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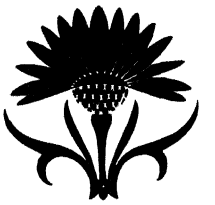

OSU Cooperative Extension Service
The Ohio State University

Ohio Agricultural Research
and Development Center

Pesticide Use on Greenhouse Floral Crops in Ohio—1978

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Introduction

The greenhouse floral industry in Ohio is an important aspect of the state's agricultural and horticultural program amounting to approximately $74 million in gross income. Although the total acreage in the greenhouse floral industry may be quite small relative to the acreages of other major and minor crops in Ohio, the input to Ohio economics is significant.

Information on pest problems and control in the greenhouse floral industry are found in appropriate bulletins published by the Cooperative Extension Service in many states and by florist associations. However, because the acreage involved is small in comparison to other crops, some agencies assume that the use of pesticides is insignificant. In reality the combination of intensive cultivation plus a protected environment plus a high-value crop results in a very high pesticide application rate per acre. But there have been very few organized efforts to determine the kinds and the quantities of pesticide chemicals actually used. Researchers and Extension Specialists have indicated that greenhouse growers as a group are reluctant to reveal their production practices and in many cases, because of lack of records, may not know how much of what they did use. Part of this stems from the difficulties in obtaining and/or justifying pesticide registrations on non-food crops where formerly the label provided no consideration for such. The complications of Amended FIFRA and EPA regulations have made it difficult for the producer of non-food products to comply completely with pesticide label regulations and still maintain an adequate pest control program, particularly when materials had been used successfully for several years but under the Amended FIFRA resulted in "Use inconsistent with the label." Fortunately, many of those non-food uses are now included on the label of the registered pesticides.

It was expressed by Cooperative Extension Specialists and associated research scientists that pesticide use information related to the greenhouse floral industry was necessary in assisting to determine the essential uses of certain pesticide materials. Such information would be useful in establishing benefit/use data in response to EPA's registration review of pesticide products and thus providing one basis for protecting the registration of those materials essential to pest control in floral crops. Information could also be useful to the Cooperative Extension Service in helping to determine programs to satisfy the educational needs of the greenhouse industry.

Procedures

A survey questionnaire was prepared and mailed in early December 1978, with a letter of introduction and request for cooperation to approximately 300 producers as determined from the list of Commercial Greenhouse Florists in Ohio. This list was compiled in 1976-77 by Cooperative Extension Specialists associated with the industry and consisted of approximately 800 names. The list was alphabetized by county and also indicated the size in square feet of growing space for each operation. Consequently, we first organized the list according to the size of operation with

11 square footage categories. We then determined the number of growers in each size category and the percent of those growers to be included in the representative sampling of approximately 300. The decision was to weight the sampling somewhat toward the larger producers (where there were considerably fewer) with capacities above 100,000 square feet. From each of these revised lists, growers were selected randomly, making sure that all counties were represented as appropriate in the overall sample, until a total of 300 had been designated who subsequently received the questionnaire with a self-addressed stamped return envelope.

A second request to return the questionnaire was mailed to non-respondents in mid-January 1979. Because the response was not as great as anticipated, a new mailing was sent in late May 1979 to 87 of the selected growers whose size of operation was significant in the industry. Most of these growers had been contacted in the earlier mailings. This mailing was requested by the Extension Floriculturalists as a means to get a more representative sampling and was preceded by notices of the intent and need in Extension Service publications mailed to Ohio growers.

Results

The organization of the greenhouse florist list in regard to size of operation and the numbers selected from each size to constitute the initial 309 grower sample is shown in Table 1. Total response to the three mailings was the return of 115 questionnaires of which 97 had usable data. Responses from the sample mailings indicated considerable changes in the listing of Commercial Greenhouse Florists in Ohio and consequently a need to update that listing. In accordance with the survey questionnaires returned and consultation with Extension Specialists, greenhouse operations were organized into seven size categories for the purposes of this report (Table 2). Thirty-one percent of those receiving questionnaires constituting approximately 12 percent of the growers responded with usable data although in many cases it was not complete and the enumerators had to consult recommendation bulletins and Extension Specialists in order to provide proper evaluation. The grower listing indicated Greenhouse florists were located in 84 counties in Ohio. Questionnaires were returned from 48 of those counties as indicated in Figure 1.

Fig. 1: Distribution of Usable Information Sources by County From Greenhouse Florists in Ohio — 1978.[1]

[1] First number of 1/1 indicates number of usable responses and second number indicates number questionnaires mailed.

The total area of greenhouse floral cropping in Ohio in 1978, as calculated from survey tabulations, was 24,056,630 sq. ft. or 552.3 acres. Calculations on the area of produced crops were based upon a formula involving the average of the area for each size category as reported by growers on the returned survey forms minus the average area for the same growers on our mailing list plus the average area for all greenhouse growers in that category on the mailing list. This adjusted average was then multiplied by the total growers in that size category on the mailing list to arrive at an estimated total area for that category. The tabulation relative to the size of operation and the type of floral plants is indicated in Table 2. The data indicate that bedding plants constituted the largest acreage (25.9 percent of the total) followed by lilies and poinsettias (13.3 percent), potted plants (11.4 percent), and chrysanthemums (10.1 percent).

The estimated square footage area of greenhouse floral production in Ohio in 1978 as calculated in Table 2 represents approximately a 4.6 percent increase over that reported by the Ohio Crop Reporting Service. The CRS report of April 30, 1979 was not available at the time the survey questionnaire for the project reported herein was developed and the data collected and thus there are some differences in the listing of floral crops. The CRS report for Ohio Commercial Floriculture Sales in 1978 for those 430 producers who grossed $10,000 and over listed the crop area as follows: (1) Cut Flowers: including Carnations - 272,000 sq. ft.; Roses - 1,110,000 sq. ft.; Chrysanthemums - 1,760,000 sq. ft.; Snapdragons - 246,000 sq. ft.; and Others - 1,250,000 sq. ft. for a total of 4,638,000 sq. ft. (2) Potted Plants: including Chrysanthemums - 1,324,000 sq. ft.; