

# **Pesticide Use Survey in Ohio Nurseries**

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# Pesticide Use Survey in Ohio Nurseries<sup>1</sup>

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## INTRODUCTION

### Background

With the advent of the Rebuttable Presumption Against Registration (RPAR) system, an increasing demand arose for information on various facets of pesticide use in crop production, including the nursery industry.

Specialists working with the nursery industry had a general idea of which pesticides were available and recommended, but lacked solid data on those being used. Lack of sound information was common throughout the North Central Region and other regions in the United States.

The nursery industry in Ohio is large and typical with respect to the types of plants grown, principal pest problems, and kinds of pesticides available in this region. Pesticide use data from Ohio are applicable to this and nearby regions as well.

### Objectives

The overall objective of this effort was to obtain, by personal interview, accurate information on types of pesticides used by the nursery industry in Ohio.

The specific information on each pesticide desired included: 1) names of pesticides and their formulations used during 1977; 2) quantities used; 3) size of the area treated; 4) total number of times applied; 5) purpose for use, including site and pest when applicable; and 6) information relating to alternate controls.

The intent of the survey was to identify all pesticides Ohio nurserymen use to produce their crops, including chemical control of aquatic weeds in irrigation water and chemical preservatives used on wood propagating frames and benches.

## METHODS AND PROCEDURES

The survey was conducted by personal interviews with approximately 11% of the nurseries in Ohio. In 1977 Ohio had 1,238 nurseries consisting of 11,489 licensed acres. Those surveyed were

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TABLE 1.—Plant Types and Acreage in Production in Ohio Nurseries During 1978.

Plant Type	Acreage	Percent of Growers Producing Plants
Evergreens	6,573	57.2
Deciduous	4,624	40.2
Perennials	132	1.2
Fruit and Nut Trees	97	.8
Small Fruits	63	.6
TOTAL	11,489	100.0

selected at random from licensee lists published annually by the Ohio Department of Agriculture. Their lists indicate size and major stock produced.

Before selecting those to be surveyed, all licensed nurseries were organized into sub-lists according to the kind(s) of stock produced. The categories of plants grown, their acreage, and the percentage of Ohio growers producing these plants are summarized in Table 1.

Each sub-list was numbered consecutively. Working from random number tables, a sample was drawn from each sub-list proportionate to the number of nurseries in each category plus a few extras for use as substitutes. The selection procedures based on plant categories was employed because the types of plants grown at each nursery influenced pest control practices and choice of pesticides. A sample derived in this manner contained both large and small growers from all parts of Ohio and was proportionately representative of the plant diversity in the industry. The sample size totaled 137 nurseries. The plant types, number of growers selected in each category, and acreage they represent are summarized in Table 2.

The survey was conducted entirely through personal contact. A mail survey was considered, but rejected for the usual reasons, including insuf-

TABLE 2.—Plant Types and Acreage in Production in Ohio Nurseries Surveyed to Determine Pesticide Usage in 1977-78.

Plant Type	Number of Growers Surveyed	Acreage
Evergreens	58	1,185
Deciduous	49	1,725
Small Fruits	13	32
Perennials	9	44
Fruit and Nut Trees	8	35
	137 (11.0%)*	3,055 (26.6%)†

\*Represents 11% of Ohio nurserymen

†Represents 26.6% of Ohio nursery acreage

ficient returns, incomplete answers, misinterpreted questions, etc. The survey began in April 1978 and continued through October 1978. In addition to the authors, interviews were conducted by nursery inspectors of the Ohio Department of Agriculture.

In order to achieve consistency in conducting interviews and recording data, each of the nursery inspectors accompanied one of the principal investigators for 1 or 2 days prior to interviewing alone. At each nursery the interviewer met with the individual in the position of knowing which pesticides were used, as well as other pertinent information. Sometimes this person was the nursery owner/manager, or in the case of larger nurseries the person in charge of spraying and other quality-control practices.

Before starting the interview, the individual was assured that any information provided would not be used to incriminate him or the nursery, or to criticize their pest control practices. All sources were to remain anonymous. This policy was strictly followed. The fact that the survey was an effort to determine which pesticides were being used by the grower, regardless of whether they were legal or not, was emphasized.

During the interview the individual was asked to recall all compounds employed in furthering the production of their crop, including: insecticides, fungicides, herbicides, rodenticides, fumigants, molluscicides, animal repellents, wood preservatives, etc. For each compound named, he was asked the formulation used, the quantity applied, size of the area treated, number of applications made, application site(s), purpose of the treatment, and any information he could give relative to available substitutes. Data were recorded on mimeographed work sheets.

When a pesticide was applied directly to a plant to control or prevent infestation of pest organisms, the names of the plants treated and the target pest were recorded. Frequently this information was stated in general terms. The growers were asked what control measures they would turn to if the material they used was no longer available. Whenever an alternative pesticide was named, the grower was questioned as to its efficacy, cost, availability, and ease of application in relation to the material being replaced. In many instances, information on a substitute pesticide was lacking, and a grower would indicate that when the time came to select a pesticide substitute, he would consult an Extension bulletin and make a choice. This information was also recorded on the work sheet.

