Pest and Pesticide Use Assessment and Use and Care of Personal Protective Equipment for Grape Production in New York State for 1993

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SECTION ONE:

PEST AND PESTICIDE USE ASSESSMENT

INTRODUCTION

The overall assessment and effectiveness of pest control techniques for grape production systems are an ongoing process for scientists at Cornell's College of Agriculture and Life Sciences. Not only must the specifics of pest dynamics and pest induced losses be assessed, but the more general problem of designing and implementing appropriate pest management systems for grower acceptance must be addressed as well.

New York has approximately 32,500 acres of grapes. It is a national leader in fruit production, ranking third behind California and Washington in total grape production. Significant grape acreage is concentrated in ten counties located in four regions: Western New York, the Finger Lakes region, Long Island, and the Hudson River Valley (Figure 1).

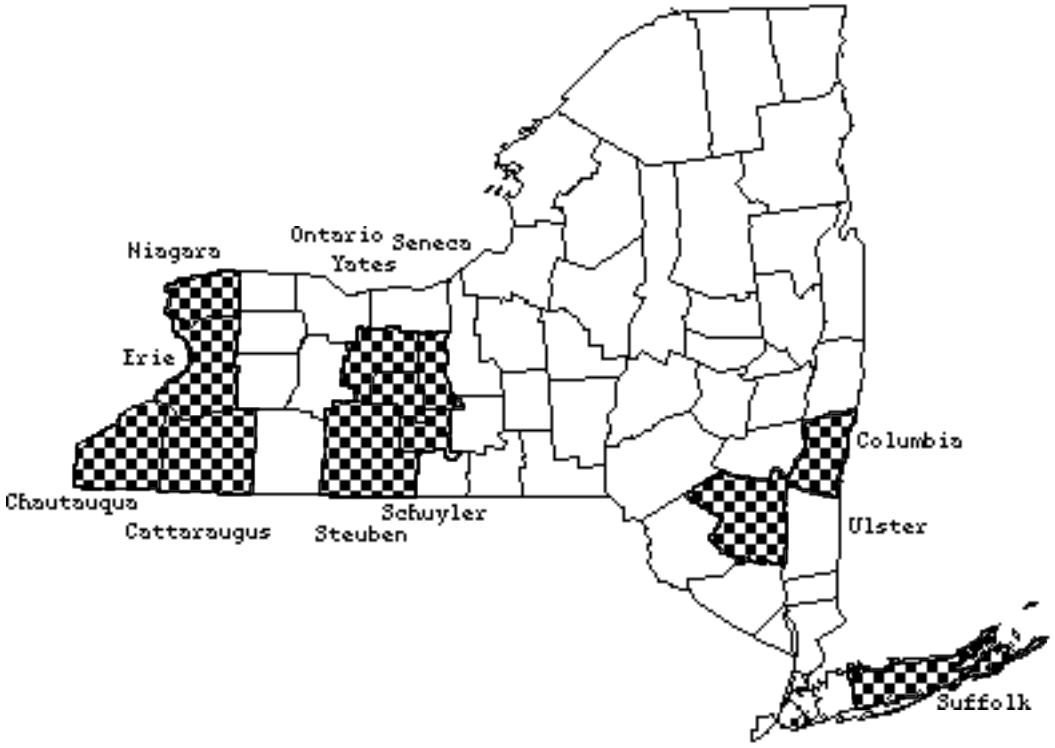

Figure 1: New York counties with major grape production

The value of the 1993 New York State grape crop was estimated at $26.5 million dollars with 118,000 tons of grapes (all varieties) being produced. Average yield was estimated at 3.6 tons/acre (New York State Agricultural Statistics Service, 1993 Annual Summary).

Programs attempting to address the issues surrounding pesticides have a critical need to obtain use information about those chemicals being applied in the grape productions systems in New York State. Downy mildew, a serious disease of grapes, is currently controlled by the use of one of three fungicide complexes--captan, EBDC fungicides, or copper. Although reregistered by the Environmental Protection Agency (EPA), captan has been suspended from use by all juice processors in New York. Some wineries are also reluctant to use captan because of its poor public image. EBDC fungicides, such as maneb and mancozeb, have been reregistered by the EPA but most juice processors continue to restrict their use to the prebloom period in spite of a 66-day

preharvest interval (PHI).

Because all processors in New York apply these restrictions regarding captan and the EBDCs, growers do not have the option of selling their crop to less restrictive processors. Furthermore, unless the recent ruling by the Ninth Circuit Court of Appeals in California against EPA's interpretation of the Delaney Clause is reversed, or new legislation is passed, the registration of captan and the EBDC fungicides for processed grapes will be canceled.

Further developments affecting the grape industry in New York are:

- Resistance of powdery mildew to benomyl (Benlate) has become widespread.
- There is confirmed resistance of powdery mildew to triadimefon (Bayleton) in some vineyards.
- Karathane, an excellent material for powdery mildew was not reregistered.
- Fungicides available for black rot control after bloom are limited. These include the sterol inhibiting fungicides Bayleton and Nova. Also, ferbam (carbamate) is restricted to one post bloom application in New York due to label interpretation.
- The major grape variety, Concord (grown primarily in Western New York) is highly susceptible to phytotoxicity from the use of sulfur and moderately sensitive to copper, thus making these choices for powdery mildew control less attractive.
- On Long Island, pesticides used to control grape insect and disease pests are harmful to naturally occurring predators of European red mite (ERM), which have the ability to keep ERM in check. Thus, by controlling one pest, another pest problem is being created.
- There are only two miticides registered for use. One miticide is no longer being used in many wine growing regions due to pest resistance. The second miticide is expensive. This means growers use mainly the cheaper material, which will drastically increase the rate at which resistance develops. This will soon leave growers with only one, very expensive option.

Due to the aforementioned problems facing the grape industry, it is essential to compile not only pesticide use data, but also all pest management practices currently employed by grape producers. This report contains such a compilation. This information should aid policy makers, researchers, extension specialists and industry personnel in evaluating pesticide use patterns, current pest management strategies, and the economic impacts of regulatory actions on specific pesticides. Funding for this project was provided by the National Agricultural Pesticide Impact Assessment Program (NAPIAP), United States Department of Agriculture.

OBJECTIVES

To obtain the following information for grape production systems in New York State:

A. Acres planted
B. Average yield
C. Contract, processor and restriction information
D. For each pest type (weed, insect and disease) affecting crop
    1. Chemical used for control
        a) Formulation
        b) Who applied
        c) Acres treated
        d) Number of treatments
        e) Application site
    2. Time of application
    3. Target pest(s)
    4. Cost comparison of chemicals
E. Alternative Control Measures: cultural, biological, no treatment
F. Potential yield changes from alternatives
G. Cost per acre
    1. Chemical control
    2. Non-chemical control
H. Calibration of equipment
    1. Frequency
    2. Method
I. Basis for application, and recommendation of pesticides
J. Storage of pesticides
K. Disposal
    1. Rinsate
    2. Unwanted/unused pesticides
    3. Empty pesticide containers

PROJECT DESIGN, IMPLEMENTATION AND ANALYSIS

Questionnaires were developed from previous NAPIAP and other surveys that had been conducted in New York State. The first drafts were reviewed by grape specialists, IPM specialists, extension agents and grape processors for comment and critique. Final survey forms were printed and duplicated (see Appendix for survey form samples) based on input from these groups.

Letters were sent to grape processors, specialists and extension agents explaining the project and requesting assistance in the implementation of the survey. A one hour pesticide applicator training presentation on EPA's "Special Review" process, and personal protective equipment (PPE) use (see section two of this report) was given prior to the completion of the survey questionnaire. In order to attract growers to the meetings, two recertification credits were given to all those who participated. Three meetings were set up: one on Long Island, and two which covered the Finger Lakes region. A mailing list was used to send surveys to Western New York grape growers. Response was approximately 25%.

Once data were collected, database management files were developed using FileMaker Pro 2.0 for compilation and analysis of the data. This report contains data pertaining to the objectives stated previously.

Certain words and/or terms used throughout this paper are defined below:

- Active ingredient (AI) - The portion of the pesticide product which controls the pest. All quantities and application rates are reported in pounds of active ingredient.
- Acres treated - The area treated with a pesticide one or more times.
- Number of applications - Number of times a pesticide was applied to acres treated.
- Times applied - Average number of applications, weighted by acres treated.
- Acre treatments - "Acres treated" multiplied by "times applied."
- Record - One survey complete with all responses within that survey (synonymous with one grower or one grape producer).
- Response - One entry within a record (survey). Since there can be more than one response to certain questions, the distinction between records and responses is important.
- Product name/trade name - The name designated for a chemical by a company. Similar formulations can have different product/trade names.
- Fungicides - Materials that control diseases.
- Herbicides - Materials that control weeds.
- Insecticides - Materials that control insects. Miticides, materials that control mites, are included in this category.
- Tank mixes - Two or more pesticides mixed in the same spray tank by the grower and applied together. In this survey pesticides mixed together were only considered tank mixes if they were two different types - a fungicide and insecticide mixed together, rather than two or more of the same type of pesticide mixed together.

Results and Discussion

DEMOGRAPHICS

The total 1993 acreage of the 137 vineyards sampled was 7,291 acres (22% of total NY grape acreage) with only 251.4 acres nonbearing (Table 1). The Finger Lakes region produced 1,838 acres (88.8%) of grapes for wine, 227 acres (11.0%) for juice and 5 acres (0.2%) of table grapes. In Western New York, 97.6% of the 3,603 acres reported were in juice production, 1.8% were for wine and 0.4% were for table grapes. All of the Long Island grape production was for wine. The average yield for wine grapes was 4.3 tons/acre, 5.2 tons/acre for juice, and 4.5 tons/acre for table grapes.

Table 1: Demographics of grape vineyards in New York in 1993

Region Grape type	# of records	Bearing acreage	Non-bearing acreage	Average yield (tons)	# of growers reporting yield
Western New York (Chautauqua, Erie, Niagara Counties)					
Juice	86	3,518.7	175.2	5.2	84
Wine	4	66.0	0.0	2.5	3
Table	3	14.5	0.0	4.5	2
Totals	**93**	**3,599.2**	**175.2**	**5.1**	**89**
Finger Lakes (Cayuga, Ontario, Schuyler, Seneca, Steuben, Yates Counties)					
Juice	4	226.5	10.5	5.7	3
Wine	33	3,037.9	53.2	4.7	29
Table	1	5.0	0.0	NS	0
Totals	**38**	**3,269.4**	**63.7**	**4.8**	**32**
Long Island (Suffolk County)					
Wine	6	171.0	12.5	2.6	6
Totals	**6**	**171.0**	**12.5**	**2.6**	**6**
Total Juice	90	3,745.2	185.5	5.2	87
Total Wine	43	3,274.9	65.9	4.3	38
Total Table	4	19.5	0.0	4.5	2
TOTAL	**137**	**7,039.6**	**251.4**	**4.9**	**127**

NS = not specified

One hundred and thirteen growers (81.9%) indicated they were under contract with a processor (Table 2). Ninety-one (80.5%) of those under contract indicated there were pesticide restrictions placed on them by the processor. Table 3 summarizes those restrictions. Although answers varied, over half of the growers indicated that captan use was not allowed, and that EBDCs could not be used after bloom.

Table 2: Contracts and restrictions for grape growers in NY for 1993

Under contract? With whom?	# of records	% of records
No	**25**	**18.1**
Yes	**113**	**81.9**
National Grape Cooperative	60	53.1
Westfield Grower's Cooperative	20	17.7
Canandaigua Wine Co.	13	11.5
Cliffstar	5	4.4
Coca Cola Foods	3	2.7
Royal Wine Company	3	2.7
Seneca Foods	2	1.8
Taylor Wine Company	2	1.8
Not specified	2	1.8
Fall Bright the Winemakers Shoppe	1	0.9
Mogen David	1	0.9
Red Wing	1	0.9

Table 3: Restrictions placed on grape growers in NY for 1993 (91 records)

What restrictions are placed on growers?	# of growers with restrictions	% of records with restictions
No EBDC use after bloom	57	62.6
No captan	49	53.8
No Alar	19	20.9
Not specified	10	11.0
Only use approved products	9	9.9
No parathion	7	7.7
No Roundup after bloom	3	3.3
No Benlate	2	2.2
No 2,4-D	1	1.1
Several	1	1.1
Must follow label requirements	1	1.1
Do not use any restricted material before harvest	1	1.1
Only use pesticides in Cornell Recommends	1	1.1
Do not remember	1	1.1

HERBICIDE USE

One hundred and twenty-five (91.2%) growers made 341 herbicide applications to 92.9% of the vineyard acres in 1993, for an average of 2.7 applications per grower (Table 4). The percent of growers using herbicides in Western New York, the Finger Lakes and Long Island was approximately the same (93.5%, 86.8% and 83.3%, respectively). Growers in Western New York applied herbicides to 96.6% of their acreage, 89.7% in the Finger Lakes and 76.6% on Long Island.

Table 4: NY grape growers using herbicides in 1993

Region	# of growers using herbicides	# of applications	# of applications per grower	Acreage receiving herbicides
Western	87	238	2.7	3,478.2
Finger Lakes	33	88	2.7	2,932.4
Long Island	5	15	3.0	131.0
Total	**125**	**341**	**2.7**	**6,541.6**

Table 5 summarizes who applied the herbicides to grapes in 1993. Ninety-eight percent of herbicide applications were made by the grower, or his/her employee. The type of application equipment used most often was a boom sprayer (84.5%, Table 6). All herbicide applications were ground applications.

Table 5: Who applied herbicides to NY grape crop in 1993

Who applied	# of applications	% of applications
Grower/employee	335	98.2
Custom applicator	6	1.8

Table 6: Equipment used to apply herbicides to NY grape crop in 1993

Type of equipment	# of applications	% of applications
Boom sprayer	288	84.5
Not specified	26	7.6
Air-blast sprayer	12	3.5
Hand-held sprayer	10	2.9
Piston-pump sprayer	5	1.5

Table 7 summarizes the herbicides used by grape growers in 1993. A total of 34,015.42 lbs of herbicide active ingredients were applied to 6,541.6 acres of vineyard surveyed in 1993. The active ingredient used most often was diuron (applied by 72.8% of growers using herbicides). It was applied to 244.84 acres an average of 1.2 times at a rate of 9.0 or 9.6 lbs active ingredient per acre, for a total of 20,389.49 lbs diuron applied to the survey area.

Table 7: Herbicide use on NY grape crop in 1993 (all regions)

Active Ingredient Trade Name	# of records	Total acres treated a/	Times applied b/	Acre treatments	Rate AI per acre (lb) c/	Total lbs AI applied
diuron	**91**					**20,389.49**
Direx & Karmex 4L	13	244.84	1.2	293.81	9.0	2,644.29
Direx 80DF, Diuron 80WDG & Karmex DF	78	1,848.46	1.0	1,848.46	9.6	17,745.20
glyphosate	**89**					**4,120.26**
Roundup	89	3,092.23	1.3	4,120.26	1.0	4,120.26
simazine	**65**					**7,571.69**
Princep Caliber 90	29	476.10	1.0	476.10	4.77	2,271.00
Princep 4L, 80W, & Simazine 80W	30	643.81	1.0	643.81	4.8	3,090.29
Sim-trol & Simazine 4L	6	460.50	1.2	552.6	4.0	2,210.40
paraquat	**54**					**1,532.45**
Gramoxone Extra	54	1,451.69	1.1	1,634.61	0.94	1,532.45
oryzalin	**5**					**306.23**
Surflan A.S.	5	51.04	1.0	51.04	6.0	306.23
norflurazon	**4**					**95.30**
Solicam DF	4	24.25	1.0	24.25	3.93	95.30
Total						**34,015.42**

a/ When under-trellis applications were made, acres treated are based on width of spray band and distance between vineyard rows.

b/ Average, weighted by acres treated.

c/ Based on high label rates

Figure 2 illustrates the pounds of herbicide active ingredients applied to the 1993 grape crop in each region. Long Island growers did not use diuron or norflurazon, and Finger Lakes growers used neither oryzalin nor norflurazon.

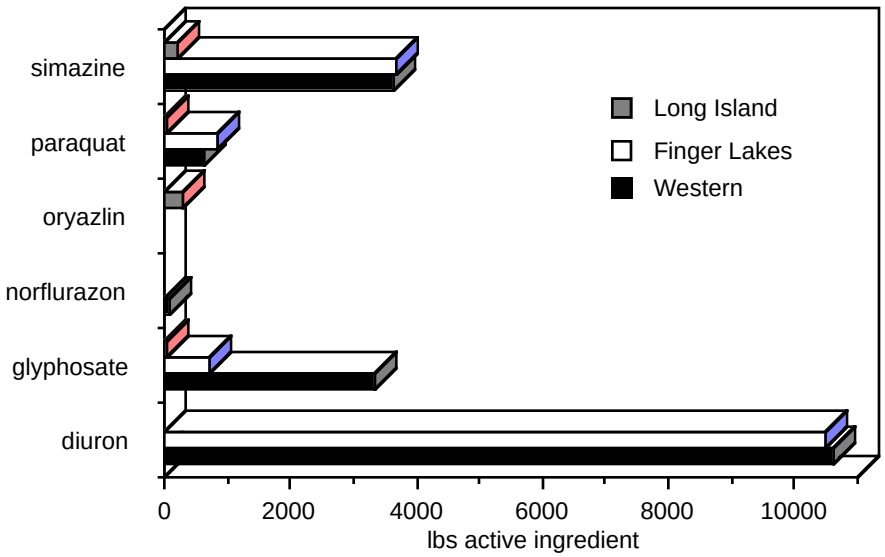

Figure 2: Pounds of herbicide AIs applied to 1993 grape crop by region in NY

Pounds of herbicide active ingredients applied per acre in each region are shown in Figure 3. Long Island growers treated 131 acres with 558.54 lbs (AI) of herbicides (4.3 lbs AI/A); Finger Lakes growers applied 15,790.23 lbs to 2,932.4 acres (5.4 lbs AI/A), and Western New York growers used 18,380.51 lbs (AI) of herbicides on 3,478.2 acres of vineyard (5.3 lbs AI/A).

