INCREMENTAL WPS COST TO FORESTRY

APPENDIX C

High and Low Options

Total First Year Costs	
High Option	Low Option
---- (Million $) ----	
	HIGH AND LOW OPTION CALCULATIONS
	1. Restricted-Entry Interval
31.6	7.9	Total first and out year cost to vegetable crops (Appendix Tables HL-1 and HL-2).
42.2	10.5	Total first and out year cost to fruit crops (Appendix Tables HL-1 and HL-2).
		a. Costs due to early entry on cut flower and cut fern establishments.
		Under the high option, NO early entry is allowed on any agricultural establishment.
43.7		Appendix Table REI-12 calculates this cost ($43.7 million) to the cut flower and fern industry.
		Under the low option, early reentry on cut flower & fern establishments is allowed with PPE.
		Per worker cost of PPE = $57.85 (Appendix Table REI-11).
		There would be an estimated 3,179 early entry cut flower workers (Appendix Table REI-11).
	0.2	Low option cost = $57.85 X 3,179 = $183,905
		2. Personal Protective Equipment
		HIGH OPTION:
		The cost of work clothing = $25 per handler (shirt & pants, Old RIA).
		$25 X 618,170 hired handlers = $15,454,250
		$25 X 38,000 commercial handlers = $950,000
		No cost for family member handlers (already have work clothing)
		Current total first year PPE costs to hired handlers, commercial handlers
		and unpaid family-member handlers = $84.9 million
101.4		$84.9 M + $15.5 M + $1 M = $101.4 million total.
		LOW OPTION:
	2.2	From old RIA $2.2 million

High & Low Options continued . . .

Total First Year Costs	
High Option	Low Option
---- (Million $) ----	

3. Decontamination HIGH & LOW Options

HIGH OPTION:
Eyewash disps for all handlers:
$6 X 618,170 hired handlers = $3,709,020
$6 X 38,000 commercial handlers = $228,000
$22.3 Million for decontamination items provided for total days of work–hired handlers
$13.5 million decontamination for commercial handlers (same as final rule)
$31 per farm for emergency change & eyeflush dispenser X 309,085 farms = $9,581,635
$31 per commercial handling establishment for emergency change & eyeflush dispenser X 8,500 estab = $263,500
$113 per farm for body drench hose X 309,085 farms = $34,926,605
$113 per comm. hdlr estab for body drench hose X 8,500 farms = $960,500

86.0 Total high option cost = $86 million

LOW OPTION:
Final rule cost for comm. hdlrs = $894,789
Final rule cost for hired hdlrs = $13,534,336

14.4 Total low option cost = $14.4 million

4. Notification

HIGH OPTION

24.0 $24 million - - Based on treated area posting, oral warnings, and central notice for all pesticide applications, in addition to daily oral warnigs.

LOW OPTION
$8.2 million - - Based on treated area posting and oral warnings for pesticides with greater than 48 hr REIs.
Oral warnings or treated area posting for all other applications for all other applications.

8.2 Pesticide specific information available on request.

High & Low Options continued . . .

Total First Year Costs	
High Option	Low Option
---- (Million $) ----	
19.4	
	5.7
0.08	
	0
9.5	
	0
6.2	6.2
$364.1	$55.3

5. Training

HIGH OPTION
Workers get handler level training = $9.90 per worker X 847,138 workers = $8.4 million

Hired Handlers of Tox I's get trained & certified: 326,000 handlers X (12.90 for training + 7.00 more for certif. (1 hour to take certification test)) = $20. $20 X 326,000 = $6,520,000
All other handlers get trained: 292,000 X $12.90 = $3.8 million
9,500 comm hdlers need certif: 9,500 X ($7 cert cost. + $17.40 training cost) + (28,500 X $17.40 training cost) = $727,700
Total high option cost = $19.4 million

LOW OPTION
Handlers: $5 million for training hired handlers + $0.7 million for commercial handlers = $5.7 M
No worker training

6. Emergency Assistance

HIGH OPTION
MSDS for all workers: .05 per copy X 847,138 workers = $42,357
+ final rule cost = $39,628
Total high costs = $81,985

LOW OPTION
Nothing

7. Cholinesterase Monitoring

HIGH OPTION
$250 per commercial handler X 38,000 commercial handlers = $9.5 million