The nurserymen were asked whether the pesticides used were applied by their own personnel or a custom applicator. They were also asked the type

of spray equipment they owned and whether they had prescribed safety equipment, such as respirators, goggles, rubber suits, and gloves.

Interviews usually lasted 15-60 minutes, depending upon the size of the nursery and number of compounds used. Some growers answered the questions from memory; others referred to written spray records or scanned the pesticide storage area in order to recall what they had used. In many instances the interviewer needed to look up the formulation in a pesticide handbook or check the actual container to obtain accurate information.

The cooperation received was excellent. All nurserymen contacted agreed to participate in the survey. In a few instances the nursery owner could not be reached and so a substitute nursery was surveyed.

After the interviews were completed, summaries were formulated for each pesticide.

## RESULTS AND DISCUSSION

Results of the survey are presented in Table 3. Figures estimating the statewide use of each compound identified during the survey are presented in Tables 4-10. Totals are extrapolations from sample data, computed on the basis of sample sized relative to the percent of nurserymen in the sample (11%) as well as the percent of acreage represented in the survey (26%). This latter consideration is of obvious importance in projecting for total amounts used and for total area treated. The major uses of the compounds are also listed.

## COMMENTS AND OBSERVATIONS

Twelve of 137 growers surveyed indicated they had not used pesticides during 1977. Four of these had nurseries of 1 acre or less; others ranged from 2 to 30 acres.

A significant increase in pesticide use was evident among nurseries engaged in propagating at least a portion of their own stock. These nurseries tended to use a far greater number of pesticides than those doing no propagation. This was largely due to the increased use of fungicides in the propagating frames, beds, or benches to prevent root and stem rot. Propagating nurseries also tended to make more frequent applications of pesticides.

In many instances, nurserymen did not use the most effective, registered pesticides available for a given problem. They tended to rely on established, safer, broad-spectrum materials. Among those surveyed, 50% used four or fewer pesticidal products during 1977; the other half each used from 5 to 27 different compounds.

There did not appear to be a relationship between the number of compounds used and the size

of the nursery. The quantities of pesticides were somewhat less than expected by the authors. Many growers were simply practicing minimal chemical pest control.

Generally, records of pesticide application were inadequate. The vast majority of growers had no written spray records. Some kept a few notes, but these were often misplaced or lacked detailed information.

### RECOMMENDATIONS

The survey indicated a need for major effort to encourage growers to maintain accurate spray records. Inclusion of record charts on the back of

Cooperative Extension Service pest control bulletins would be helpful to the nurseryman.

Information summarized in this paper will soon be out of date. New materials become available and others are dropped for various reasons. Therefore, a similar survey should be conducted every 3 to 5 years. This can be most effectively accomplished through personal interviews, rather than by mail. The nursery inspection force of the Ohio Department of Agriculture should assist the Extension Specialist with these contacts. The survey should be made during October through December to facilitate more accurate recall of materials used and to avoid interference with the nurseryman during his busiest work periods.

**TABLE 3.—Results of a Survey to Determine the Pesticides, Formulations and Amount of Active Ingredient Used by Ohio Nurserymen During the 1977-78 Growing Season.**

Pesticide Name Common / Trade / Formulation	Type of Pesticide	Amount of Active Ingredient Used	No. of Growers Using Material
acephate (Orthene) 75% SP	I	40.5 lb	7
acephate (Orthene) 1.3 EC	I	9.1 lb	7
		49.6 lb	14
alachlor (Lasso II) 15% G	H	30.0 lb	1
alachlor (Lasso) 4 EC	H	286.0 lb	4
		316.0 lb	5
aldicarb (Temik) 15% G	I	0.15 lb	1
aldicarb (Temik) 10% G	I,N	18.6 lb	9
		18.75 lb	10
aminotriazole (Amitrole) 15% WP	H	1.95 lb	1
aminotriazole (Amitrole) 90% L	H	13.8 lb	3
aminotriazole (Amitrole) 1.33 EC	H	19.95 lb	1
		35.70 lb	4
amizine 1.33 EC	H	1.33 lb	1
amizine 95% WP	H	4.75 lb	1
		6.08 lb	2
anilazine (Dyrene) 50% WP	F	2.5 lb	2
atrazine (Aatrex) 80% WP	H	20.8 lb	2
azinphosmethyl (Guthion) 2 E	I	102.0 lb	2
azinphosmethyl (Guthion) 50% WP	I	32.0 lb	5
		134.0 lb	7
Bacillus thuringiensis (Dipel) 3.2%	I	5.0 lb	2
Bacillus thuringiensis (Thuricide) .8% L	I	½ pt	1
		5 lb, ½ pt	3
banrot 40% WP	F	20.7 lb	4
benomyl (Benlate) 50% WP	F	143.0 lb	27
cacodylic acid (Phytar 138) 2 EC	H	8.0 lb	1
cacodylic acid + sodium cacodylate (Phytar 560) 26.6% L	H	12.0 lb	2
captan 50% WP	F	359.0 lb	29

AR = Animal Repellent, B = Bactericide, F = Fungicide, FUM = Fumigant, H = Herbicide, I = Insecticide, M = Molluscicide, N = Nematicide, R = Rodenticide.