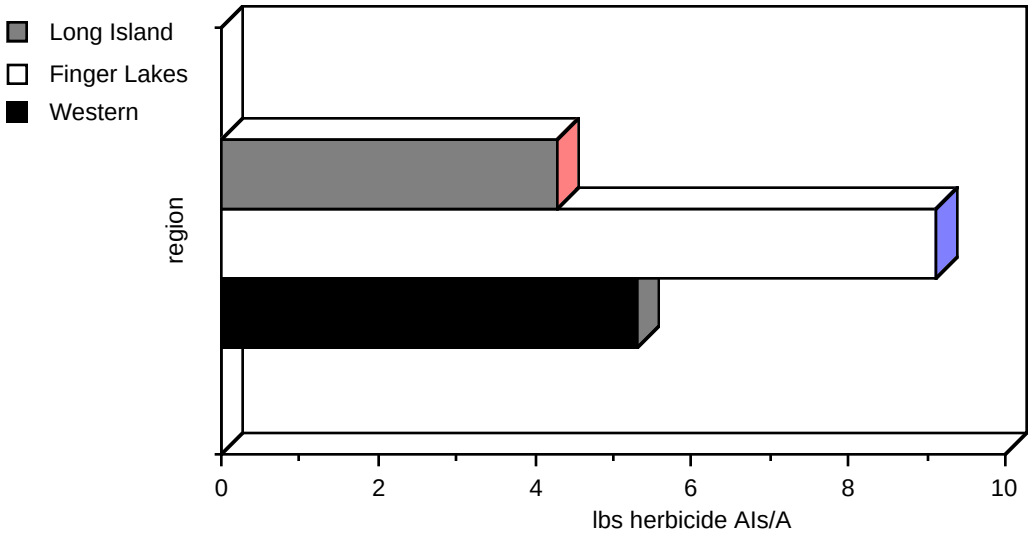

Figure 3: Pounds of herbicide AIs applied per acre in NY in 1993

Herbicide applications were made both pre- and post- weed emergence almost equally (Table 8). The most common site of application of herbicides was "under the trellis" (69.8%, Table 9).

Table 8: Timing of application of herbicides on NY grape crop in 1993

Time of Application	# of applications	% of applications
Preemergence	169	49.6
Postemergence	172	50.4

Table 9: Site of application of herbicides on NY grape crop in 1993

Site of application	# of applications	% of applications
Under the trellis	238	69.8
Between the row	53	15.5
Spot treatment	50	14.7

Table 10 indicates the frequency of herbicide applications for weed pests. Annual grass and annual broadleaf weeds accounted for 59.8% and 57.2% of herbicide applications, respectively, to vineyards in 1993. Broadleaf weeds (both annual and perennial) were targeted more often on Long Island, while annual weeds (both broadleaf and grasses) were targeted more often in the Finger Lakes and Western New York. There was no chemical suckering control indicated on Long Island (Figure 4). A cost comparison of herbicides used in vineyards is shown in Table 11.

Table 10: Frequency of herbicide applications for target pests of grapes in NY in 1993

Weed pest	# of applications	% of applications
Annual grass	204	59.8
Annual broadleaf	195	57.2
Perennial broadleaf	170	49.9
Perennial grass	170	49.9
Biennial weeds	129	37.8
Chemical suckering	36	10.6
Not specified	65	19.1

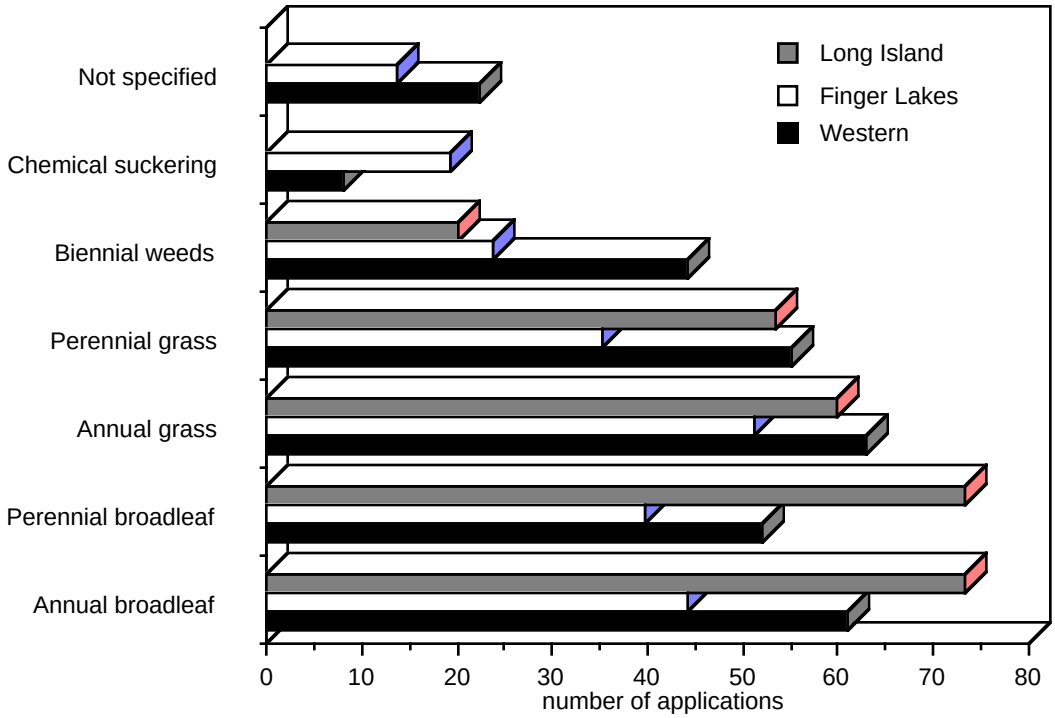

Figure 4: Frequency of herbicide applications for target pests of grapes by region in NY in 1993

Table 11: Cost comparison of herbicides used in grape production

Herbicide	Active ingredient	Maximum rate/A (lbs of AI)	Median cost/lb of AI a/	Cost per acre per application	Avg. # of times applied	Total cost
Karmex 4L	diuron	9.0	$5.06	$45.54	1.2	$54.65
Karmex DF	diuron	9.6	5.06	48.48	1.0	48.58
Roundup	glyphosate	1.0	12.50	12.50	1.3	16.25
Princep Cal 90	simazine	4.77	3.50	16.70	1.0	16.70
Princep 4L	simazine	4.8	3.00	14.40	1.0	14.40
Princep 80W	simazine	4.8	3.50	16.80	1.0	16.80
Gramoxone Extra	paraquat	0.938	7.84	7.35	1.1	8.09
Surflan A.S.	oryzalin	6.0	16.16	96.96	1.0	96.96
Solicam DF	norflurazon	3.93	19.00	74.67	1.0	74.67

a/ Price obtained from AGCHEMPRICE Current U.S.A. Prices of Non-Fertilizer Agricultural Chemicals April 1992. Published by DPRA Incorporated. Costs may not reflect 1994 prices, and may vary.

INSECTICIDE USE

Seventy-two (52.6%) growers made 136 insecticide applications to 43.5% of the vineyard acres in 1993. An average of 1.9 applications were made per grower (Table 12). Long Island growers, who applied insecticides to 83.0% of grape acreage, made considerably more applications than Finger Lakes or Western New York growers. Vineyards in the Fingers Lakes and Western New York received insecticide treatments on 29.8% and 54.4% of acreage, respectively.

Table 12: NY grape growers using insecticides in 1993

Region	# of growers using insecticides	# of applications	Avg. # of applications per grower	Acreage receiving herbicides
Western	50	90	1.8	1,960.5
Finger Lakes	17	30	1.8	975.0
Long Island	5	16	3.2	142.0
Total	**72**	**136**	**1.9**	**3,077.5**

Table 13 summarizes who applied insecticides to grapes in 1993. Ninety-eight and one-half percent of insecticide applications were made by the grower/employee. The majority of applications (94.1%, Table 14) were foliar and applied with an air-blast sprayer (84.6%, Table 15).

Table 13: Who applied insecticides to NY grape crop in 1993

Who applied	# of applications	% of applications
Grower/employee	134	98.5
Custom applicator	2	1.5

Table 14: Type of coverage of insecticides on NY grape crop in 1993

Type of coverage	# of applications	% of applications
Foliar	128	94.1
Border/spot	5	3.7
Not specified	3	2.2

Table 15: Equipment used to apply insecticides to NY grape crop in 1993

Type of equipment	# of applications	% of applications
Air-blast sprayer	115	84.6
Boom sprayer	17	12.5
Helicopter	1	0.7
Not specified	3	2.2

Table 16 summarizes the insecticides used by grape growers in 1993. A total of 9,204.97 lbs of insecticide active ingredients were applied to 3,077.5 acres of vineyard surveyed in 1993. The active ingredient used most often was carbaryl (applied by 95.8% of growers using insecticides). It was applied to 2,460.1 acres, an average of 1.7 times at a rate of 2.0 lbs active ingredient per acre, for a total of 8,364.34 lbs carbaryl applied to the survey area.

Table 16: Insecticide use on NY grape crop in 1993

Active Ingredient Trade name	# of records	Total acres sprayed	Times applied	Acre treatments	Rate AI per acre	Total lbs AI applied
carbaryl	**69**					**8,364.34**
Carbaryl & Sevin	69	2,460.1	1.7	4,182.17	2.0	8,364.34
methyl parathion	**8**					**388.00**
Penncap-M	8	170.0	1.1	194.00	2.0	388.00
dicofol	**5**					**169.63**
Kelthane 35	2	50.0	1.3	65.00	1.225	79.63
Kelthane 50	3	72.0	1.0	72.00	1.25	90.00
azinphos-methyl	**3**					**95.00**
Guthion WP	3	55.0	1.7	95.00	1.0	95.00
phosmet	**3**					**153.00**
Imidan 50-WP	3	67.0	1.5	102.00	1.5	153.00
fenbutatin-oxide	**1**					**35.00**
Vendex 50WP	1	28.0	1.0	28.0	1.25	35.00
Total						**9,204.97**

Figure 5 illustrates the pounds of insecticide active ingredients applied to the 1993 grape crop in each region. Long Island growers were the only growers who applied dicofol, fenbutatin-oxide or phosmet, while Western New York growers were the only ones to apply azinphos-methyl.

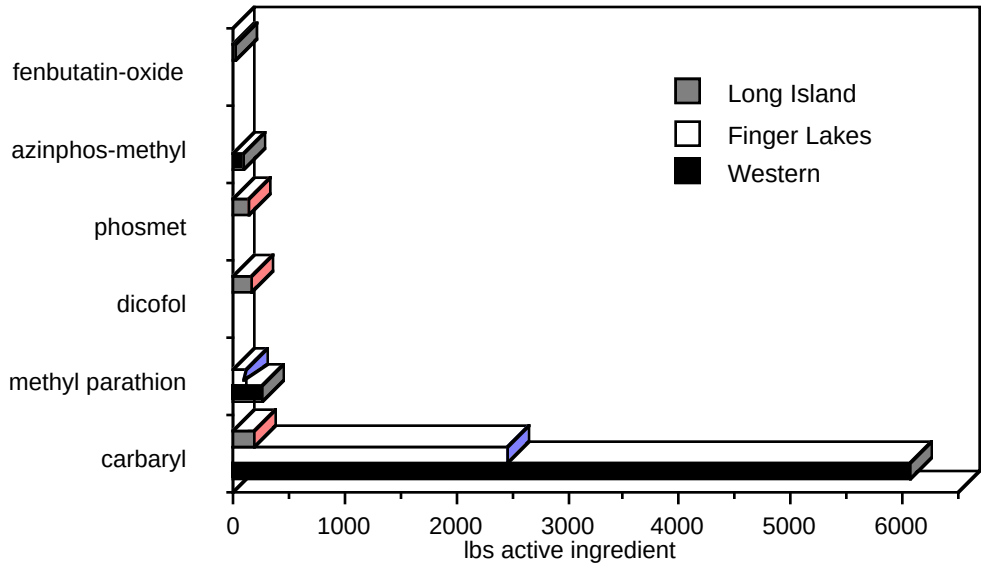

Figure 5: Pounds of insecticide AIs applied to 1993 grape crop by region

Pounds of insecticide active ingredients applied per acre in each region is shown in Figure 6. Long Island vineyards carried the greatest insecticide load - 545.83 lbs (AI) of insecticides to 142.0 acres (3.8 lbs AI/A). Western New York growers applied 6,445.10 lbs of insecticide active ingredients to 1,960.5 acres (3.3 lbs AI/A), and 975.0 Finger Lakes acres were treated with 2,575.20 lbs (2.6 lbs AI/A).

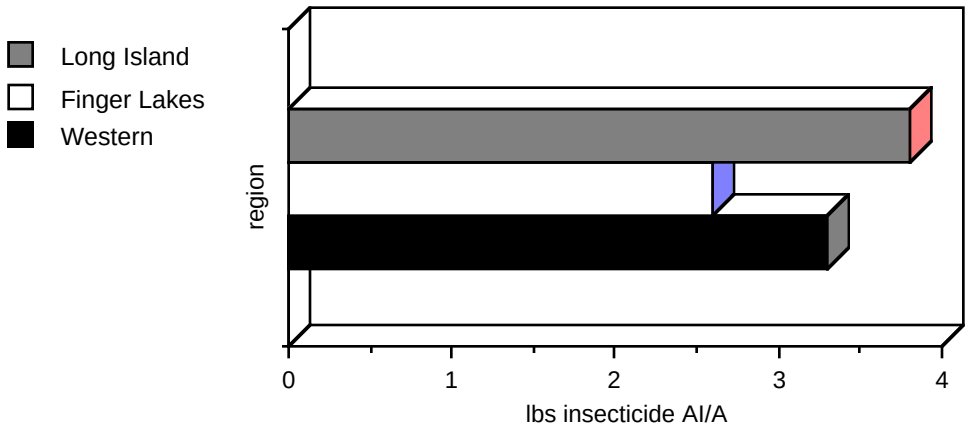

Figure 6: Pounds of fungicide AIs applied per acre in NY in 1993

Insecticide applications were applied most frequently as a midsummer spray (36.0%), followed by second postbloom and first postbloom sprays (25.0% and 19.9% respectively, Table 17). Long Island growers applied insecticides as first and second postbloom and midsummer sprays only, while Western New York growers applied insecticides at all stages except bud swell and 1 inch shoot growth (Figure 7).