LOW OPTION
Nothing

8. Rule Familiarization

HIGH OPTION & LOW OPTION
Costs are the same as the final Rule = $6.2 million

TOTAL HIGH AND LOW COSTS

Appendix Table HL-1. Total first year restricted-entry interval (REI) costs to vegetable crops UNDER HIGH OPTION

Affected Vegetable Crops	Base Acreage (1988-90 ave)	Percent of Base Acreage Treated with 72 Hr REI Pesticides	Average per Acre Impact from 72 hr REI's (% yield/ quality loss)	Per Acre Crop Value (1988-90 ave)	Per Acre Income Loss	Aggregate Income Loss
				($/Acre)	($/Acre)	($)
Artichokes	10,244	100%	1.0%	3,212	32.12	329,081
Cauliflower	60,526	100%	1.0%	2,734	27.34	1,654,655
Snap Beans	34,564	100%	1.0%	1,578	15.78	545,515
Tomatoes	128,029	100%	1.0%	7,428	74.28	9,510,431
Cucumbers	110,547	100%	3.0%	1,714	51.43	5,685,309
Melons	242,813	100%	3.0%	1,353	40.58	9,853,923
Squash	20,021	100%	7.0%	2,902	203.16	4,067,412
						$31,646,326

Note: Assumes there are no price effects.

Source: Appendix Tables REI-1 to REI-12 and the assumption that yield loss with 72-hour REIs would be double the yield loss of 48-hour REIs.

Appendix Table HL-2. Total first year restricted-entry interval (REI) costs to vegetable crops UNDER LOW OPTION

Affected Vegetable Crops	Base Acreage (1988-90 ave)	Percent of Base Acreage Treated with 24 Hr REI Pesticides	Average per Acre Impact from 24 hr REI's (% yield/ quality loss)	Per Acre Crop Value (1988-90 ave)	Per Acre Income Loss	Aggregate Income Loss
				($/Acre)	($/Acre)	($)
Artichokes	10,244	100%	0.3%	3,212	8.03	82,270
Cauliflower	60,526	100%	0.3%	2,734	6.83	413,664
Snap Beans	34,564	100%	0.3%	1,578	3.95	136,379
Tomatoes	128,029	100%	0.3%	7,428	18.57	2,377,608
Cucumbers	110,547	100%	0.8%	1,714	12.86	1,421,327
Melons	242,813	100%	0.8%	1,353	10.15	2,463,481
Squash	20,021	100%	1.8%	2,902	50.79	1,016,853
						$7,911,582

Note: Assumes there are no price effects.
Source: Appendix Tables REI-1 to REI-12 and the assumption that yield loss with 24-hour REIs would be half the yield loss of 48-hour REIs.

Appendix Table HL-3. Total first year restricted-entry interval (REI) costs to fruit crops UNDER HIGH OPTION

Affected Fruit Crops	Base Acreage (1988-90 ave)	Percent of Base Acreage Treated with 72 Hr REI Pesticides	Average per Acre Impact from 72 hr REIs (% yield/ quality loss)	Per Acre Crop Value (1988-90 ave)	Per Acre Income Loss	Aggregate Income Loss
					($/Acre)	($)
Blackberries	4,061	100%	1.0%	2,495	24.95	101,316
Cherries (Sweet)	44,801	100%	1.0%	2,753	27.53	1,233,358
Peaches	171,063	100%	1.0%	1,998	19.98	3,417,839
Plums	38,573	100%	1.0%	2,659	26.59	1,025,643
Raspberries	9,016	100%	1.0%	2,586	25.86	233,153
Strawberries	42,682	100%	7.0%	12,106	847.42	36,169,813
						$42,181,123

Note: Assumes there are no price effects.

Source: Appendix Tables REI-1 to REI-12 and the assumption that yield loss with 72-hour REIs would be double the yield loss of 48-hour REIs.