**TABLE 3 (continued).—Results of a Survey to Determine the Pesticides, Formulations and Amount of Active Ingredient Used by Ohio Nurserymen During the 1977-78 Growing Season.**

Pesticide Name Common / Trade / Formulation	Type of Pesticide	Amount of Active Ingredient Used	No. of Growers Using Material
carbaryl (Sevin) 5% D	I	0.4 lb	1
carbaryl (Sevin) 4 EC	I	284.4 lb	14
carbaryl (Sevin) 80% S	I	80.0 lb	4
carbaryl (Sevin) 50% WP	I	904.5 lb	52
		<u>1,269.3</u> lb	<u>71</u>
carbofuran (Furadan) 4 F	I	2.0 lb	1
chloramben (Amiben) 1.2% G	H	0.054 lb	1
chlordan 5% D	I	15.0 lb	1
chlordan 40% WP	I	30.0 lb	1
chlordan 10% G	I	48.0 lb	4
chlordan 72% EC	I	116.0 lb	9
		<u>209.0</u> lb	<u>15</u>
chlorothalonil (Bravo, Daconil) 75% WP	F	6.38 lb	5
chlorothalonil (Bravo, Daconil) 6 F	F	24.0 lb	2
chlorothalonil (Bravo, Daconil) 50% WP	F	1.75 lb	2
chlorothalonil (Exotherm Termil) 20% D	F	1.84 lb	3
		<u>33.97</u> lb	<u>12</u>
chloroxuron (Tenoran) 50% WP	H	2.0 lb	1
chlorpropham (Chloro-IPC) 10 G	H	150.0 lb	1
chlorpyrifos (Dursban) 2 E	I	40.0 lb	1
chlorthal dimethyl (Dacthal) 75% WP	H	12.0 lb	3
chlorthal dimethyl (Dacthal) 2% G	H	1.0 lb	1
chlorthal dimethyl (Dacthal) 50% WP	H	108.0 lb	1
chlorthal dimethyl (Dacthal) 5% G	H	56.5 lb	5
		<u>177.5</u> lb	<u>10</u>
copper, fixed 52% WP	F	2.12 lb	1
copper, fixed (Bordeaux) 12.75% WP	F	0.75 lb	1
		<u>2.87</u> lb	<u>2</u>
copper hydroxide (Kocide) 4 EC	F,B	7.2 lb	1
copper hydroxide (Kocide) 77% WP	F	30.0 lb	1
		<u>37.2</u> lb	<u>2</u>
copper naphthenate 8% L	F	0.48 gal	2
copper sulfate, basic 53% WP	F	7.95 lb	2
copper sulfate, basic 25.2% SP	F	18.9 lb	3
		<u>26.85</u> lb	<u>5</u>
2,4-D 3 EC	H	3.0 lb	1
2,4-D 4 EC	H	24.0 lb	2
		<u>27.0</u> lb	<u>3</u>
2,4-D + 2,4,5-T 2/2 EC	H	13.0 lb	3
2,4-D (Lithate) 95% WP	H	120.9 lb	2
DDT 50% WP	I	25.0 lb	1
dalapon (Dowpon) 85% WP	H	11.05 lb	1
deet (Off) 47.5% L	I	6.0 oz	2
deet (Off) 14.25% aerosol	I	28.2 oz	3
deet (Deep Woods Off) 19% aerosol	I	49.0 oz	1
		<u>83.2</u> oz	<u>6</u>
diazinon 50% WP	I	13.5 lb	7
diazinon 25% EC	I	4.25 lb	5
diazinon 4 EC	I	79.0 lb	8
diazinon 2% G	I	0.4 lb	1
		<u>97.15</u> lb	<u>21</u>

AR = Animal Repellent, B = Bactericide, F = Fungicide, FUM = Fumigant, H = Herbicide, I = Insecticide, M = Molluscicide, N = Nematicide, R = Rodenticide.

**TABLE 3 (continued). — Results of a Survey to Determine the Pesticides, Formulations and Amount of Active Ingredient Used by Ohio Nurserymen During the 1977-78 Growing Season.**