Table 17: Timing of insecticide application on NY grape crop in 1993

Time of Application	# of applications	% of applications
Bud swell	1	0.7
1" shoot growth	1	0.7
3-5" shoot growth	2	1.5
10-12" shoot growth	9	6.6
Prebloom	9	6.6
Trace bloom	2	1.5
1st postbloom spray	27	19.9
2nd postbloom spray	34	25.0
Midsummer spray	49	36.0
Postharvest	2	1.5

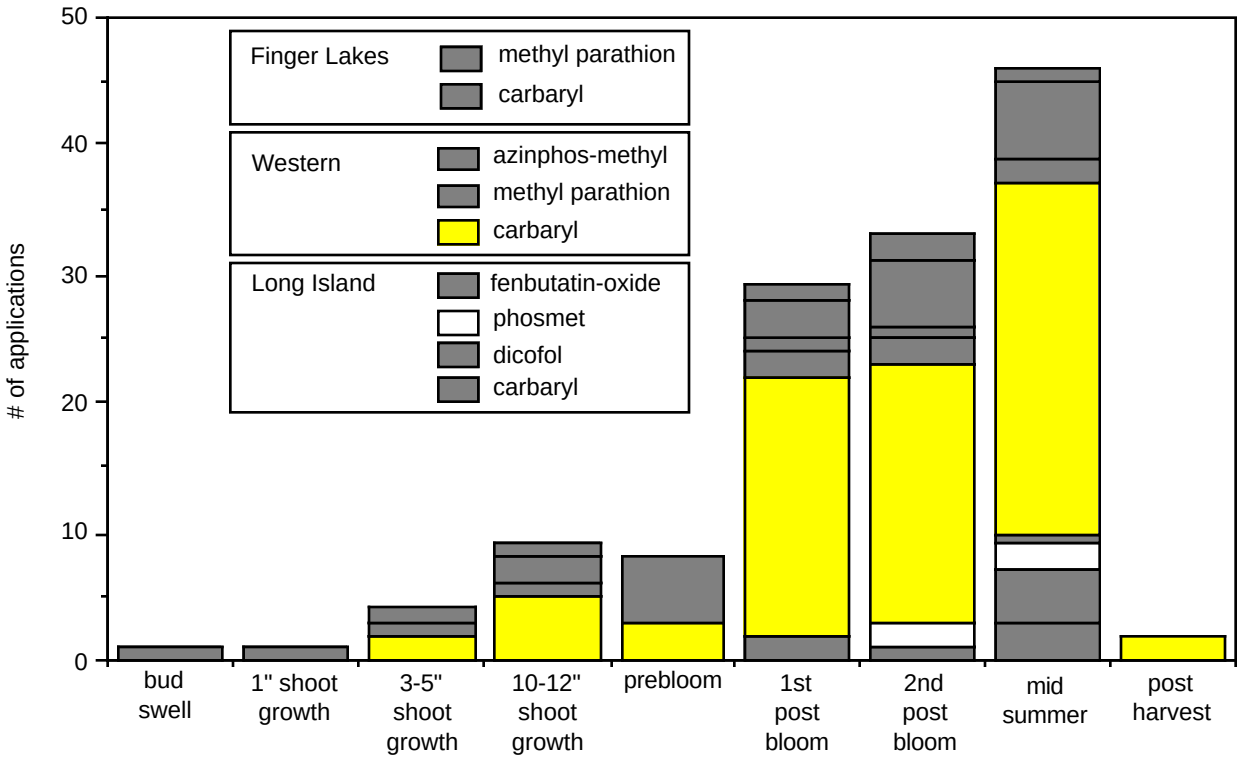

Figure 7: Number of insecticide applications at various stages of vineyard growth in NY in 1993

Table 18 indicates the frequency of insecticide applications for insect pests. Applications made for both grape berry moth and leafhoppers were most common (56.6%), followed by applications to control the Japanese flea beetle (43.4%). A similar pattern was followed in Western New York and the Finger Lakes, but on Long Island, the most common target pest was the European red mite which received 43.8% of all insecticide applications there (Figure 8).

Table 18: **Frequency of insecticide applications for target pests of grapes in NY in 1993**

Insect pest	# of applications	% of applications
Grape berry moth and Leafhopper together	77	56.6
Japanese beetle	59	43.4
Grape flea beetle	25	18.4
Grape berry moth	24	17.6
Leafhopper	14	10.3
Grape cane girdler	11	8.1
Climbing cutworm	8	5.9
European red mite	7	5.1
Not specified	7	5.1
Grape rootworm	5	3.7
Grape cane gallmaker	2	1.5
Rose chafer	2	1.5
Leafrollers	2	1.5

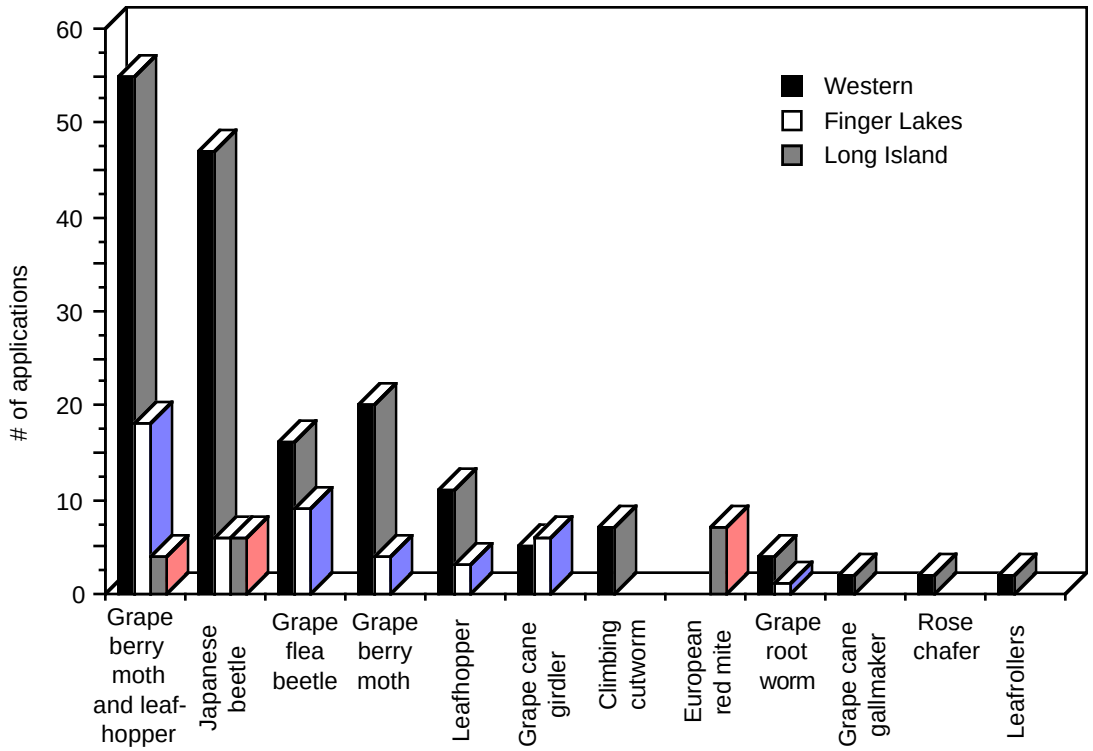

Figure 8: Frequency of insecticide applications for target pests on grapes in NY in 1993

A cost comparison of insecticides used on vineyards is shown in Table 19.

Table 19: Cost comparison of insecticides used in grape production

Insecticide	Active ingredient	Maximum rate/A (lbs of AI)	Median cost/lb of AI a/	Cost per acre per application	Avg. # of times applied	Total cost
Guthion WP	azinphos-methyl	1.0	$12.60	$12.60	1.7	$21.42
Sevin 50W	carbaryl	2.0	5.50	11.00	1.7	18.70
Sevin 80S	carbaryl	2.0	5.00	10.00	1.7	17.00
Kelthane 35	dicofol	1.225	17.71	21.69	1.3	28.20
Vendex 50WP	fenbutatin-oxide	1.25	36.43	45.54	1.0	45.54
Penncap-M	methyl parathion	2.0	10.50	21.00	1.1	23.10
Imidan 50-WP	phosmet	1.5	5.80	8.70	1.5	13.05

a/ Price obtained from AGCHEMPRICE Current U.S.A. Prices of Non-Fertilizer Agricultural Chemicals April 1992. Published by DPRA Incorporated. Costs may not reflect 1994 prices, and may vary.

FUNGICIDE USE

One hundred and thirty (94.9%) growers made 927 fungicide applications to 89.4% of the vineyard acres in 1993, for an average of 7.1 applications per grower (Table 20). Western New York growers made considerably less applications per grower (4.3), than growers in the Finger Lakes and Long Island (12.3 and 18.2, respectively). However, percent of acreage treated was approximately the same (Western New York - 97.5%, Finger Lakes - 99.3% and Long Island - 100%).

Table 20: NY grape growers using fungicides in 1993

Region	# of growers using fungicides	# of applications	# applications per grower	Acreage receiving fungicides
Western	88	375	4.3	3,508.2
Finger Lakes	36	443	12.3	3,247.4
Long Island	6	109	18.2	171.0
Total	**130**	**927**	**7.1**	**6,926.6**

All of the fungicide applications were made by the grower/employee in 1993. Eighty-five percent were made with an air-blast sprayer (Table 21), and all were foliar applications.

Table 21: Equipment used to apply fungicides to NY grape crop in 1993

Type of equipment	# of applications	% of applications
Air-blast sprayer	792	85.4
Boom sprayer	107	11.5
Hand-held sprayer	6	0.6
Not specified	22	2.4

Table 22 summarizes the fungicides used by grape growers in 1993. A total of 123,725.6 lbs of fungicide active ingredients were applied to 6,926.6 acres of vineyard surveyed. The active ingredient used most often was mancozeb (applied by 72.3% of growers using fungicides). A total of 40,280 lbs mancozeb was applied to 4,696 vineyard acres. Although used by only 37.7% of growers, the amount of sulfur applied to New York vineyards (55,827 lbs) was even greater than the amount of mancozeb.

Figure 9 illustrates the pounds of the eight most widely used fungicide active ingredients applied in each region. The majority of sulfur (89.4%), mancozeb (70.5%), and captan (85.6%) was applied in the Finger Lakes. Long Island growers did not use myclobutanil or fenarimol, and they used extremely small amounts of triadimefon (7.4%) and mancozeb (6.5%).

Table 22: Fungicide use on NY grape crop in 1993 (all regions)

Active Ingredient Trade name	# of records	Total acres sprayed	Times applied	Acre treatments	Rate AI per acre	Total lbs AI applied
mancozeb	**94**					**40,280.02**
Dithane DF, Manzate 200 DF, & Penncozeb DF	51	1,702.5	2.2	3,745.50	3.0	11,236.50
Dithane M-45, Mancozeb 80W, & Penncozeb	41	2,893.5	3.1	8,969.85	3.2	28,703.52
Mancozeb 4L	2	100.0	1.0	100.0	3.4	340.00
myclobutanil	**76**					**1,063.07**
Nova 40W	76	4,062.0	2.1	8,504.55	0.125	1,063.07
sulfur	**49**					**55,827.23**
Micro Flo Sulfur	3	75.2	6.0	450.20	6.0	2,701.20
Microthiol Special	2	53.0	3.8	203.00	8.0	1,624.00
Super Six Liquid Sulfur	7	95.4	3.7	356.67	1.5	535.01
Thiolux	2	56.0	2.5	140.00	4.8	672.00
Wettable Sulfur	35	2,417.7	4.5	10,933.70	4.6	50,295.02
triadimefon	**47**					**690.79**
Bayleton	47	2,171.0	1.7	3,684.20	0.188	690.79
ferbam	**47**					**3,654.51**
Carbamate WDG	47	1,508.5	1.6	2,404.28	1.52	3,654.51
fenarimol	**41**					**168.14**
Rubigan E.C.	41	1,994.8	1.8	3,592.80	0.047	168.14
maneb	**29**					**11,523.34**
Maneb 80	8	542.0	2.8	1,536.50	3.2	4,916.80
Manex II	21	1,261.5	1.5	1,943.10	3.4	6,606.54
captan	**25**					**5,142.54**
Captan 50-WP, 80-WP, & Captec 4L	25	1,353.3	1.9	2,571.27	2.0	5,142.54
copper hydroxide	**19**					**809.90**
Kocide 101	10	482.5	1.0	482.50	1.0	482.50
Kocide DF	9	409.3	1.0	409.25	0.8	327.40
copper oxychloride sulfate	**19**					**1,773.00**
C-O-C-S WDG	19	721.5	1.2	886.50	2.0	1,773.00
iprodione	**15**					**545.50**
Rovral	15	357.0	1.5	545.50	1.0	545.50
maneb and dinocap	**6**					**1,718.08**
Dikar	6	470.0	1.2	560.00	3.07	1,718.08
copper sulfate	**4**					**268.18**
Basicop	4	253.0	1.0	253.00	1.06	268.18
benomyl	**4**					**66.00**
Benlate	4	88.0	1.0	88.00	0.75	66.00
copper	**3**					**130.47**
Tenn-Cop 5E	3	46.1	1.0	46.39	2.81	130.47
metalaxyl & copper hydroxide	**3**					**25.20**
Ridomil/Copper 70W	3	18.0	1.0	18.00	1.4	25.20
metalaxyl	**1**					**34.00**
Ridomil 2E	1	17.0	1.0	17.00	2.0	34.00
dinocap	**1**					**5.63**
Karathane LC	1	7.5	1.0	7.50	0.75	5.63
Total						**123,725.60**

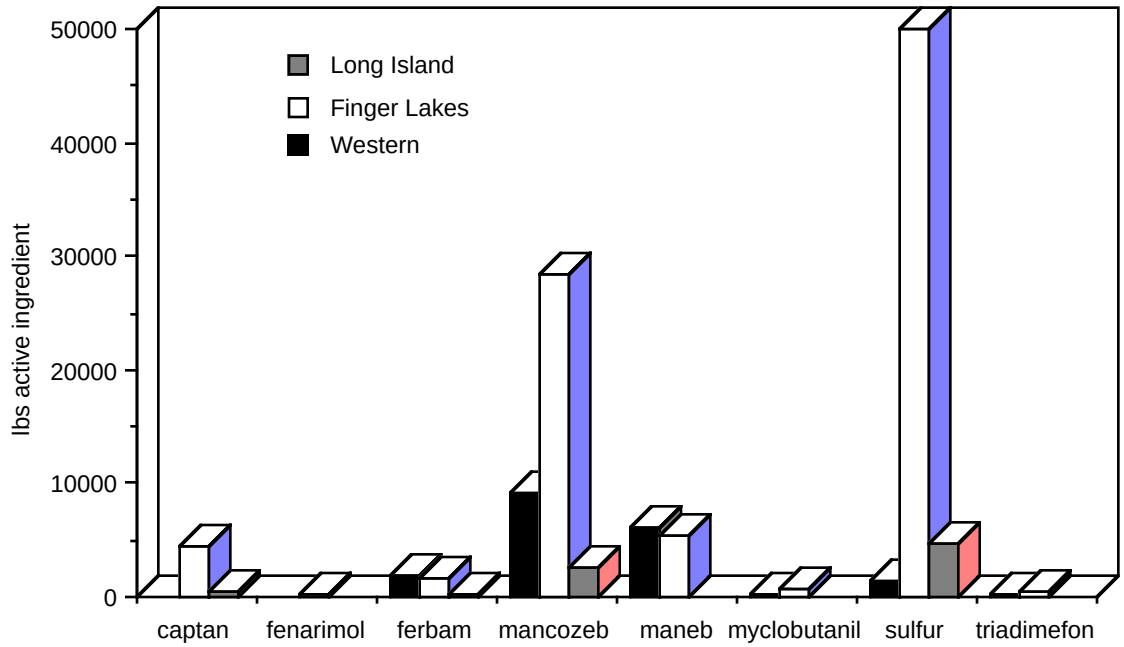

Figure 9: Pounds of fungicide AIs applied to 1993 grape crop by region in NY

Pounds of fungicide active ingredients applied per acre in each region is shown in Figure 10. As with insecticides, Long Island vineyards carried the greatest fungicide load, applying 8,254.5 lbs (AI) to 171 acres (48.3 lbs AI/A). The Finger Lakes growers applied 91,617.95 lbs of fungicide active ingredients to 3,247.4 acres (28.2 lbs AI/A), and the vineyards surveyed in Western New York carried a fungicide load of only 6.8 lbs AI/A (23,695.35 lbs {AI} applied to 3,508.2 acres).

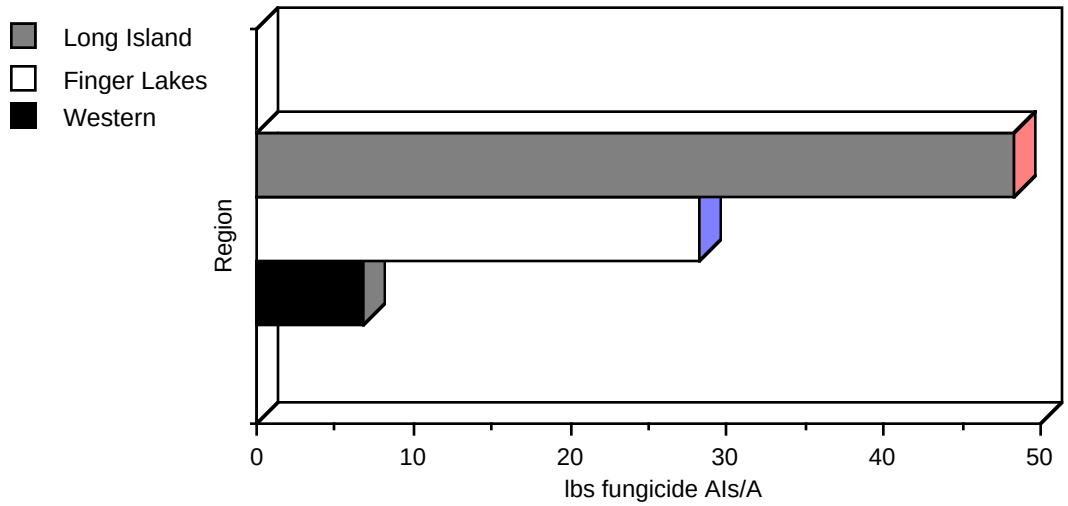

Figure 10: Pounds of fungicide AIs applied per acre in NY in 1993

Fungicide applications were applied most frequently as a midsummer spray (22.0%), followed by prebloom sprays (19.5%, Table 23). All three regions followed this same pattern. Figure 11 illustrates fungicide applications at different stages of vineyard development. Where EBDCs were not used for juice grapes after first bloom (generally in Western New York), myclobutanil and triadimefon became popular.