Veg & Fruit Total $73,827,449

Appendix Table HL-4. Total first year restricted-entry interval (REI) costs to fruit crops UNDER LOW OPTION

Affected Fruit Crops	Base Acreage (1988-90 ave)	Percent of Base Acreage Treated with 24 Hr REI Pesticides	Average per Acre Impact from 24 hr REI's (% yield/ quality loss)	Per Acre Crop Value (1988-90 ave)	Per Acre Income Loss	Aggregate Income Loss
					($/Acre)	($)
Blackberries	4,061	100%	0.3%	2,495	6.24	25,329
Cherries (Sweet)	44,801	100%	0.3%	2,753	6.88	308,340
Peaches	171,063	100%	0.3%	1,998	5.00	854,460
Plums	38,573	100%	0.3%	2,659	6.65	256,411
Raspberries	9,016	100%	0.3%	2,586	6.47	58,288
Strawberries	42,682	100%	1.8%	12,106	211.86	9,042,453
						$10,545,281

Note: Assumes there are no price effects.

Source: Appendix Tables REI-1 to REI-12 and the assumption that yield loss with 24-hour REIs would be half the yield loss of 48-hour REIs.

LOW	
Veg & Fruit	$18,456,862

APPENDIX D

Small Entities Cost Data

NEW APPENDIX TABLE RF-1. IMPACTS ON SMALL FARMS (w/o hired labor) VS. LARGE FARMS (w/ hired labor)

	RESTRICTED ENTRY			TRAINING			DECONTAMINATION			PERS. PROTECT. EQUIP.			NOTIFICATION			EMERGENCY ASSISTANCE			FAMILIARIZATION			TOTAL		
	All	W/hired@	W/O hired	All	W/hired@	W/O hired	All	W/hired@	W/O hired	All	W/hired@	W/O hired	All	W/hired@	W/O hired	All	W/hired@	W/O hired	All	W/hired@	W/O hired	All	W/hired@	W/O hired
(INCREMENTAL FIRST YEAR COSTS, $1,000)																								
FEED & GRAIN				2,625	2,625		3,786	3,786		8,498	5,354	3,144	3,281	3,281		3	3		3,035	1,858	1177	21,227	16,906	4,321
COTTON				437	437		598	598		814	700	114	672	672		1	1		254	219	35	2,768	2,617	149
TOBACCO				773	773		1,268	1,268		2,536	2,358	178	1,288	1,288		1	1		760	707	53	6,626	6,395	231
OTHER FIELD				999	999		1,248	1,248		1,702	1,225	477	3,756	3,756		1	1		738	477	261	8,414	7,677	738
VEG/FRUIT/NUT	20,711	19,468	1,243	1,853	1,853		4,347	4,347		3,244	2,725	519	3,898	3,898		3	3		949	805	144	34,805	32,899	1,906
NURS/GRNHS	435	383	52	428	428		1,059	1,059		1,059	794	265	2,680	2,680		1	1		361	261	90	6,011	5,604	407
COMM. APP.				61	61		421	421		1,576	1,576	0	0	0		0	0		85	85		2,143	2,143	0
Total	21,146	19,851	1,295	6,944	6,944	0	12,716	12,716	0	19,429	14,733	4,698	15,575	15,575	0	10	10	0	6,172	4,412	1,760	81,992	74,241	7,751
(INCREMENTAL OUT YEAR COSTS, $1,000)																								
FEED & GRAIN				866	866		2,287	2,287		4,445	2,800	1,645	1,007	1,007		3	3		506	310	196	9,094	7,254	1,841
COTTON				153	153		397	397		441	379	62	236	236		1	1		42	37	6	1,270	1,203	68
TOBACCO				239	239		734	734		1,383	1,286	97	311	311		1	1		127	118	9	2,795	2,689	106
OTHER FIELD				340	340		829	829		929	669	260	844	844		1	1		123	80	43	3,086	2,763	303
VEG/FRUIT/NUT	20,711	19,468	1,243	582	582		3,714	3,714		1,732	1,455	277	1,254	1,254		3	3		158	134	24	28,154	26,610	1,544
NURS/GRNHS	435	383	52	145	145		864	864		585	424	141	1,274	1,274		1	1		58	43	15	3,342	3,133	208
COMM. APP.				55	55		386	386		1,082	1,082	0	0	0		0	0		14	14		1,517	1,517	0
Total	21,146	19,851	1,295	2,380	2,380	0	9,171	9,171	0	10,577	8,095	2,482*	4,928	4,928	0	10	10	0	1,028	736	293	49,238	45,169	4,070

Source: Appendix A.

@/ Based on percent of acres from Table III-1.

#/ Calculated; Percent farms with family labor only (Col.7,TableIII-3) times total no. of handlers (pIII-7)