Pesticide Name Common / Trade / Formulation	Type of Pesticide	Amount of Active Ingredient Used	No. of Growers Using Material
dichlobenil (Casoron) 4% G	H	247.5 lb	15
dichlobenil (Casoron) 50% WP	H	206.0 lb	2
		453.5 lb	17
dichlone 50% WP	F	25.0 lb	1
dichloropropene (Telone II)	FUM	4,950 lb	1
dicofol (Kelthane) 35% WP	I	240.9 lb	24
dicofol (Kelthane) 1.6 EC	I	104.2 lb	16
		345.1 lb	40
dieltrin 1.5 EC	I	59.19 lb	7
dieltrin 50% WP	I	2.5 lb	1
dieltrin 10% G	I	3.0 lb	1
dieltrin 25% WP	I	0.75 lb	1
		65.44 lb	10
dimethoate (Cygon, Defend) 2 E	I	243.5 lb	20
dinocap (Karathane) 25% WP	F	4.75 lb	3
diphacin (Ramik) .005% bait	R	1.04 lb	3
diphenamid (Dymid) 80% WP	H	6.4 lb	1
diphenamid (Enide) 50% WP	H	454.5 lb	3
diphenamid (Dymid) 5% G	H	15.0 lb	1
		475.9 lb	5
disulfoton (Di-Syston) 15% G	I	201.0 lb	6
disulfoton (Di-Syston) 7.5 % G	I	0.75 lb	1
disulfoton (Di-Syston) 6 EC	I	0.75 lb	1
		202.50 lb	8
diuron (Karmex) 80% WP	H	1.7 lb	2
dodine (Cyprex) 65% WP	F	15.11 lb	3
endosulfan (Thiodan) 50% WP	I	8.5 lb	2
endosulfan (Thiodan) 3 EC	I	0.38 lb	1
		8.88 lb	3
endothall (Hydrothol) 3 EC	H	3.0 lb	1
endothall (Hydrothol) 11% G	H	5.5 lb	1
		8.5 lb	2
eptam (EPTC) 7 EC	H	28.0 lb	1
ethazol (Truban) 30% WP	F	6.3 lb	5
ethazol (Truban) 25% EC	F	0.006 lb	1
		6.306 lb	6
ethylene dibromide (Larvatox) 98% LC	FUM	1.96 gal	2
fenaminosulf (Dexon) 35% WP	F	10.33 lb	4
fenaminosulf (Dexon) 70% WP	F	3.5 lb	1
		13.83 lb	5
ferbam 76% WP	F	321.0 lb	7
folpet (Phaltan) 50% WP	I	1.1 lb	3
formaldehyde 37% L	FUM	0.75 lb	1
glyphosate (Roundup) 3 EC	H	420.6 lb	20
heptachlor 2 EC	I	0.125 lb	1
lead arsenate 97% WP	I	242.5 lb	3
lime sulfur 29% LC	F,I	205.0 lb	6

AR = Animal Repellent, B = Bactericide, F = Fungicide, FUM = Fumigant, H = Herbicide, I = Insecticide, M = Molluscicide, N = Nematicide, R = Rodenticide.

**TABLE 3 (continued). — Results of a Survey to Determine the Pesticides, Formulations and Amount of Active Ingredient Used by Ohio Nurserymen During the 1977-78 Growing Season.**

Pesticide Name Common / Trade / Formulation	Type of Pesticide	Amount of Active Ingredient Used		No. of Growers Using Material
lindane 72% EC	I	24.0	lb	1
lindane 25% WP	I	6.28	lb	2
lindane 20% EC	I	68.4	lb	16
		98.68	lb	19
malathion 57% EC	I	525.0	lb	49
malathion 25% WP	I	135.0	lb	11
malathion 5 M	I	7.5	lb	1
malathion 50% EC	I	77.5	lb	23
		745.0	lb	84
mancozeb (Dithane M-45, Fore) 80% WP	F	59.2	lb	6
maneb (Dithane M-22, Manzate-D) 80% WP	F	0.8	lb	1
mercaptodimethur (Mesuro) 2% bait	M	0.8	lb	3
metaldehyde 3.25% bait	M	0.36	lb	4
metaldehyde 20% L	M	1.0	lb	1
		1.36	lb	4
metam-sodium (Vapam) 32.7% S	FUM	10.4	lb	2
methidathion (Supracide) 2 E	I	10.0	lb	2
methomyl (Lannate) 1.8 L	I	10.4	lb	3
methoxychlor (Marlate) 50% WP	I	25.5	lb	2
methyl bromide 98% com. gas	FUM	4167	lb	8
mexacarbate (Zectran) 12.8% L	I	0.06	lb	1
monosodium methanearsenate (Daconate, MSMA) 6 E	H	3.0	lb	1
nicotine sulfate (Black Leaf 40) 40% S	I	4.0	lb	1
oil (70° ) 92% L	I,F	837	gal	22
oil (95%) + ethion (2%)	I	46 gal + 4.8 lb		6
oryzalin (Surflan) 75% WP	H	785.6	lb	3
ovex 50% WP	I	15.0	lb	1
oxamyl (Vydate) 24% L	N	0.23	lb	1
oxydemeton methyl (Metasystox-R) 2 EC	I	140.0	lb	5
oxydiazon (Ronstar) 2% G	H	12.0	lb	1
paraquat 2 EC	H	166.0	lb	16
parathion 15% WP	I	2.0	lb	4
PCNB (Terraclor) 75% WP	F	37.0	lb	5
pentac 50% WP	I	1.1	lb	3
pirimicarb (Pirimor) 50% WP	I	0.5	lb	2
Pramitol 5 PS (prometol 5%, sodium chlorate 40%, metaborak 50%, simazine .75%) 95.75% pellets	H	19.2	lb	1

AR = Animal Repellent, B = Bactericide, F = Fungicide, FUM = Fumigant, H = Herbicide, I = Insecticide, M = Molluscicide, N = Nematicide, R = Rodenticide.