Table 23: Timing of application of fungicides on NY grape crop for 1993

Time of Application	# of applications	% of applications
Bud swell	12	1.3
1" shoot growth	44	4.7
3-5" shoot growth	89	9.6
10-12" shoot growth	110	11.9
Prebloom	177	19.5
Trace bloom	19	2.0
1st postbloom spray	147	15.9
2nd postbloom spray	120	12.9
Midsummer spray	204	22.0
Postharvest	4	0.4

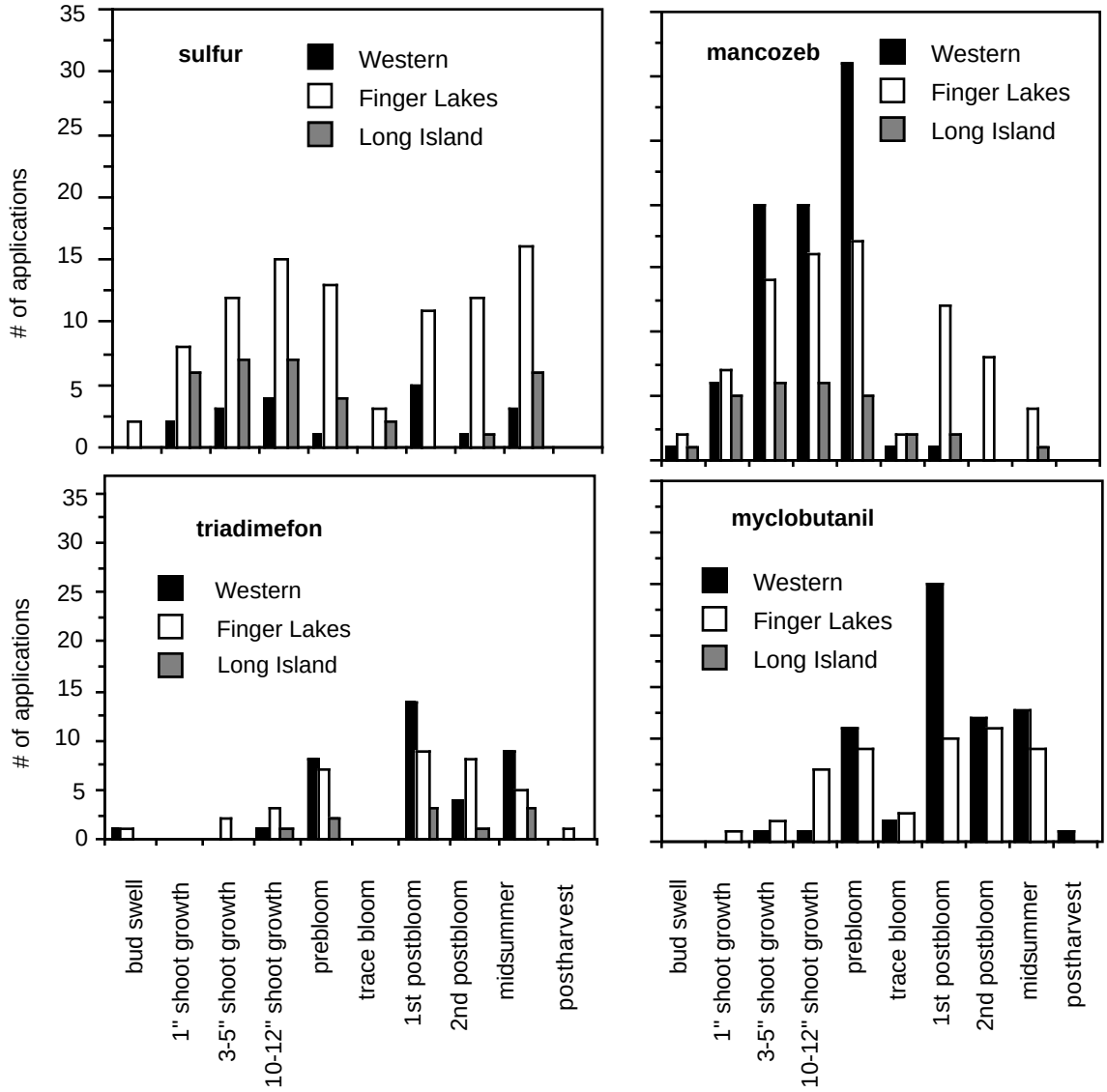

Figure 11: Number of fungicide applications at different stages of vineyard development in NY in 1993

Table 24 indicates the frequency of fungicide applications for disease pests. Fungicides were applied most often for powdery mildew and black rot (72.0% and 68.6% respectively), followed by downy mildew (52.5%). Finger Lakes growers applied fungicides for the previously mentioned pests in that same order, while Western New York growers applied for black rot most often (76%). Long Island growers applied fungicides for all three of the above diseases and for Phomopsis Cane and Leaf Spot with the same frequency (Figure 12). A cost comparison of fungicides used on vineyards is shown in Table 25.

Table 24: Frequency of fungicide applications for target pests of grapes

Disease pest	# of applications	% of applications
Powdery mildew	667	72.0
Black rot	636	68.6
Downy mildew	487	52.5
Phomopsis Cane and Leaf Spot	246	26.5
Botrytis bunch rot	65	7.0
Not specified	48	5.2

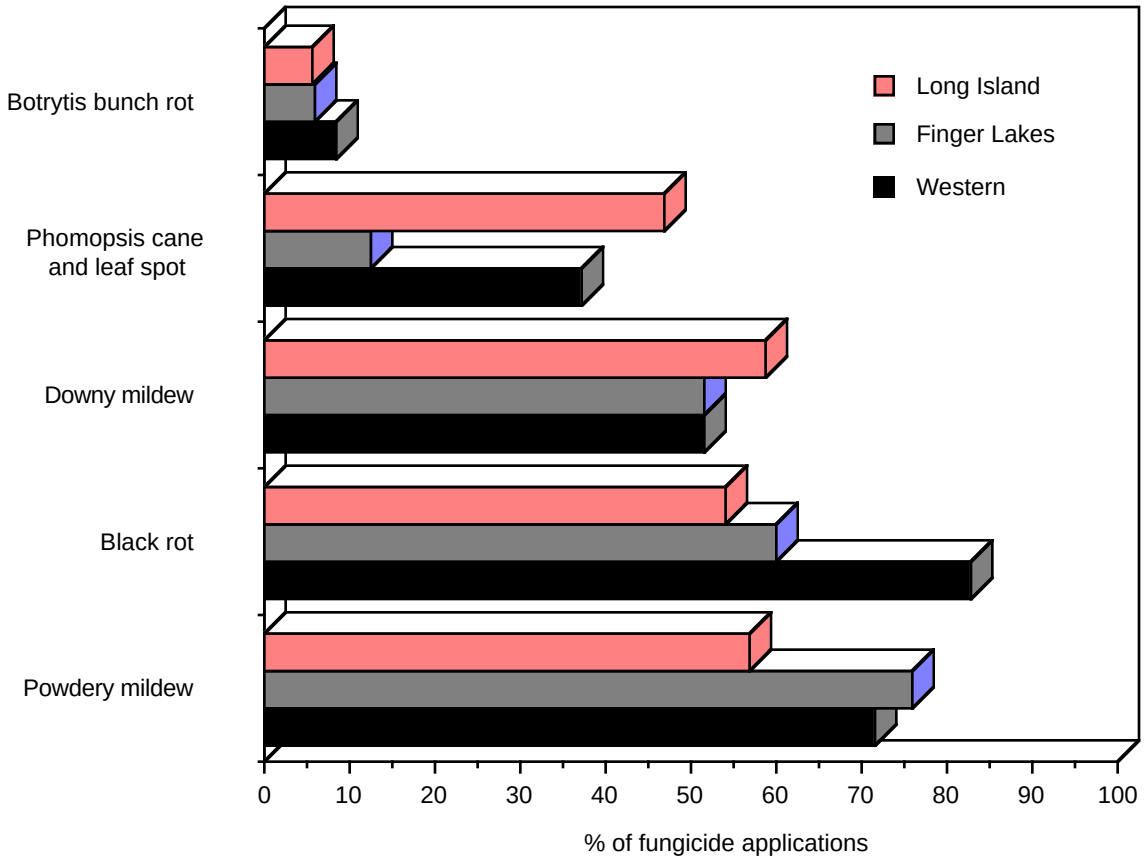

Figure 12: Frequency of fungicide applications for target pests of grapes in NY in 1993

Table 25: Cost comparison of fungicides used in grape production

Fungicide	Active ingredient	Maximum rate/A (lbs of AI)	Median cost/lb of AI [a/]	Cost per acre per application	Avg. # of times applied	Total cost
Benlate	benomyl	0.75	$30.90	$23.18	1.0	$23.18
Captan 50-WP	captan	2.0	4.12	8.24	1.9	15.66
Rovral	iprodione	1.0	37.50	37.50	1.5	56.25
Dithane DF	mancozeb	3.0	3.60	10.80	2.2	23.76
Dithane M-45	mancozeb	3.2	3.40	10.88	3.1	33.73
Manzate 200DF	mancozeb	3.0	2.20	6.60	2.2	14.52
Ridomil 2E	metalaxyl	2.0	71.00	142.00	1.0	142.00
Wettable Sulfur	sulfur	4.6	0.16	0.74	4.5	3.31
Bayleton	triadimefon	0.18	92.00	16.42	1.7	27.92

[a/] Price obtained from AGCHEMPRICE Current U.S.A. Prices of Non-Fertilizer Agricultural Chemicals April 1992. Published by DPRA Incorporated. Costs may not reflect 1994 prices, and may vary.

TANK MIX USE

Fifty-three (38.7%) growers made tank mix (combination of insecticide and fungicide) applications to 35.2% of the vineyard acres surveyed in 1993. An average of 1.8 tank mix applications were made per grower (Table 26). Growers in all three regions made approximately the same number of applications, but growers on Long Island treated a greater percentage of vineyard acres: 79.8% vs. 41.4% for Western New York and 26.0% for the Finger Lakes region.

Table 26: NY grape growers using tank mixes in 1993

Region	# of growers using tank mixes	# of applications	Avg. # of applications per grower	Acreage receiving tank mixes
Western	36	60	1.6	1,488.3
Finger Lakes	12	25	2.1	853.5
Long Island	5	8	1.6	136.5
Total	**53**	**93**	**1.8**	**2,478.3**

All of the tank mix applications were made by the grower/employee and were foliar applications. The type of equipment used most often to apply tank mixes was an air-blast sprayer (72.0%, Table 27).

Table 27: Equipment used to apply tank mixes to NY grape crop in 1993

Type of equipment	# of applications	% of applications
Air-blast sprayer	67	72.0
Boom sprayer	18	19.4
Hand-held sprayer	3	3.2
Not specified	5	5.4

Table 28 summarizes the tank mixes used by grape growers in 1993. The combination of carbaryl and myclobutanil (Sevin and Nova) was the most common tank mix. Seventeen growers (32% of those using tank mixes) applied Sevin/Nova on 662.6 acres, an average of 1.3 times for a total of 1,830.4 lbs AI applied. Carbaryl was the insecticide active ingredient used most often in tank mixes, and myclobutanil was the fungicide AI used most often in tank mixes.

Table 28: Tank mix use on NY grape crop in 1993 (all regions)

Active Ingredient Trade name	# of records	Total acres sprayed	Times applied	Acre treatments	Rate AI per acre	Total lbs AI applied
azinphos-methyl & captan						
Guthion, Captan	1	6.0	1.0	6.00	3.0	18.00
azinphos-methyl & triadimefon						
Guthion, Bayleton	1	1.5	1.0	1.50	2.19	3.28
captan & carbaryl						
Captan, Sevin	2	21.5	1.0	21.50	4.0	86.00
captan, carbaryl, & benomyl						
Captan, Sevin, Benlate	1	6.0	2.0	12.00	4.75	57.00
captan, carbaryl, dicofol & triadimefon						
Captan, Sevin, Kelthane, Bayleton	1	50.0	1.0	50.00	5.44	271.88
captan, carbaryl & myclobutanil						
Captan, Sevin, Nova	2	100.0	1.0	100.00	4.13	412.50
captan, carbaryl & triadimefon						
Captan, Sevin, Bayleton	2	40.3	1.0	40.25	4.19	168.55
captan, triadimefon & dicofol						
Captan, Bayleton, Kelthane	1	10.0	1.0	10.00	3.39	33.88
captan, triadimefon & fenbutatin-oxide						
Captan, Bayleton, Vendex	1	28.0	1.0	28.00	3.44	96.25
captan, triadimefon, phosmet						
Captan, Bayleton, Imidan	1	28.0	1.0	28.00	3.69	103.25
carbaryl, dicofol, ferbam & sulfur						
Sevin, Kelthane, Carbamate, Liquid Sulfur	1	29.0	1.0	29.00	6.27	181.83
carbaryl & fenarimol						
Sevin, Rubigan	1	45.0	1.0	45.00	2.05	92.11
carbaryl, fenarimol & ferbam						
Sevin, Rubigan, Carbamate	2	126.0	1.0	126.00	3.57	449.42
carbaryl, fenarimol & mancozeb						
Sevin, Rubigan, Dithane/ Penncozeb/Mancozeb	5	338.0	1.3	439.40	5.25	2,305.53
carbaryl, fenarimol & maneb						
Sevin, Rubigan, Maneb	1	9.5	1.0	9.50	5.25	49.84
carbaryl & ferbam						
Sevin, Carbamate	1	105.0	1.0	105.00	3.52	369.60
carbaryl, ferbam & myclobutanil						
Sevin, Carbamate, Nova	3	32.0	1.0	32.00	3.65	116.64
carbaryl, ferbam, myclobutanil & sulfur						
Sevin, Carbamate, Nova, Wettable Sulfur	1	2.0	1.0	2.00	8.25	16.49
carbaryl, ferbam & triadimefon						
Sevin, Carbamate, Bayleton	1	10.0	1.0	10.00	4.19	41.88
carbaryl & mancozeb						
Sevin, Penncozeb	1	40.0	1.0	40.00	5.00	200.00
carbaryl, mancozeb & myclobutanil						
Sevin, Dithane, Nova	2	45.0	1.9	85.50	5.33	455.29
carbaryl, mancozeb, myclobutanil & sulfur						
Sevin, Dithane, Nova, Sulfur	1	50.0	1.0	50.00	9.925	496.25

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Table 28: Tank mix use on NY grape crop in 1993 (continued)

Active Ingredient. Trade name	# of records	Total acres sprayed	Times applied	Acre treatments	Rate AI per acre	Total lbs AI applied
carbaryl, mancozeb & sulfur						
Sevin, Dithane/Penncozeb Micro Flo/Wettable Sulfur	2	57.0	1.0	57.00	10.58	603.20
carbaryl, mancozeb & triadimefon						
Sevin, Penncozeb, Bayleton	1	45.0	2.0	90.00	5.19	466.88
carbaryl, maneb, & sulfur						
Sevin, Manex, Sulfur	1	17.0	1.0	17.00	10.00	170.00
carbaryl, methyl parathion & triadimefon						
Sevin, Penncap-M, Bayleton	1	10.0	1.0	10.00	4.19	41.88
carbaryl & myclobutanil						
Sevin, Nova	17	662.6	1.3	861.38	2.13	1,830.43
carbaryl & triadimefon						
Sevin, Bayleton	2	30.0	3.5	104.00	2.19	227.50
carbaryl, triadimefon & maneb						
Sevin, Bayleton, Maneb	1	290.0	2.0	580.00	5.39	3,124.75
dinocap, ferbam & methyl parathion						
Karathane, Carbamate, Penncap-M	2	65.4	1.0	65.40	4.27	279.26
fenarimol, ferbam & methyl parathion						
Rubigan, Carbamate, Penncap-M	2	71.5	1.0	71.50	3.57	255.03
fenarimol & methyl parathion						
Rubigan, Penncap-M	1	130.0	1.0	130.00	2.05	266.08
ferbam, methyl parathion & myclobutanil						
Carbamate, Penncap-M, Nova	1	37.0	1.0	37.00	3.65	134.87
mancozeb & methyl parathion						
Penncozeb, Penncap-M	1	12.0	3.0	36.00	5.20	187.20
mancozeb, methyl parathion & sulfur						
Manzate, Penncap-M, Sulfur	1	5.0	1.0	5.00	9.60	48.00
methyl parathion & myclobutanil						
Penncap-M, Nova	5	244.25	1.4	344.25	2.13	731.53
Total						**14,392.08**

Figure 13 illustrates the pounds of tank mix active ingredients applied per acre in each region. Although more tank mixes were used in Western New York than in the Finger Lakes or Long Island, Western New York vineyards received a considerably smaller pesticide load (4.0 lbs/A for Western New York vs. 9.3 and 10.7 lbs/A for the Finger Lakes and Long Island, respectively). This is due, in part, to the fact that almost all tank mixes in Western New York used myclobutanil (low rate of active ingredient per acre), while tank mixes in the Finger Lakes and on Long Island used more products with higher active ingredient rates per acre (mancozeb and sulfur).