**TABLE 3 (continued).— Results of a Survey to Determine the Pesticides, Formulations and Amount of Active Ingredient Used by Ohio Nurserymen During the 1977-78 Growing Season.**

Pesticide Name Common/Trade/Formulation	Type of Pesticide	Amount of Active Ingredient Used	No. of Growers Using Material
pronamide (Kerb) 50% WP	H	850.0 lb	14
propoxur (Baygon) 1.5 EC	I	3.0 lb	1
propoxur (Baygon) .5% L	I	2.4 oz	2
		3 lb, 2.4 oz	3
pyrethrin .1% L	I	0.03 oz	1
resmethrin 24.6% L	I	17.1 oz	1
simazine (Princep) 4 L	H	50.0 lb	2
simazine (Princep) 80% WP	H	1042.0 lb	15
simazine (Princep)	H	938.0 lb	37
		2030.0 lb	54
sodium arsenate 4 EC	H	34.0 lb	3
streptomycin (Agristrep) 21.2% L	B	106.2 lb	2
strychnine 1% bait	R	2.0 lb	2
sulfur 90% D	F,I	11.2 lb	2
sulfur 95% WP	F	27.6 lb	2
		38.8 lb	4
2,4,5-T (ester) 4 EC	H	6.0 lb	2
tetradifon (Tedion) 25% WP	I	1.4 lb	2
tetradifon (Tedion) 50% WP	I	2.0 lb	1
		3.4 lb	3
thallium sulfate 1% bait	R	0.4 lb	1
thiram (Arasan) 42% S	AR	259.0 lb	12
thiram (Tersan) 75% WO	AR	54.0 lb	1
trichlorfon (Dylox) 80% WP	I	40.0 lb	1
trifluralin (Treflan) 4 EC	H	21.0 lb	3
trifluralin (Treflan) 2% G	H	1.0 lb	1
trifluralin (Treflan) 5% G	H	80.0 lb	9
		102.0 lb	13
warfarin (De-Con) .025% bait	R	0.027 lb	12
warfarin (Crumbles) .025% bait	R	0.0025 lb	1
		0.0295 lb	13
Z.I.P. 20% EC	AR	4.0 lb	1
zinc phosphide 80% bait	R	363.0 lb	5
zineb (Dithane Z-78) (Parzate-C) 75% WP	F	39.8 lb	8

AR = Animal Repellent, B = Bactericide, F = Fungicide, FUM = Fumigant, H = Herbicide, I = Insecticide, M = Molluscicide, N = Nematicide, R = Rodenticide.

**TABLE 4.—Total Estimated Use of Insecticides by Ohio Nurserymen Based on a Survey of Grower Use During the 1977-78 Growing Season.**

Compound	Percent of Growers Using Compound	Total Active Ingredient Used (lb)	Total Area Treated (Acres)	Total Number of Applications	Main Uses
Acephate (Orthene)	10.3	186.0	143.0	346	Black vine weevil, mealybugs on Taxus; general insects
Aldicarb (Temik)	7.4	170.0	124.0	146	Sucking insects and foliar nematodes on perennials, general insects
Azinphosmethyl (Guthion)	5.1	504.0	924.0	191	Black vine weevil, scale, and general insects
Bacillus thuringiensis (Dipel) (Thuricide)	2.2	5.2	2.3	127	Caterpillars on perennials
Carbaryl (Sevin)	52.1	4772.0	3906.0	1817	Japanese beetle, aphids, and general insects
Carbofuran (Furadan)	0.7	7.5	3.7	18	Black vine weevil on rhododendron and azaleas
Chlordane	11.0	786.0	118.4	183	Black vine weevil, Japanese beetle certification, and general insect control
Chlorpyrifos (Dursban)	0.7	150.0	150.0	9	Sucking insects on shade trees
DDT*	0.7	94.0	75.0	9	Japanese beetle (adults)
Deet (Off)	4.4	81.5	Not Applicable	Not Applicable	Repellent for biting flies
Diazinon	20.5	365.0	93.3	566	Aphids, mites, fungus gnats, and general insects
Dicofol (Kelthane)	29.2	1298.0	3180.0	1009	Various spider mites
Dieldrin*	7.3	228.0	47.5	163	Black vine weevil, Japanese beetle, borers, and general insects
Dimethoate (Cygon) (Defend)	14.6	915.4	1917.0	500	Leafminers and various sucking insects
Disulfoton (Di-Syston)	5.8	761.0	174.0	63	Leafminers and sucking insects
Endosulfan (Thiodan)	2.2	33.4	22.5	63	Peach borers and black vine weevil
Ethylene dibromide (Larvatox)	1.5	7.35 gal.	3.75	18	Japanese beetle certification
Heptachlor*	0.7	0.5	7.5	9	General insects
Lead arsenate*	2.2	912.0	876.0	45	General insects
Lime sulfur	2.9	731.0	71.5	73	Scale, spruce gall aphids, whiteflies, spider mites
Lindane	13.9	398.0	376.0	436	Borers, aphids, leafminers, and general insects
Malathion (Cythion)	61.2	2819.0	3505.0	2280	General insects
Methidathion (Supracide)	1.5	37.6	169.0	27	Scale and mites
Methomyl (Lannate)	2.2	39.0	51.0	91	Various caterpillars
Methoxychlor (Marlate)	1.5	96.0	4.25	45	Borers and aphids
Mexacarbate (Zectran)*	0.7	1.0	0.9	18	Sowbugs, slugs, and wireworms
Nicotine sulfate (Black Leaf 40)	0.7	15.2	38.0	9	Japanese beetle

\*Compound not on the market.