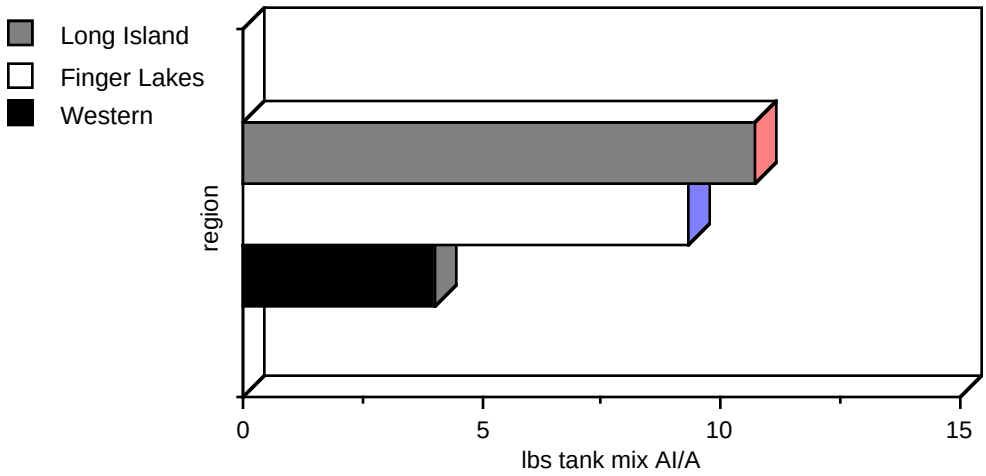


Figure 13: Pounds of tank mix AIs applied per acre in NY in 1993

Tank mix applications were applied most often as midsummer sprays (39.7%, Table 29), followed by first and second postbloom sprays. Twenty-five percent of the midsummer applications and one-third of the first and second postbloom sprays were tank mixes of Nova and Sevin.

Table 29: Timing of application of tank mixes on NY grape crop in 1993

Time of Application	# of applications	% of applications
Bud swell	0	0.0
1" shoot growth	2	2.2
3-5" shoot growth	2	2.2
10-12" shoot growth	1	1.1
Prebloom	11	11.8
Trace bloom	0	0.0
1st postbloom spray	20	21.5
2nd postbloom spray	21	22.6
Midsummer spray	36	38.7
Postharvest	0	0.0

Table 30 indicates the frequency of tank mix applications for insect and disease pests. Tank mixes were applied most often for leafhopper (74.2%), grape berry moth (72.0%), black rot (87.1%) and powdery mildew (87.1%). Fifty-one applications (54.8%) were made for all four of the above. Only eight of the grape berry moth and ten of the leafhopper applications were made without targeting both insect pests. Only six black rot and powdery mildew applications were made without targeting both diseases.

Table 30: Frequency of tank mix applications for target pests of grapes (all regions) in NY in 1993

Insect pest	# of appl.	% of appl.	Disease pest	# of appl.	% of appl.
Leafhopper	69	74.2	Black rot	81	87.1
Grape berry moth	67	72.0	Powdery mildew	81	87.1
Japanese beetle	44	47.3	Downy mildew	55	59.1
Grape flea beetle	17	18.3	Phomopsis cane and leaf spots	29	31.2
Grape cane girdler	13	14.0	Botrytis bunch rot	9	9.7
Grape cane gallmaker	11	11.8	Not specified	4	4.3
Not specified	8	8.6			
Climbing cutworm	5	5.4			
Grape rootworm	5	5.4			
European red mite	3	3.2			
Rose chafer	2	2.1			
Thrips	1	1.1			

Figure 14 illustrates the frequency of tank mix use for target pests by region. Western New York growers were the only ones who targeted thrips, rose chafers and botrytis bunch rot. Long Island growers targeted Japanese beetle and European red mite most often. All tank mix applications on Long Island that targeted Japanese beetle were also used for powdery and downy mildew, as well as black rot. Forty-four of the 46 tank mix applications that targeted grape berry moth in Western New York also targeted black rot and powdery mildew. Twenty-one of the 22 tank mix applications targeting downy mildew in the Finger Lakes also targeted leafhoppers.

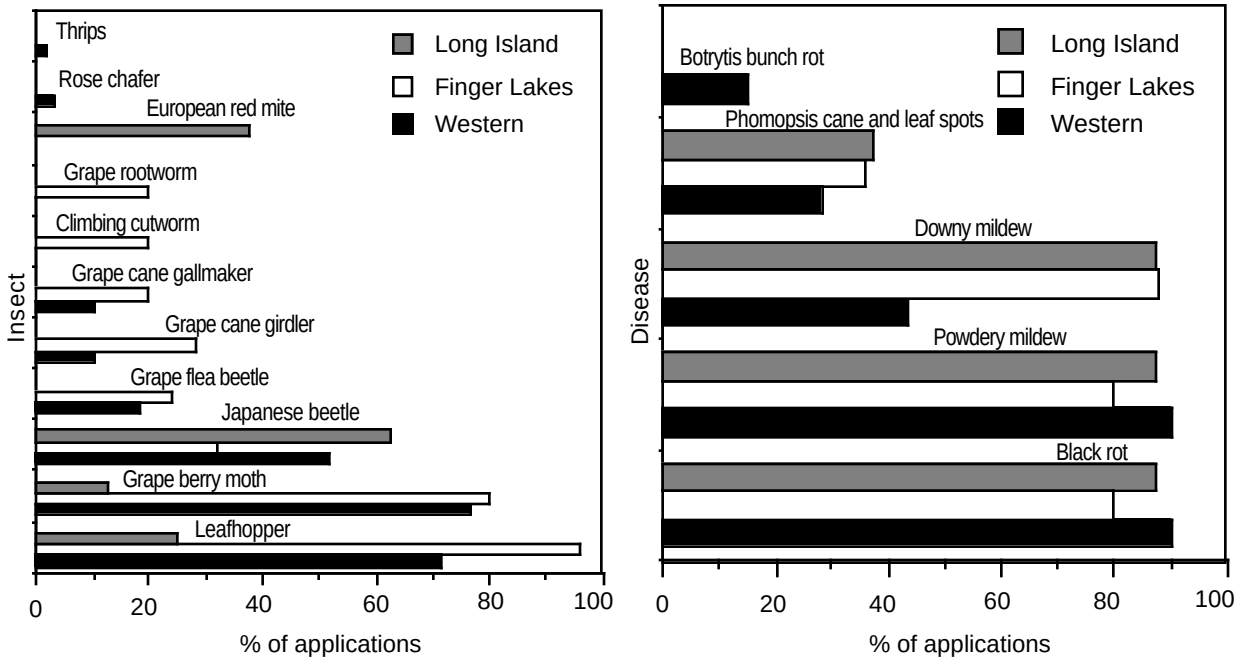


Figure 14: Frequency of tank mix applications for target pests of grapes by region in NY in 1993

MISCELLANEOUS

The cost of chemical pest control is illustrated in Table 31. The most common amount spent on chemical pest control, not including the response "over $250" where the actual amount was unspecified, was $51 - 150 (10.9%) followed by $151 - 250 (8.7%). It is unclear from the answers whether or not growers read the question correctly, since it asked for a per acre cost, and many of these answers appear to be extremely high.

Table 31: Cost of chemical pest control per acre for NY grape crop in 1993

Cost	# of records	% of records
$0	1	0.7
$11-50	2	1.4
$51-150	15	10.9
$151-250	12	8.7
Over $250 (amount not specified)	26	18.8
$251-500	8	5.8
$501-750	6	4.3
$751-1,000	8	5.8
$1,000-1,500	12	8.7
$1,501-2,000	2	1.4
$2,001-3,000	9	6.5
$3,001-5,000	9	6.5
$5,001-7,500	4	2.9
$7,501-10,000	8	5.8
$10,001-25,000	3	2.2
$28,000	1	0.7
$90,000	1	0.7
Don't know	2	1.4
Not specified	8	5.8

Nonchemical pest control cost was $0 (58.0%, Table 32). It is unclear what growers considered nonchemical control when answering this question, but some of the comments on the surveys indicated the following: leaf removal, hedging, bird control and hydraulic grape hoe. There is, however, a cost attached to nonchemical methods which include man hours and equipment costs.

Table 32: Cost of nonchemical pest control per acre for NY grape crop in 1993

Cost	# of records	% of records
$0	80	58.0
Less than $10	1	0.7
$11-50	11	8.0
$51-150	6	4.4
$151-250	9	6.5
Over $250 (amount not specified)	7	5.1
$251-750	3	2.1
$751-2000	4	2.8
Not specified	14	10.1
Don't know	2	1.4

Forty three and one-half percent of the growers surveyed indicated that they calibrated their application equipment once per season (Table 33). Approximately one-third calibrated before each application. The most common method of calibrating equipment was the "known area method" (spray water on a measured acre and then calculate how many gallons of water were used) (38.4%, Table 34).

Table 33: Frequency of calibration of equipment for NY grape crop in 1993

Frequency of calibration	# of records	% of records
Once per season	60	43.5
Before each application	41	29.7
Two to three times a season	29	21.0
At the time of equipment purchase	2	1.4
At the time of equipment purchase and once a season	2	1.4
Not specified	2	1.4
Before each application & two to three times a season	1	0.7
Every two to three years	1	0.7

Table 34: How NY grape growers calibrated their equipment in 1993

Method of calibration	# of records	% of records
Gallons of water/acre	53	38.4
Nozzle output (quart jar method)	23	16.7
Gallons of water/acre, speed of equipment	18	13.0
According to manual	14	10.1
Not specified	11	8.0
Acres covered over time	3	2.2
Gallons of water /acre and nozzle output	3	2.2
Other[a/]	13	9.4

a/ Other includes: "adjust pressure as the acre is sprayed", "experimentation", "feet X mph X psi", "land speed and pressure", "make sure everything works properly", "not easily", "person who services sprayer does it", "replace tee jets and maintain proper pressure", "stopwatch distance" and "the right way".

Growers were asked to select **one** of the following choices releated to applying pesticides in their vineyard in 1993: "spray schedule", "presence of pest" or "IPM program." The results are shown in Table 35. Almost half of the growers indicated they used a spray schedule that was recommended by Extension (Table 36). There were many comments on this question indicating that growers felt the question was difficult to answer:

- "I really use a spray schedule integrated with IPM, that's why I only applied 3 or 4 sprays this year."
- "I feel a spray schedule takes into account IPM."
- "This is a bad question--to do the best conscientious job, one does all three."
- "For grape berry moth, I scout, but this is minor compared to a schedule for weeds and diseases."
- "I use presence of pest, including disease pressure/presence from pervious year."

Table 35: Basis for application of pesticides on NY grape crop in 1993

Basis for application	# of records	% of records
Spray schedule	63	45.7
Presence of pest	36	26.1
IPM program	30	21.7
All three	4	2.9
Presence of pest and spray schedule	2	1.4
Not specified	2	1.4
Presence of pest and IPM program	1	0.7

Table 36: Recommendation of spray schedule on NY grape crop in 1993

Who recommends schedule	# of records	% of records
Extension system	24	34.8
Extension system and myself	11	15.9
Myself	10	14.5
Extension system and pesticide dealer	4	5.8
Extension system and processor	4	5.8
Processor	4	5.8
Various combinations of above	12	17.4

Tables 37, 38 and 39 show the spray schedules used by growers who indicated that they used a spray schedule to apply pesticides in 1993. Thirty-seven Western New York growers, 25 Finger Lakes growers and two Long Island growers used spray schedules. Herbicide sprays consisted of a preemergent spray of either diuron or simazine (Table 37) in Western New York and the Finger Lakes, oryzalin or simazine on Long Island, and a postemergent spray of glyphosate or paraquat. Western New York and Finger Lakes growers also used glyphosate for spot treatments. Eight percent of Western New York growers and 16% of Finger Lakes growers who said they used a spray schedule in 1993 did not use any herbicides.

Table 37: Herbicide spray schedule used by NY grape growers in 1993

	Western		Finger Lakes		Long Island	
Timing	AI	% growers using	AI	% growers using	AI	% growers using
Pre-emergeence	diuron	67.5	diuron	60.0	oryzalin	50.0
	simazine	40.5	simazine	48.0	simazine	50.0
	glyphosate	8.0	paraquat	4.0		
	norflurazon	5.4				
Post-emergence	glyphosate	67.6	paraquat	64.0	glyphosate	100.0
	paraquat	24.3	glyphosate	48.0	paraquat	50.0
	diuron	13.5	simazine	8.0		
	simazine	2.7				
	norflurazon	2.7				
Spot treatment	glyphosate	24.3	glyphosate	32.0		
	paraquat	2.7	paraquat	20.0		
			simazine	4.0		

Insecticide sprays in Western New York and the Finger Lakes consisted of a prebloom (includes bud swell through prebloom) spray(s) of carbaryl, a postbloom (includes first and second postbloom sprays) spray(s) of carbaryl, and a midsummer spray(s) of carbaryl. Forty-three percent of Western New York growers and 60% of Finger Lakes growers using spray schedules did not use insecticides alone on their 1993 grape crop. Long Island growers using a spray schedule did not apply a prebloom spray, applied dicofol postbloom, and carbaryl midsummer (Table 38).

Table 38: Insecticide spray schedule used by NY grape growers in 1993

	Western		Finger Lakes		Long Island	
Timing	**AI**	**% growers using**	**AI**	**% growers using**	**AI**	**% growers using**
Prebloom	carbaryl	18.9	carbaryl	20.0	none used	
	methyl parathion	2.7	methyl parathion	4.0		
Postbloom	carbaryl	72.0	carbaryl	24.0	dicofol	100.0
	methyl parathion	2.7	methyl parathion	8.0	phosmet	50.0
	azinphos-methyl	2.7				
Midsummer	carbaryl	37.9	carbaryl	12.0	carbaryl	100.0
	azinphos-methyl	5.4	methyl parathion	4.0	dicofol	50.0
			phosmet	50.0		

The most common prebloom fungicide sprays for all three regions were mancozeb and/or sulfur for those growers who used a spray schedule (Table 39). The postbloom sprays in Western New York were myclobutanil, while mancozeb and sulfur were applied in the Finger Lakes region. Long Island growers applied captan and triadimefon. Midsummer copper applications were most common in Western New York, sulfur and captan in the Finger Lakes and captan, copper, iprodione and sulfur on Long Island. Eight percent of Western New York and Finger Lakes growers who used spray schedules, did not apply fungicides (not including fungicides in tank mixes) to their 1993 grape crop.

Table 39: Fungicide spray schedule used by NY grape growers in 1993

	Western		Finger Lakes		Long Island	
Timing	AI	% growers using	AI	% growers using	AI	% growers using
Prebloom	mancozeb	45.9	mancozeb	88.0	mancozeb	100.0
	maneb	27.0	sulfur	72.0	sulfur	100.0
	triadimefon	13.5	fenarimol	52.0	triadimefon	50.0
	fenarimol	10.8	triadimefon	44.0		
	sulfur	10.8	maneb	28.0		
	maneb/dinocap	5.4	myclobutanil	24.0		
	ferbam	16.0	captan	11.0		
Postbloom	myclobutanil	43.2	mancozeb	75.9	captan	100.0
	ferbam	27.0	sulfur	68.0	triadimefon	100.0
	triadimefon	24.3	myclobutanil	44.0	ferbam	50.0
	copper oxychloride		fenarimol	44.0	benomyl	50.0
	sulfate	13.5	ferbam	32.0		
	fenarimol	8.1	captan	24.0		
			maneb	24.0		
			benomyl	4.0		
			copper oxy sulfate	4.0		
			iprodione	4.0		
			metalaxyl	4.0		
Midsummer	copper hydroxide	21.6	sulfur	48.0	captan	100.0
	copper oxychloride		captan	40.0	copper	100.0
	sulfate	16.2	iprodione	32.0	iprodione	100.0
	triadimefon	16.2	myclobutanil	20.0	sulfur	100.0
	myclobutanil	13.5	triadimefon	20.0	triadimefon	100.0
	captan	8.1	fenarimol	12.0	ferbam	50.0
	copper sulfate	2.7	mancozeb	12.0		

Sixty-five percent of Western New York growers and 64% of Finger Lakes growers using a spray schedule did not apply tank mixes to their 1993 grape crop. In addition, 16.2% of Western New York growers made a postbloom and/or midsummer application of carbaryl and myclobutanil.

Growers selected "Extension" (87.0%, Table 40) as the primary source for pesticide information relating to pesticide application decisions. "Past success" was next with 53.6% responding.

Table 40: Decision about which pesticides to apply on NY grape crop in 1993

Who recommends, or who decides	# of responses	% of records
Extension system	120	87.0
Past success with product	74	53.6
Processor	57	41.3
Salesperson	42	30.4
Other grower	19	13.8
Private consultant	11	8.0
Other[a/]	7	5.1

[a/]Other includes: "cost", "safety", "availability" or no answer specified

The most common alternative method used by grape growers to control pest problems in the vineyard in 1993 was mowing (82.6%, Table 41). Over half the growers used pruning (to remove infected or infested growth) and cultivation as alternative methods. Figure 15 illustrates alternative methods used by region. Long Island growers indicated pruning was used most often followed by row orientation and then mowing. Western New York growers pruned more often, while Finger Lakes growers mulched at greater frequency.