**TABLE 4 (continued). — Total Estimated Use of Insecticides by Ohio Nurserymen Based on a Survey of Grower Use During the 1977-78 Growing Season.**

Compound	Percent of Growers Using Compound	Total Active Ingredient Used (lb)	Total Area Treated (Acres)	Total Number of Applications	Main Uses
Oil	16.2	3147 gal.	842.0	291	Scale, mites, aphids, and general insects
Oil + ethion	4.4	171 gal. + 18 lb.	150.0	91	Scale, mites, and aphids
Ovex*	0.7	56.5	132.0	27	Spider mites
Oxydemetonmethyl (Metasystox-R)	3.6	526	786	127	Sucking insects, spider mites on various hosts
Parathion	2.9	7.0	12.0	82	Nematodes on mums, scale
Pentac	2.2	10.0	1.75	100	Spider mites on azaleas and ground cover
Pirimicarb (Pirimor)	1.5	5.1	2.4	45	Aphids on mums
Propoxur (Baygon)	2.2	11.4	594 ft <sup>2</sup>	159	Black vine weevil, hornet nests in plants
Resmethrin	1.5	44 oz.	1.5	72	Whiteflies on perennials
Tetradifon (Tedion)	2.2	12.7	15.0	63	Spider mites on evergreens and honeylocust
Trichlorfon (Dylox)	0.7	150.0	75.2	9	General insects in shade trees

\*Compound not on the market.

**TABLE 5. — Total Estimated Use of Fungicides by Ohio Nurserymen Based on a Survey of Grower Use During the 1977-78 Growing Season.**

Compound	Percent of Growers Using Compound	Total Active Ingredient Used (lb)	Total Area Treated (Acres)	Total Number of Applications	Main Uses
Anilazine (Dyrene)	0.7	9.4	1.88	27	General disease control on broadleaf evergreens
Banrot	2.9	78.0	7.3	64	Preventing root and stem rots in propagating areas
Benomyl (Benlate)	19.7	1300.0	1462.0	1327	Control of a wide range of diseases of ornamentals, fruit and nut trees
Captan	21.2	1353.0	475.0	1317	Control of wide variety of fungal diseases on small fruits, fruit trees and various ornamentals
Chlorothalonil (Bravo) (Daconil 2787) (Exotherm Termil)	6.6	128.0	35.0	1737	Control of wide range of diseases of perennials and various cuttings
Copper-fixed	1.5	15.2	1.3	45	Leaf diseases on deciduous and evergreen plants and ground covers
Copper hydroxide (Kocide)	1.5	140.0	18.8	100	Fireblight and Juniper blight on deciduous trees and evergreens
Copper naphthenate	1.5	1.8	55,639 ft <sup>2</sup>	18	Wood preservation

**TABLE 5 (continued).— Total Estimated Use of Fungicides by Ohio Nurserymen Based on a Survey of Grower Use During the 1977-78 Growing Season.**

Compound	Percent of Growers Using Compound	Total Active Ingredient Used (lb)	Total Area Treated (Acres)	Total Number of Applications	Main Uses
Copper sulfate	2.2	44.1	13.1	91	Control of scab, anthracnose, and wilt on deciduous trees
Dichlone	0.7	94.0	244.0	18	Scab on crabapples
Dinocap (Karathane)	2.2	17.9	41.4	100	For powdery mildew control on various fruit trees
Dodine (Cyprex)	2.2	56.8	52.6	145	Control of scab on apple and pyracantha, powdery mildew on apple, and leaf spots on mums
Ethazol (Truban)	4.4	57.9	27.0	173	Propagating areas for root and rot control
Fenamiosulf (Dexon)	3.6	52.0	4.5	282	General disease control in propagation areas
Ferbam	5.4	5964.0	771.0	145	For control of various fungal diseases on general nursery stock
Folpet (Phaltan)	1.5	7.0	105,000 ft <sup>2</sup>	64	Mildew control on oaks and roses
Lime sulfur	1.5	56.2	9.4	45	Fireblight and scab, anthracnose, and wilt on deciduous trees
Mancozeb (Dithane-M-45) (Fore)	4.4	222.0	15.4	273	General disease control in propagating areas and for cedar-apple rust control on crabs
Maneb (Dithane-M22) (Manzate-D)	0.7	3.0	227 ft <sup>2</sup>	27	Root rot control on rhododendron and azalea
Oxamyl (Vydate L)	0.7	2.1	909 ft <sup>2</sup>	9	Stem nematode on phlox
PCNB (Terraclor)	3.6	338.0	20.5	218	For control of storage molds on general nursery stock; disease control on perennials and evergreens
Streptomycin (Agri-Strep) (Agrimycin)	1.5	7.0	105,000 ft <sup>2</sup>	64	Mildew control on oaks and roses
Sulfur	2.9	293.0	13.0	136	Anthracnose and storage molds on small fruits; fungal diseases on evergreens
Zineb (Dithane-Z-78) (Parzate-C)	5.8	166.0	23.0	109	Control of various fungal diseases on general nursery stock

**TABLE 6. — Total Estimated Use of Herbicides by Ohio Nurserymen Based on a Survey of Grower Use During the 1977-78 Growing Season.**

Compound	Percent of Growers Using Compound	Total Active Ingredient Used (lb)	Total Area Treated (Acres)	Total Number of Applications	Main Uses
Chloramben (Amiben)	0.7	0.2	3.8	9	Pre-emergent control of annual weeds
Amitrole (Aminotriazole)	3.6	134.2	462.0	45	Post-emergent weed control
Amizine (Amitrole + Simazine)	1.5	23.0	20.6	27	General weed control
Atrazine (Aatrex)	1.5	78.2	71.4	18	Pre-emergent control of annual weeds and perennial grasses
Dichlobenil (Casoron)	12.4	1704.0	604.0	155	Pre-emergent control of general weeds
Chlorpropham (Chloro-IPC)	0.7	564.0	188.0	9	Pre-emergent control of annual weeds
Copper sulfate	1.5	57.0	8.8	45	Control of pondweeds and algae in irrigation water
2,4-D	3.6	605.0	793.0	54	Post-emergent control of broadleaf weeds
Cacodylic acid* (Phytar 138)	0.7	30.0	1.0	18	Post-emergent control of general weeds around roadways
Cacodylic acid + sodium cacodylate* (Phytar 560)	1.5	45.0	76.0	45	Post-emergent control of general weeds
2,4-D + 2,4,5-T	2.2	49.0	9.5	55	Post-emergent control of broadleaf weeds
Monosodium methanearsenate (MSMA) (Daconate)	0.7	11.3	6800 ft <sup>2</sup>	73	Post-emergent control of general weeds under greenhouse benches
Chlorthal dimethyl (DCPA) (Dacthal)	7.3	668.0	34.0	191	Pre-emergent control of annual weeds
Dalapon (Dowpon)	0.7	42.0	75.0	9	Post-emergent control of grasses
Diphenamid (Dymid) (Enide)	3.6	1790.0	957.0	163	Pre-emergent control of annual weeds
Diuron (Karmex)	1.5	6.4	20.0	27	Pre-emergent control of weeds in apples and irrigation ponds
Endothal (Hydrothal)	1.5	32.0	20.7	18	Control of aquatic weeds in irrigation ponds
Eptam (EPTC)	0.7	105.0	19.0	9	Pre-emergent control of annual weeds and perennial grasses in apple plantings
Pronamide (Kerb)	10.2	3195.0	1887.0	127	Pre-emergent control of general weeds
Alachlor (Lasso)	3.6	1188.0	1086.0	74	Pre-emergent control of annual grasses and broadleaf weeds
Paraquat	11.7	624.0	2259.0	236	Post-emergent control of general weeds
Simazine (Princep)	39.4	7630.0	7976.0	609	Pre-emergent control of general weeds
Oxadiazon (Ronstar)	0.7	45.0	15.0	9	Pre-emergent control of annual weeds

\*Compound no longer on the market.

**TABLE 6 (continued).— Total Estimated Use of Herbicides by Ohio Nurserymen Based on a Survey of Grower Use During the 1977-78 Growing Season.**

Compound	Percent of Growers Using Compound	Total Active Ingredient Used (lb)	Total Area Treated (Acres)	Total Number of Applications	Main Uses
Glyphosate (Roundup)	14.6	1581.0	1963.0	282	Post-emergent control of general weeds
Sodium arsenite	2.2	309.0	13.6	54	General weed control in mum beds, nursery paths, and under greenhouse benches
Oryzalin (Surflan)	2.2	2954.0	827.0	27	Pre-emergent control of annual weeds
2,4,5-T	1.5	22.4	3.8	18	Post-emergent control of broadleaf weeds in fence and hedge rows
Chloroxuron (Tenoran)	0.7	18.0	2.3	9	Pre- and post-emergent control of annual broadleaf weeds in strawberry plantings
Trifluralin (Treflan)	9.5	383.0	522.0	136	Pre-emergent control of annual weeds

\*Compound no longer on the market.

**TABLE 7.— Total Estimated Use of Rodenticides by Ohio Nurserymen Based on a Survey of Grower Use During the 1977-78 Growing Season.**

Compound	Percent of Growers Using Compound	Total Active Ingredient Used (lb)	Total Area Treated (Acres)	Total Number of Applications	Main Uses
Diphacin (Ramik)	2.2	3.9	37.6	36	Mice and shrew control in perennials, around storage, and production grounds
Strychnine	1.5	7.5	22.6	18	Rodent and rabbit control around apple trees and propagating beds
Warfarin (De-Con)	9.5	0.27	45.5	370	For control of rodents in and around buildings, storage and production areas, and in perennial and fruit tree plantings
Zinc phosphide	3.6	2856.0	96.0	45	For rodent control in and around various nursery structures; in fruit tree, perennial, and small fruit plantings

**TABLE 8. — Total Estimated Use of Fumigants by Ohio Nurserymen Based on a Survey of Grower Use During the 1977-78 Growing Season.**