Table 41: Alternative methods used to control grape pests in NY in 1993

Alternative method	# of responses	% of records
Mowing	114	82.6
Pruning to remove infected or infested growth	76	55.1
Cultivation	74	53.6
Burn/bury/remove infected plants/berries	36	26.1
Rows oriented to promote good air circulation	26	18.8
Cover crop	25	18.1
Mulching	25	18.1
Other[a/]	13	9.4
Do not use	5	3.6
Baited traps	1	0.7

a/Other includes: "leaf removal in fruit zone", "bird netting", "shoot thinning", "summer pruning", "canopy management", "grub hoe", "do not know", "mating disruption", "encouraging insect eating birds to nest around vineyard"

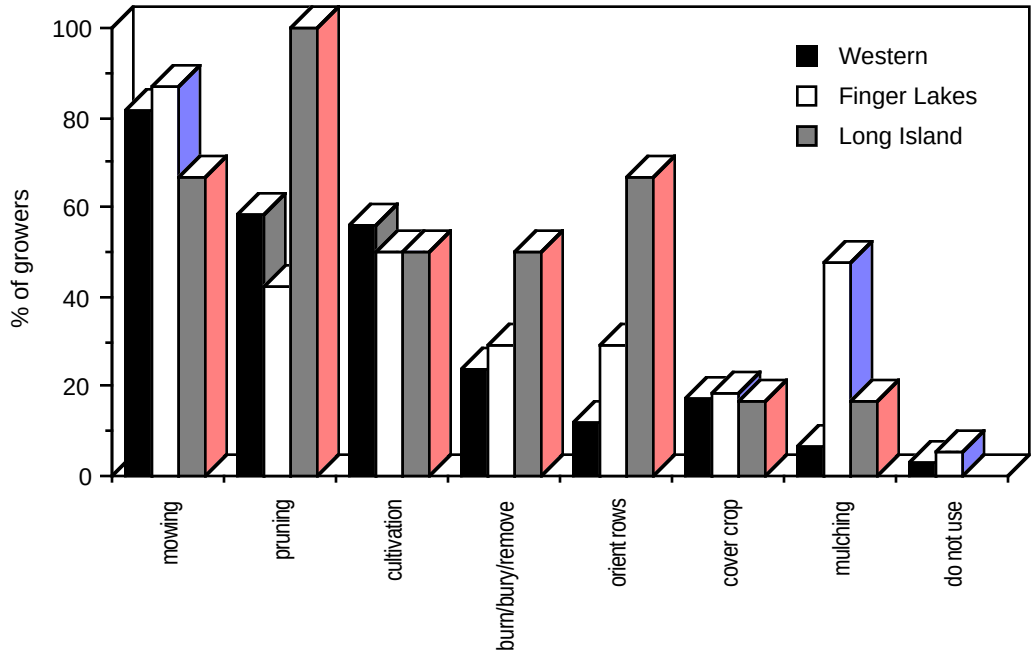


Figure 15: Alternative methods used to control grape pests in NY in 1993

Respondents indicated that pesticides were stored in a locked storage facility (60.1%, Table 42). Empty containers were burned (64.5%) or sent to the landfill after triple rinsing (47.1%, Table 43). Unwanted or unused pesticides were carried over to the next season (76.8%, Table 44) and rinsate was disposed of by spraying it back into the vineyard (48.1%, Table 45).

Table 42: Storage of pesticides for NY grape crop in 1993

Storage location	# of responses	% of records
Locked storage facility	83	60.1
Barn/tool shed	19	13.8
Open storage facility	13	9.4
Garage	7	5.1
Only buy what is needed, do not store	5	3.6
Not specified	4	2.9
Locked storage facility and basement of home	3	2.2
Locked storage in barn/tool shed	2	1.4
Basement of home	1	0.7
Return unused to supplier, do no store	1	0.7

Table 43: Disposal of empty pesticide containers for NY grape crop in 1993

Method of disposal	# of responses	% of records
Burn	89	64.5
Landfill after triple rinsing	65	47.1
Recycle after triple rinsing	18	13.0
Bury	10	7.2
Return to pesticide manufacturer/dealer	4	2.9
Other[a/]	5	3.6

[a/]Other includes: "according to label", "landfill without rinsing" or no answer specified

Table 44: Disposal of unwanted/unused pesticides for NY grape crop in 1993

Method of disposal	# of responses	% of records
Carry over to next season	106	76.8
Return to pesticide manufacturer/dealer	31	22.5
Only buy as needed/ use up	15	10.9
Bury	8	5.8
Spray on non crop land areas	5	3.6
Not specified	4	2.9
Sell to other growers	3	2.2
Amnesty programs	3	2.2
Other[a/]	12	17.4

[a/]Other includes: "according to label", "spray on crop", "need help with unwanted material"

Table 45: Disposal of rinsate for NY grape crop in 1993

Method of rinsate disposal	# of records	% of records
Spray back into vineyard	66	48.1
Not specified	30	21.7
Dump on ground	11	8.0
Spray on non-crop field	8	5.8
Other[a/]	8	5.8
Spray on border rows	6	4.3
Burn	4	2.9
Do not know	3	2.2
Spray on crops	2	1.4

[a/] Other includes: "according to label", "burn and bury", "daily removal", "empty sprayer is filled with water and detergent and used to wash the equipment off", "landfill", "safely", "trash removal", "wash with water 3 times and dispose"

CONCLUSIONS

In 1979, Fluke, Marsh and Osteen conducted a grape production pesticide use survey in New York and Pennsylvania, covering 39,270 acres. Grape growers treated 95% of the vineyard acreage surveyed with pesticides; Finger Lakes growers treated 99% and growers in Pennsylvania and Western New York treated 93% (Fluke, Marsh and Osteen, 1982). In 1993, growers treated an average of 68% of vineyard acreage surveyed; Finger Lakes growers treated an average of 61%, Western New York growers treated an average of 73% and growers on Long Island treated an average of 85% with pesticides. This is a considerable reduction since 1979, especially in the Finger Lakes. On average, in 1979, each grower applied 10.6 lbs (AI) of pesticides per acre; in 1993 that number decreased to 8.4 lbs AI/A.

In 1979, approximately 38% of acre-treatments were mixes of fungicides and insecticides. Applications of tank mixes dropped considerably in 1993, where only 5% of acre-treatments were mixes. This shows that growers are more aware of integrated pest management (IPM) practices, as IPM is trying to separate insecticide and fungicide applications. In Western New York where 8.4% of acre-treatments were tank mixes, grape berry moth phenology used was to time pesticide applications. With IPM, the prebloom spray is eliminated, and future sprays are dependent on risk and scouting, allowing fungicides to be sprayed on a preventive basis (at 3 inch shoot growth), rather than corrective basis. In the Finger Lakes region, where only 3.4% of acre-treatments were tank mixes, diseases are more of a concern and growers used to routinely add an insecticide with their fungicide applications. With IPM, insecticide applications should be based on both risk assessment and scouting. The sharp decrease in tank mix applications in both areas indicates grower acceptance of IPM practices.

As in 1979, fungicides were the most used group of pesticides. Benomyl, captan and folpet were most widely used in 1979, while mancozeb, myclobutanil and sulfur were most common in 1993. That 78,000 lbs of captan were applied in 1979, and only 5,100 lbs were applied in 1993 is indicative of the fact that many processors discourage the use of captan. As in 1979, the primary diseases were black rot and powdery mildew.

Insecticide applications in 1979 consisted most commonly of carbaryl and parathion, but there were at least ten different insecticide active ingredients used. In 1993, carbaryl was used most often, but there were only six different AIs used. The primary pests are still grape berry moth and leafhopper. Herbicide use has remained the same, with diuron being used most often.

Data collection from 1987-1989 on 1,660 acres of grapes in New York showed that fungicides accounted for 63% of total pesticide use, insecticides accounted for 22% and herbicides accounted for 15% (Long Range Plan for Grapes). In 1993, fungicides accounted for 74 %, insecticides for 6% and herbicides for 20%. This is consistent with national trends observed by the National Center for Food and Agricultural Policy (Gianessi and Anderson). It has been estimated that IPM techniques for grapes can reduce insecticide use by 50-70%. Since insecticide use as a percent of total pesticide use decreased by 75% since 1989, it is apparent that New York growers are using IPM techniques, at least for insect control.

In 1979, spray schedules determined pesticide use on 91.5% of vineyard acres (Fluke, Marsh and Osteen, 1982), while in 1993 spray schedules determined only 54.8% of pesticide use. As was evidenced by comments stated previously, many of the schedules took IPM practices and presence of pest into account. In addition, only 3% of vineyard acres were under an IPM program in 1979 versus 20% in 1993.

For cultural weed control, 95% of vineyard acreage was mowed in order to chop prunings and control growth between rows in 1979. In 1993, 85% was mowed. This is

also consistent with IPM practices. IPM is trying to move away from mowing because it is not as cost effective or as good at reducing competition as a low volume application of Roundup. Use of propane weed burners in the row can be as effective for newly emerged weed seedling control as paraquat if undertaken at the proper time and under optimum conditions (Pool 1992-1993). Use of propane burners could greatly reduce the need for mechanical cultivation, reduce the negative impacts of cultivation and improve the overall weed control program without affecting grape yields. The propane weed burner is still in the research/demonstration stage, and has not yet been made available to growers.

The use of cover crops and/or cultivation for between the row weed control has been shown to be effective against weeds, but have been associated with low yield components, while mulch tends to increase cluster and berry weights (Pool, 1992-1993). Cover crops and mulching were both used by 18% of growers surveyed on 24% and 39% of vineyard acreage, respectively. Cultivation was used by 54% of growers on 60% of the acreage. However, growers surveyed who used mulch reported an average yield of 4.4 tons/acre while those who cultivated and/or used cover crops reported an average yield of 4.8 tons/acre.

It is estimated that yield per acre in New York would decrease by 59% with no pesticide use and 21% if pesticide applications were decreased by one-half (Knutson, 1993). Because of the greater presence of diseased berries, hand harvesting would be necessary to select disease-free clusters of Concord grapes for processing. Estimated costs without the use of pesticides would thus increase markedly by about $150 per acre. According to Knutson, with zero pesticide use, the estimated cash cost per pound for Concord grapes would increase from $0.08 per pound to $0.192. However, with a 50% reduction in application, the cash cost would increase from $0.08 per pound to only $0.094.

Without herbicides, yields would be reduced by an estimated 12%, while cost per acre would increase by approximately $100 (Knutson, 1993). Under 50% herbicide reduction, yields would decrease by 5% while costs would increase by $50 per acre. According to Knutson, without fungicides, there would be a 37 percent reduction in yield, while decreasing fungicide use by one-half would reduce yield by 12%. Without the use of insecticides, yields would decrease by 10% and reducing insecticide applications by one-half would cause a yield loss of 4 percent.

In this survey, only one grower did not use pesticides in 1993. This grower reported yield of juice grapes at 4 tons/acre, a 20% reduction from the average reported yield for all growers surveyed. Eleven growers did not use herbicides; they reported an average yield of 4.5 tons/acre (10% reduction). All growers, other than the one who did not use pesticides, reported using a fungicide (includes fungicides in tank mixes). Twenty-two growers indicated insecticides were not used in 1993. These growers reported an average yield of 4.9 tons/acre: no change from those who used insecticides. Many variables are associated with yield (i.e. cultural practices, cropping histrory, climate, etc.), thus comparisons made of yields of growers not using pesticides must be assessed with that in mind.

SECTION TWO:

USE AND CARE OF PERSONAL PROTECTIVE EQUIPMENT

INTRODUCTION

Many pesticide handlers are unaware of the hazards of pesticide exposure, and uninformed about the type of personal protective equipment (PPE) that should be worn. The health risks for these workers extend beyond the workplace when pesticide-contaminated clothing is worn into the home, or when it is washed with the family laundry. With the advent of the Environmental Protection Agency's (EPA) revised Worker Protection Standard (WPS), due to go into complete effect January 1, 1995, it is important to assess growers' current practices and attitudes regarding work clothing and PPE for pesticide applications.

Growers' attitudes toward protection have the greatest influence on behavior (Stone, et. al., 1989). Those who hold the highest protection beliefs are most likely to take action when (or before) WPS goes into complete effect. This report contains current practices and attitudes held by grape growers/employees in New York State. This information should aid researchers, extension specialists and clothing/equipment manufacturers in evaluating grower concerns and practices regarding PPE for educational and manufacturing purposes. Financial assistance for this portion of this project was also received from the USDA-ES Regional Project NC-170.

OBJECTIVES

To obtain the following information for grape growers in New York State:

A. Frequency of use of work clothing
B. Frequency of use of PPE
C. Material of outer clothing
D. Use of PPE when mixing pesticides
E. Laundering
    1. Length of time outer clothing is worn
    2. Facilities
    3. Procedures
F. Frequency of replacement of work clothing
G. Limited-use or disposable garments
    1. Length of time worn
    2. Disposal method
H. Storage of PPE
I. Frequency of replacement of chemically resistant gloves
J. Label requirements (for PPE)
    1. Are they met?
    2. If "no", why not?
K. Resources to learn about PPE
L. Proportion of applications made from enclosed cab
M. Acute or short term symptoms associated with overexposure to pesticides
    1. Frequency of occurrence
    2. Was medical help sought?
    3. Did particular products cause these?
N. Chronic or long-term health problems
O. Applicator training programs
    1. Sponsors
    2. Grower/employee preferences

All of the above are discussed (where applicable) with pesticides used from section one.

PROJECT DESIGN, IMPLEMENTATION AND ANALYSIS

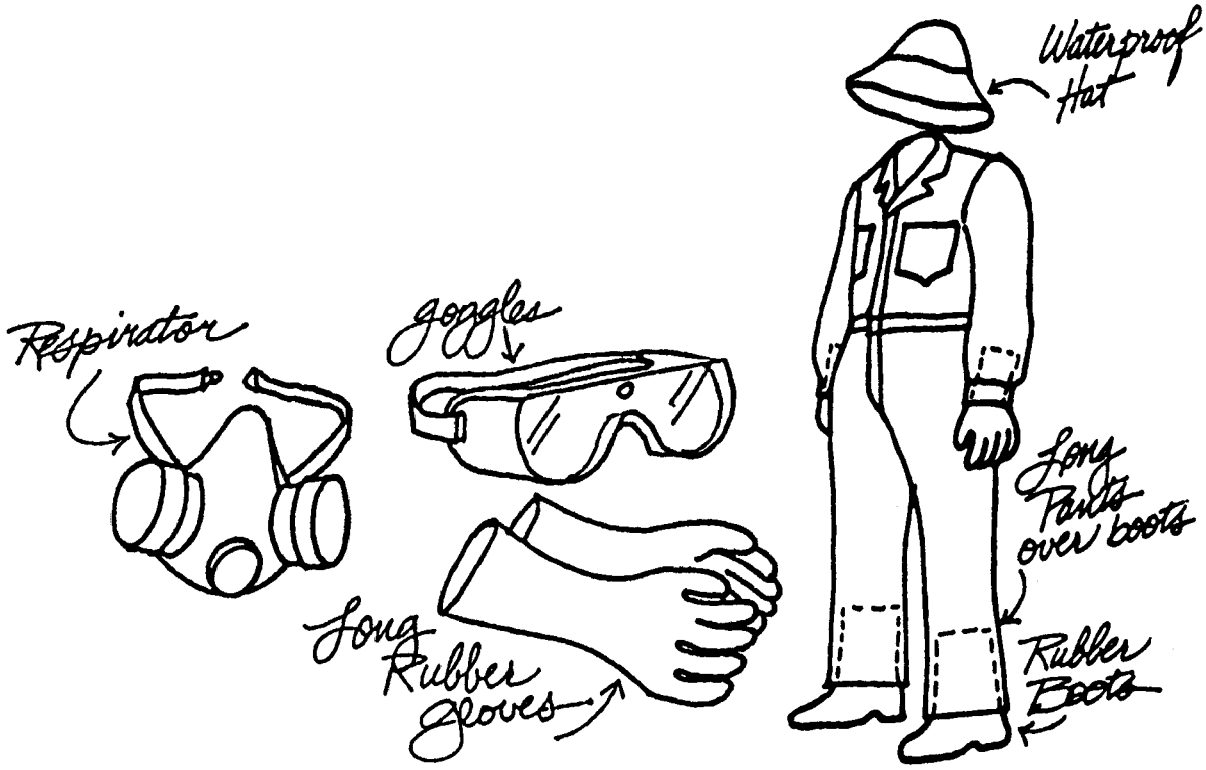
The survey was adapted from previous PPE surveys conducted in other states (Stone, et al., 1989 and Stone, et al., 1992). The first drafts were reviewed by grape specialists, textiles and apparel specialists, and others for content and accuracy. A copy of the final survey form can be found in the appendix.

The survey was implemented at the same time as the pest and pesticide use survey described previously. All surveys were coded so they could be identified with the pesticide use surveys. Employees who filled out a clothing survey may not have filled out a pest and pesticide use survey if their employer or other employees had already completed one. Therefore, there are more clothing survey results than pest and pesticide use survey results, but they all encompass the same number of vineyards. In this section, the term "grower" can mean grower or employee.