Compound	Percent of Growers Using Compound	Total Active Ingredient Used (lb)	Total Area Treated (Acres)	Total Number of Applications	Main Uses
Dichloropropene (Telone II)	0.7	18,603.0	94.0	9	Soil sterilization
Formaldehyde	0.7	2.82	3.02	9	Soil sterilization in greenhouses
Metam-sodium (Vapam)	1.5	93.6	11.4	18	Soil sterilization
Methyl bromide	5.8	37,882.0	56.9	91	Soil sterilization
Prometon, sodium chlorate, metaborate, and simazine (Pramitol 5PS)	0.7	72.0	3.8	9	General weed control

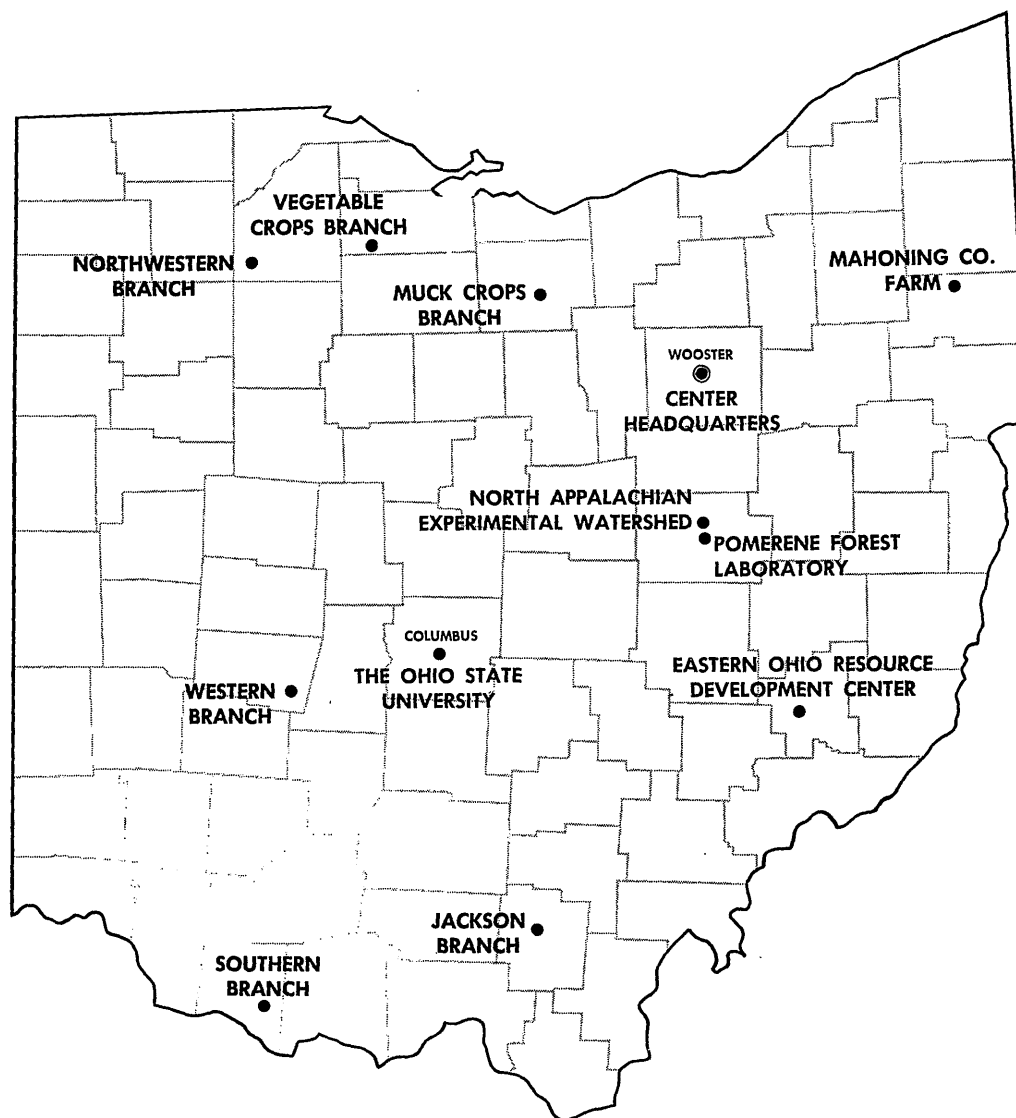
**TABLE 9. — Total Estimated Use of Molluscicides by Ohio Nurserymen Based on a Survey of Grower Use During the 1977-78 Growing Season.**

Compound	Percent of Growers Using Compound	Total Active Ingredient Used (lb)	Total Area Treated (Acres)	Total Number of Applications	Main Uses
Mercaptodimethur (Mesurol)	2.2	8.0	3.6	73	Control of slugs in mum plantings and in greenhouses
Metaldehyde	3.6	12.25	22,499 ft <sup>2</sup>	73	Slug and snail control around various plants, lath areas, and walkways

**TABLE 10. — Total Estimated Use of Animal Repellents by Ohio Nurserymen Based on a Survey of Grower Use During the 1977-78 Growing Season.**

Compound	Percent of Growers Using Compound	Total Active Ingredient Used (lb)	Total Area Treated (Acres)	Total Number of Applications	Main Uses
Z.I.P.	0.7	15	27.0	18	Repel deer and rabbits from dogwood and crabapple trees
Thiram (Arasan) (Tersan 75)	9.5	1458	283.8	127	Rodent, deer, and rabbit repellent around general nursery stock

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