Certain words and/or terms used throughout this paper are defined below:

- Work clothing - Garments growers have in their closet for everyday wear. They might be worn for pesticide work if the label does not require any special protection, they might be required by the label, or they might be worn under a protective garment.
- Personal protective equipment (PPE) - Garments that are worn specifically to protect from pesticides or pesticide residues.
- Coveralls - One or two-piece garment that covers, at a minimum, the entire body except the hands, feet, and head.
- Woven coveralls - Coveralls made of woven fabric of cotton or cotton/polyester and worn as the outer garment, but **not** over work clothes.
- Woven coveralls over work clothes - Cotton or cotton/polyester coveralls worn as the outer garment, but **over other** work clothes.
- Insulated coveralls - Padded coveralls for warmth.
- Nonwoven coveralls (limited-use or disposable) - Coveralls made from fabric that is made by bonding fibrous webs. Examples are: Tyvek®, Kleenguard®, and Comfort Gard ®
- Chemically-resistant coveralls - One or two-piece coveralls of plastic or rubber, or of fabrics coated with plastic or rubber. Examples are: PVC, Saranex-coated, Tyvek, or rainsuits which are nylon fabric with PVC coating.
- Barrier laminate - Lightweight laminate that resists permeation from a wide range of chemicals. Examples are: Silver Shield® and 4-H®.

Results and Discussion



WORK CLOTHING AND PERSONAL PROTECTIVE EQUIPMENT

One hundred and forty-nine growers completed surveys corresponding to the 137 surveys on pest and pesticide use assessment. At least three quarters of the grape growers "nearly always" wore an undershirt/T-shirt, undershorts/long johns, jeans/work trousers, socks and leather shoes when working with pesticides (Table 46). Exposure to pesticides through the skin decreases with more layers of clothing. Most growers wore undershirts and undershorts. Just over half reported "nearly always" wearing a long-sleeve shirt, while 32% wore one "occasionally, depending on the weather", and 11% indicated it "depended on the pesticide" that they were using. Work coats or jackets were worn "occasionally depending on the weather" (68.2%).

Table 46: Frequency of use of work clothes by NY grape growers when working with pesticides

	Nearly always wear		Wear occasionally: weather dependent		Wear occasionally: pesticide dependent		Rarely or never wear		Not specified	
Type of clothing	# of resp.	% of growers	# of resp.	% of growers	# of resp.	% of growers	# of resp.	% of growers	# of resp.	% of growers
Undershirt/T-shirt	112	75.7	22	14.9	0	0.0	12	8.1	2	1.4
Undershorts/long johns	115	77.7	20	13.5	0	0.0	9	6.1	3	2.0
Jeans/Work trousers	144	97.3	3	2.0	0	0.0	1	0.7	0	0.0
Overalls	14	9.5	61	41.2	9	6.1	47	31.8	18	12.2
Long-sleeved shirt	82	55.4	48	32.4	16	10.8	3	2.0	2	1.4
Short-sleeved shirt	22	14.9	55	37.2	11	7.4	34	23.0	27	18.2
Baseball-style cap	103	69.6	11	7.4	4	2.7	22	14.9	8	5.4
Straw hat	5	3.4	16	10.8	0	0.0	100	67.6	28	18.9
Socks	144	97.3	1	0.7	0	0.0	0	0.0	4	2.7
Leather shoes	121	81.8	14	9.5	1	0.7	6	4.1	7	4.7
Canvas shoes	7	4.7	23	15.5	3	2.0	91	61.5	26	17.6
Woven coveralls	12	8.1	50	33.8	17	11.5	53	35.8	18	12.2
Insulated coveralls	1	0.7	66	44.6	3	3.0	52	35.1	27	18.2
Work coat or jacket	12	8.1	101	68.2	4	2.7	13	8.8	29	19.6
Cotton/canvas gloves	16	10.8	57	38.5	14	9.5	41	27.7	20	13.5
Leather gloves	23	15.5	61	41.2	10	6.8	36	24.3	19	12.8
Wide brimmed canvas hat	1	0.7								
Earmuffs	1	0.7								

Leather shoes were "nearly always" worn by 81.8% of growers. Although leather may resist dust penetration, dust can sift into the inside, spray can be absorbed, and decontamination is a problem. The same is true of leather gloves, which were worn "nearly always" by 15.5% of growers, and occasionally, depending on the weather by 68.2%. Baseball-style caps (worn "nearly always" by 69.6% of growers) may keep the sun out of the eyes, and allow ventilation, but they do not provide a good barrier to pesticides. In addition, contaminated caps can be a source of continued exposure as they are worn for many occasions, but rarely washed. Straw hats were "rarely or never worn" (67.6%).

Exposure studies have shown hands to be the area of greatest exposure (Lavy, et al., 1983). The use of chemically-resistant gloves will reduce this exposure. Sixty-two percent of growers reported "nearly always" wearing chemically-resistant gloves, and 29.7% wore them "occasionally depending on the pesticide" (Table 47). Of the growers who wore chemically-resistant gloves "depending on the weather", "rarely or never", or indicated they were "unnecessary for the kinds of pesticides they applied", 30% used Gramoxone Extra and/or Dithane, and 35% used Mancozeb, wettable sulfur, captan and/or Rubigan. These pesticides specifically state on the label to wear chemically-resistant gloves.

Table 47: Frequency of use of protective equipment by NY grape growers when working with pesticides

Type of equipment	Nearly always wear		Wear occasionally: weather dependent		Wear occasionally: pesticide dependent		Rarely or never wear		Unecessary for kinds of pesticides I apply	
	# of resp.	% of growers	# of resp.	% of growers	# of resp.	% of growers	# of resp.	% of growers	# of resp.	% of growers
Chem.-resistant gloves	91	61.5	6	4.1	44	29.7	6	4.1	2	1.4
Rubber boots	42	28.4	30	20.3	40	27.0	23	15.5	2	1.4
Woven coveralls over work clothes	16	10.8	44	29.7	20	13.5	46	31.1	5	3.4
Nonwoven coveralls (limited use or disposable)	23	15.5	6	4.1	20	13.5	68	45.9	10	6.8
Chemical-resistant (laminated) coveralls	31	20.9	4	2.7	28	18.9	58	39.2	13	8.8
Chem.-resistant apron	8	5.4	3	2.0	19	12.8	80	54.1	14	9.5
Plastic/rubber hat	12	8.1	1	0.7	25	16.9	81	54.7	15	10.1
Hard hat	3	2.0	3	2.0	4	2.7	99	66.9	19	12.8
Chemical cartridge respirator	68	45.9	4	2.7	43	29.1	18	12.2	9	6.1
Dust/mist respirator	28	18.9	6	4.1	19	12.8	67	45.3	13	8.8
Goggles	22	14.9	11	7.4	42	28.4	47	31.8	7	4.7
Safety glasses	53	35.8	5	3.4	15	10.1	59	39.9	7	4.7
Face shield	7	4.7	5	3.4	23	15.5	76	51.4	16	10.8
Power air purifying helmet	1	0.7								
Eye glasses	1	0.7								

Chemical cartridge, or dust/mist respirators were "nearly always" worn by 64.8% of the growers, and goggles, safety glasses, or a face shield were "nearly always" worn by 56.4% of growers. This is consistent with usage of chemicals requiring this type of protection. For example, Roundup, which requires goggles, face shield or safety glasses, was used by 61% of growers. All other chemicals requiring this protection were used by less than 61% of growers.

Rubber boots were "nearly always" worn by one-third of the growers, while another third wore them "occasionally depending on the pesticide." Twenty percent of the remaining growers used Gramoxone Extra, which requires the use of waterproof footwear. Almost all of the growers either "nearly always" wore, or wore "occasionally depending on the pesticide", some form of coverall (i.e. woven over work clothes, limited-use or disposable, or chemically resistant). The material of outer clothing worn most often by grape growers was cotton/polyester blend (31.5%), followed by water-proof rubber/plastic (27.5%, Table 48).

Table 48: Material of outer clothing most often worn by NY grape growers

Material	# of growers	% of growers
Cotton/polyester blend	47	31.5
Water-proof rubber/plastic (rain gear)	41	27.5
Limited-use or disposable (Tyvek, Comfort-Gard, Kleenguard)	33	22.1
Cotton	23	15.4
Not specified	3	2.0
Do not know	2	1.3

The labels of many of the pesticides used by grape growers state that certain PPE must be worn when mixing or loading the concentrated product. Figure 16 shows what protective equipment was worn by growers when mixing pesticides, and what percent of growers used chemicals that require that equipment.

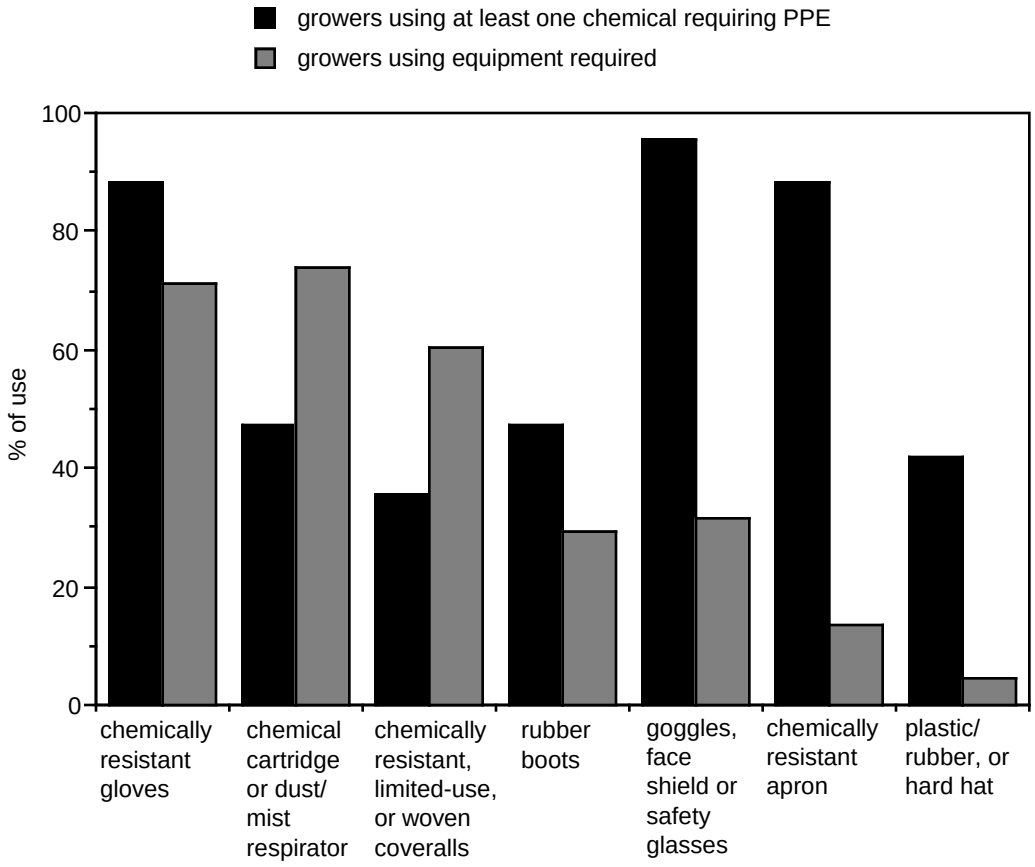


Figure 16: NY growers using PPE versus growers using chemicals requiring PPE

In almost all cases, the percent of growers that wore the protective equipment was less than the percent of growers who used chemicals that require the equipment. For example, 47.3% of growers used at least one chemical where the label states that waterproof shoe coverings are required when mixing or loading. However, only 29.5% of growers indicated they wore rubber boots when mixing pesticides. The two exceptions to this were chemical cartridge, or dust/mist respirator, and chemically-resistant, limited-use/disposable, or woven (over work clothes) coveralls. In both cases, almost twice as many growers used the equipment as used the chemicals requiring the equipment.

In addition to the protective equipment listed in the survey, growers indicated that they wore a long-sleeved shirt (6.0% of growers), jeans and leather boots (both 3.4%), cotton gloves (2.7%), socks (2.0%), undershirt (1.3%), overalls, shoes and leather gloves (all 0.7%) when mixing pesticides. Not only are these items not considered protective equipment by EPA, but some - such as leather boots/gloves - create pesticide decontamination problems. Some growers may have been confused by terminology because, although long-sleeved shirts and jeans are considered to be work clothing (not PPE), some labels do require their use. Four growers indicated they wore no protective equipment when mixing even though three of them used Gramoxone Extra (very restrictive on PPE), and three used mancozeb (chemical-resistant gloves and apron, and goggles or a face shield required).

The Gramoxone Extra label reads:

When pouring, loading, or mixing concentrate, wear:
• NIOSH/MSHA approved pesticide respirator
• Disposable suit/coveralls or long-sleeved shirt and pants
• Full face shield
• Mid-forearm waterproof gloves
• Waterproof apron and footwear

Table 49 shows what PPE was worn by growers when mixing Gramoxone Extra. At best, 73.1% of growers are in compliance with at least one item on the label (chemical cartridge respirator). Only 3.8% wore a face shield, but up to 68.3% may have used a full-face respirator instead. No PPE was worn by 5.8% when mixing.

Table 49: Protective equipment worn when mixing pesticides by NY grape growers who used Gramoxone Extra (52 records)

Protective equipment	# of growers	% of growers
Chemical cartridge, or dust/mist respirator	38	73.1
Chemically resistant gloves	32	61.5
Chemically resistant or nonwoven coveralls, or coveralls worn over work clothes	31	59.6
Rubber boots	16	30.8
Chemically resistant apron	8	15.4
Goggles	7	13.5
None	3	5.8
Face shield	2	3.8
Plastic/rubber hat	2	3.8

LAUNDERING

Proper management of clothing worn while working with pesticides can help to minimize pesticide exposure. According to the Department of Textiles and Apparel, the following rules should be used when washing clothing worn while applying pesticides:

- All clothing worn while handling or applying pesticides is contaminated
- Wear **chemical-resistant gloves** when handling highly contaminated clothing, wash hands immediately after handling others.
- Wash clothing daily
- Hang garment **outdoors** to dry
- Prerinse or presoak
- Pretreat heavily soiled garments
- Wash **separately** from family wash
- Wash only a few items at a time
- Use highest water level
- Use **hot** water
- Use longest wash time
- Use heavy-duty detergent
- **Line dry** to avoid contaminating dryer
- After washing - run machine through a complete cycle with detergent.
- Rewash contaminated garments **two or three times** before reuse for more complete pesticide removal

Table 50 shows the number of hours grape growers wore refurbishable work clothing before laundering. Although there were many answers to this question, it appears that at least 90% of the growers washed their work clothing daily, as recommended.

Eighty-six percent of growers use the family washer, but wash contaminated clothing separately from family laundry (Table 51). Table 52 shows the steps taken to launder clothes worn when working with pesticides. Forty-one percent presoaked or prerinsed, 77.9% washed in hot or warm water and 58.4% line-dried their clothing outdoors. A commendable 24.2% recognized that washing more than once before line-drying removed more pesticides. Several growers indicated that they took no special steps because they used Tyvek, or a rainsuit over their clothes. Between 10 and 20% of growers did not answer one or more of these questions. It is impossible to know whether they did not answer because they did not do that procedure, or because they did not know whether or not it was done.

Table 50: Number of hours NY grape growers wore refurbishable work clothes before laundering

Number of hours	# of growers	% of growers
One	1	0.7
Two	2	1.3
Two and one half	1	0.7
Three	4	2.7
Four	4	2.7
Four and one half	2	1.3
Five	4	2.7
Six	10	6.7
Seven	8	5.4
Seven and one half	1	0.7
Eight	66	44.3
Nine	8	5.4
Ten	4	2.7
Eleven	1	0.7
Twelve	5	3.4
Fourteen	1	0.7
Sixteen	4	2.7
Eighteen	1	0.7
Twenty-four	2	1.3
Thirty-two	1	0.7
Not specified	10	6.7
Launder after each spray	3	2.0
Do not know	2	1.3
Depends on materials and exposure	2	1.3
One day	2	1.3
Average number of hours:	**8.3**	

Table 51: Facilities used by NY grape growers to launder clothes that were worn when working with pesticides

Facility	# of responses	% of growers
Family washer, but in a **separate** load from family clothes	128	85.9
Family washer **with** family clothes	9	6.0
Grower's special facilities reserved for laundry of pesticide-soiled clothing	7	4.7
Coin operated laundromat	4	2.7
Not specified	4	2.7
Do not know	3	2.0
A commercial laundry service	2	1.3
Hose suit off with garden hose, then scrub it	1	0.7

Table 52: Frequency of steps taken by NY grape growers to launder clothes that were worn when working with pesticides

	Yes		No		Do not know	
Laundering step	# of resp.	% of growers	# of resp.	% of growers	# of resp.	% of growers
Presoak or rinse before washing with detergent	61	40.9	48	32.2	11	7.4
Wash in hot or warm rather than cold	116	77.9	9	6.0	10	6.7
Wash more than once before drying	36	24.2	69	46.3	13	8.7
Line-dry outdoors	87	58.4	36	24.2	8	5.4

REPLACEMENT OF WORK CLOTHING AND DISPOSABLE GARMENTS

Replacement of work clothing occurred most often when the clothing wore out (75.8%, Table 53). One-quarter of the growers gave more than one answer to this question. These were usually combined with "if contaminated by pesticide spill."

Table 53: Frequency of replacement of work clothing by NY grape growers

Replacement frequency	# of responses	% of growers
When it wears out	113	75.8
If contaminated by pesticide spill	46	30.9
Annually	18	12.1
Seasonally	15	10.1
Not specified	5	3.4
As required/needed	3	2.0
Two times a year	2	1.3
Depends on article	1	0.7
Do not know	1	0.7

Of the 70 growers who indicated they used disposable garments, one-third discarded them after eight hours (Table 54). However, the average length of time disposable garments were worn before discarding was 17.4 hours, which indicates that growers removed them after spraying, stored them, and reused them. One grower indicated that he/she wore them as long as 200 hours. According to the EPA, the U.S. Department of Agriculture - Extension Service (USDA-ES) and PPE manufacturers, nonwoven (limited-use or disposable) coveralls are designed to be disposed of after use. Most are intended to be worn for only one workday's exposure period (8 hours). The instructions for some coated nonwoven suits may permit them to be worn more than once if each period of use is short, if the inside of the garment is not contaminated, and they do not get much pesticide on them.

Table 54: Number of hours NY grape growers wear disposable garments before discarding

Number of hours	# of growers	% of growers who wear disposable garments
Two	2	2.9
Four	3	4.3
Five	2	2.9
Six	3	4.3
Seven	1	1.4
Eight	23	32.9
Eight and one half	1	1.4
Nine	2	2.9
Ten	3	4.3
Eleven	1	1.4
Twelve	6	8.6
Thirteen	1	1.4
Sixteen	1	1.4
Twenty	2	2.9
Twenty-four	2	2.9
Thirty-two	1	1.4
Forty	1	1.4
Forty-eight	2	2.9
Sixty	2	2.9
Eighty	1	1.4
Two hundred	1	1.4
One day	4	5.7
Every day that we spray	2	2.9
Until they wear out	2	2.9
Do not know	1	1.4
Average number of hours:	**17.4**	

Over half of the growers who wore disposable garments, burned them (Table 55). One-third sent them to the landfill. Many of those who used the landfill also indicated that they rinsed the garment three times, and sealed it in a plastic bag first.

Table 55: How NY grape growers discard of disposable garments (70 records)

Method of disposal	# of growers	% of growers who wear disposable garments
Burn	36	51.4
Landfill	24	34.3
Not specified	5	7.1
Burn or landfill	3	4.3
Bury	1	1.4
According to pesticide label	1	1.4

STORAGE OF PPE AND REPLACEMENT OF CHEMICALLY-RESISTANT GLOVES

Respirators and eyewear should be stored where they are protected from dust, sunlight, extreme temperatures, excessive moisture, pesticides and other chemicals. A zip-closable sturdy plastic bag works well for storage (EPA, USDA-ES pamphlets). Only one grower indicated that protective equipment was stored in plastic bags (Table 56). However, that was not one of the choices for the question, so others may have stored them in plastic bags within the area(s) indicated. Approximately one-quarter of the growers stored protective equipment in a pesticide storage area. As stated previously, PPE should be stored away from pesticides.

Table 56: Where protective equipment is stored by NY grape growers between wearings

Storage facility	# of responses	% of growers
In pesticide storage area	35	23.5
In dressing/changing area with no shower	33	22.1
At home	28	18.8
With other clothing items at work	28	18.8
Barn/shop	16	10.7
Storage area away from clothing and pesticides	7	4.7
In dressing/changing area with a shower	6	4.0
Not specified	6	4.0
In vehicle	5	3.4
In plastic bags	1	0.7
In a locked cabinet	1	0.7

Chemically-resistant (reusable) gloves should be inspected before use for signs of wear or abrasion (EPA, USDA-ES pamphlets). If they show any sign of wear, they should be discarded. Even if there are no signs of wear, reusable chemically-resistant gloves should be replaced regularly since residues that cannot be detected may remain in the material even after washing and adequate airing. A good rule of thumb is to dispose of gloves that have been worn for about one week of work. Because hand protection is the most important concern for pesticide handlers, glove replacement is a high priority. Over half of the growers replaced chemically-resistant gloves "when a leak was detectable" and/or they appeared worn out (Table 57). About 15% of growers gave two answers to this question: "seasonally", and "when a leak is detectable". It appears that growers are not replacing their gloves often enough, as only 3.4% indicated replacing them weekly.

Table 57: Frequency of replacement of chemically-resistant gloves by NY grape growers

Replacement frequency	# of responses	% of growers
When a leak is detectable/appear worn out	89	59.7
Seasonally	63	42.3
Do not wear chemically-resistant gloves	12	8.1
Monthly	9	6.0
Weekly	5	3.4
With each use/spray	4	2.7
Not specified	4	2.7
Every 2-3 years	1	0.7
Have not replaced yet	1	0.7

LABEL REQUIREMENTS FOR CLOTHING AND PPE, USE OF ENCLOSED VEHICLES, AND EDUCATIONAL RESOURCES

Growers were asked if they wore the minimum protective equipment as required on the pesticide label. Table 58 illustrates the results found. Sixty-eight percent (101 growers) indicated that they either met, or exceeded label requirements. However, a large percentage of these growers indicated that many protective equipment items were either "rarely or never worn", or "unnecessary for the types of pesticides they applied" (Table 59). For example, 57 of these growers used Roundup, which requires the use of goggles, face shield or safety glasses, but an average of 49% of those who used Roundup indicated they either "rarely or never" wore these items, or they were "unnecessary for the types of pesticides they applied." However, 54% "nearly always" wore a chemical cartridge respirator, which may have been a full-face respirator, and 39% made "more than two-thirds" to "essentially all" pesticide applications from an enclosed vehicle. Similarly, 34 growers used Gramoxone Extra (face shield and chemically-resistant apron required), but 55% did not use a face shield, and 53% did not use an apron. Again, 59% "nearly always" wore a chemical cartridge respirator, and 41% made "more than two-thirds" or "essentially all" pesticide applications from an enclosed vehicle.

Table 58: Protective equipment worn by NY grape growers as required on the pesticide label

Label requirements met	# of responses	% of growers
Yes, MORE THAN minimum requirements	53	35.6
Yes, minimum requirements	48	32.2
Mostly, but not always	34	22.8
Often not	7	4.7
Do not know	4	2.7
Not specified	3	2.0

Table 59: Protective equipment rarely or never worn, or considered unnecessary by NY grape growers who indicated they wore minimum or exceeded minimum requirements on pesticide labels

Type of clothing	Rarely or never wear % of growers	Unnecessary for kinds of pesticides I apply % of growers
Chemically-resistant gloves	1.0	2.0
Rubber boots	10.0	1.0
Woven coveralls over work clothes	33.0	5.0
Nonwoven coveralls (limited use or disposable)	40.0	9.0
Chemically-resistant (laminated) coveralls	29.0	11.0
Chemically-resistant apron	44.0	11.0
Plastic/rubber hat	48.0	12.0
Hard hat	63.0	15.0
Chemical cartridge respirator	5.0	9.0
Dust/mist respirator	41.0	13.0
Goggles	29.0	6.0
Safety glasses	30.0	6.0
Face shield	45.0	14.0

The remaining 48 growers, who did not always wear minimum label requirements, indicated that the reason was primarily because protective equipment is too hot (64.6%, Table 60). Many indicated that the trouble of using protective equipment prompted them to purchase tractors with enclosed cabs. Research has shown that dermal exposure to the applicator in an enclosed tractor cab during ground boom application is one-sixth the exposure to the applicator conducting similar operations with an open tractor cab (Lunchick, et al, 1988). This same research showed exposure to be thirtyfold less when airblast applications were made in enclosed vehicles versus open vehicles. Twenty-eight percent of growers made "essentially all" of their pesticide applications from an enclosed cab (Table 61). However, they did not indicate whether or not they kept required equipment in the cab as directed on labels.

Table 60: Reasons why protective equipment worn by NY grape growers does NOT meet minimum requirements (48 records)

Reason	# of responses	% of growers who do not meet label requirements
Protective equipment is too hot	31	64.6
Protective equipment restricts movements	10	20.8
Not specified	6	12.5
Minimum requirements are too strict	5	10.4
Protective equipment is too expensive	4	8.3
Use a spray-safe cab	4	8.3
Protective equipment is uncomfortable	1	2.0
It is unnecessary for chemicals I use	1	2.0
Not always sure of requirements	1	2.0
Do not use any protective equipment	1	2.0

Table 61: Proportion of pesticide applications made from an enclosed vehicle in 1993

Proportion of pesticide applications	# of growers	% of growers
None	89	59.7
Essentially all	41	27.5
More than two-thirds	11	7.4
One-third to two-thirds	3	2.0
Less than one-third	2	1.3
Not specified	3	2.0

Many growers who indicated they met or exceeded label requirements also felt compelled to answer the question about reasons why they may not always wear protective equipment. Sixty-nine percent said it was too hot, 17% said requirements were too strict, 10% indicated protective equipment restricted their movements, and 7% said it was too expensive.

When asked what three resources grape growers would most likely use to learn about protective equipment, they chose "fact sheets" (67.1%), "exhibit" (47.7%) and "kit of sample protective equipment" (41.6%, Table 62).

Table 62: Resources NY grape growers would most likely use to learn about protective equipment

Resource	# of responses	% of growers
Fact sheets	100	67.1
Exhibit	71	47.7
Kit of sample protective equipment	62	41.6
PAT manual	44	29.5
Videotape	34	22.8
Telephone hot line	20	13.4
Media (TV, radio, newspaper)	17	11.4
Slide set	6	4.0
Computer program	3	2.0

SHORT- AND LONG-TERM HEALTH PROBLEMS ASSOCIATED WITH OVEREXPOSURE TO PESTICIDES

There are many short-term or acute symptoms associated with overexposure to pesticides. The most common complaint was eye irritation (19.5%), followed by headache (18.1%, Table 63). However, very few short-term symptoms were experienced in 1993. An average of 94% of growers never experienced any of the 11 symptoms listed. Five of the growers indicated they had experienced some of the symptoms, but were more inclined to blame them on heat stress from protective equipment than overexposure to pesticides.

Table 63: Acute or short term symptoms associated with overexposure to pesticides felt to be related to handling or applying pesticides by grape growers in the past crop year

	Never		Once		2 to 3 times		4 to 5 times		5 times or more	
Symptom	# of resp.	% of growers	# of resp.	% of growers	# of resp.	% of growers	# of resp.	% of growers	# of resp.	% of growers
Excessive fatigue	140	94.0	4	2.7	5	3.4	0	0.0	0	0.0
Headache	122	81.9	10	6.7	16	10.7	1	0.7	0	0.0
Dizziness	144	96.6	4	2.7	1	0.7	0	0.0	0	0.0
Eye irritation	120	80.5	11	7.4	12	8.1	2	1.3	3	2.0
Skin irritation	133	89.3	8	5.4	7	4.7	0	0.0	2	1.3
Nausea	143	96.0	3	2.0	2	1.3	1	0.7	0	0.0
Diarrhea	148	99.3	0	0.0	0	0.0	1	0.7	0	0.0
General weakness	144	96.6	3	2.0	2	1.3	0	0.0	0	0.0
Chest discomfort	148	99.3	1	0.7	0	0.0	0	0.0	0	0.0
Heat fatigue	148	99.3	0	0.0	1	0.7	0	0.0	0	0.0
Allergic reactions	148	99.3	0	0.0	1	0.7	0	0.0	0	0.0

Of the 11 symptoms, medical help was sought by growers for only three. Table 64 shows that those symptoms were headache, dizziness and nausea. Only one of the growers who experienced each of these symptoms sought medical attention.

Table 64: Was medical attention sought for symptoms felt by NY grape growers in 1993?

	Yes	No
Symptom	% of growers experiencing symptoms	
Headache (n=27)	3.7	96.3
Dizziness (n=5)	20.0	80.0
Nausea (n=6)	16.7	83.3

When asked if any particular chemical caused these acute or short-term symptoms, 23.2% of growers who had experienced at least one symptom, one or more times, said "yes, a particular trade name caused this" (Table 65). Nine of those growers indicated that sulfur, alone or with some other chemical, caused the problem, basically because the fine powder can bother the eyes.

Table 65: NY grape growers who felt that a particular chemical pesticide caused acute or short term exposure symptoms

Caused by a particular pesticide?					
	# of responses	% of growers	Pesticide	# of growers	Why
No	41	73.2			
Yes	13	23.2			
			sulfur	7	burns eyes when it's hot
					improper fit of PPE
					sulfur stings the eyes
					the smell
					drift
					used all the time
					not specified
			sulfur and maneb/ mancozeb products	1	poor eye protection, and products are fine powders. Would be better if came encapsulated
			sulfur and ferbam	1	affects the eyes most of the time
			ferbam	1	burns skin
			parathion	1	not specified
			Bayleton	1	headache
			Guthion	1	do not know

When asked about chronic or long-term health problems, only one grower indicated that he/she felt his/her cancer was caused by overexposure to pesticides. On the other hand, two different growers made the following comments:

- "For years I have had a pre-season blood check as part of a normal health check-up - no evidence on cell count of spray effect."
- "No chronic or long-term problems, and I have been spraying for 40 years."

APPLICATOR TRAINING PROGRAMS

Grape growers indicated that the Extension service, followed by the chemical company/dealer was most likely to sponsor the educational programs they attended (89.3%, 61.1% respectively, Table 66). They also indicated that they prefer the training session format for pesticide training (63.1%, Table 67).

Table 66: Sponsors of applicator certification and continuing education programs attended by NY grape growers[a/]

	Yes		No		Do not recall	
Sponsor	**# of responses**	**% of growers**	**# of responses**	**% of growers**	**# of responses**	**% of growers**
Employer	20	13.4	123	82.6	1	0.7
Grape processors/buyers	37	24.8	104	69.8	3	2.0
Extension service	133	89.3	11	7.4	0	0.0
Chemical company/dealer	91	61.1	52	34.9	1	0.7
Grape grower's association	44	29.5	96	64.4	4	2.7

[a/]Five surveys gave no response at all to any of the above questions

Table 67: Educational format preferred by NY grape growers for pesticide training

Format	**# of responses**	**% of growers**
Training session	94	63.1
Self study	50	33.6
Study group	40	26.8
Conference	12	8.1
Satellite downlink	10	6.7

CONCLUSIONS

New York State grape growers appear to be wearing PPE when working with pesticides. However, many seem to wear what they think they need, rather than what is required on the pesticide label. Comparisons to other surveys are difficult due to the different climates, pesticides, crops, equipment, regional attitudes, etc., but some relationships between these data and those of a 1992 Iowa State University study (Stone, et.al., 1992) may be useful. The percent of New York grape growers "nearly always" wearing an undershirt, a long-sleeved shirt, and/or a work coat or jacket was approximately twice that of Iowa commercial agriculture applicators. The percent of NY grape growers "nearly always" wearing a chemical cartridge respirator was nine times that of Iowa applicators. However, 20% more Iowa respondents "nearly always" wore chemically resistant gloves, and 9% more wore goggles or a face shield (safety glasses were not in the Iowa survey). The latter statistic may be misleading as persons wearing full-face respirators would not need other eye protection.

New York growers, in general, seem to be following correct laundering procedures. Refurbishable clothing is laundered daily, separate from family clothing, prerinsed, washed in hot water, and line-dried. A relatively large percentage are even washing clothing more than once before drying. The Iowa study showed approximately the same results.

Disposable garments are being worn too long by approximately one-third of New York growers surveyed before they are being discarded; half of them are being burned. Although reusable PPE is being stored by 23.5% of New York growers in their pesticide storage area, it is a 15% decrease from Iowa, where 38% of applicators stored their PPE in a pesticide storage area. Also, in Iowa, 40% stored protective gear in their vehicle where it would be subject to extreme temperatures. Only 3% of New York growers used their vehicle as a storage area.

Replacement of chemically-resistant gloves by New York growers was infrequent. Only 3.4% replaced them weekly, as recommended, whereas 18% replaced them weekly in Iowa. It is possible though, that some growers spend no more than 40 hours (1 week equivalent) each growing season handling pesticides. Both Iowa applicators and New York growers replaced them when a leak was detectable with the same frequency.

Label compliance was reported at the same frequency in New York as in Iowa, but as discussed previously, it appears that New Yorkers falsely believe that they are meeting the requirements. As indicated by one of the growers, "I do not always know what the requirements are". Confusion exists as to location and exact meaning of PPE information on old labels. The revised WPS should correct this problem as new labels become available.

Grape growers demonstrated an interest in learning about protective equipment through tangible resources such as exhibits and kits of sample PPE. They attend programs sponsored by Extension, and prefer a training session format.

All short-term symptoms associated with overexposure to pesticides were felt at least once by at least one grape grower in New York. However, many times it was attributed more to heat stress than pesticides. All of the symptoms were experienced more often by Iowa applicators. In both New York and Iowa, very few respondents sought medical help for the symptoms.

It appears that New York grape growers are concerned about, and willing to comply with regulations related to the use and care of PPE. Unfortunately, many seem to be unformed or uncertain, confirming the need for good educational programs on PPE.

APPENDIX

REFERENCES

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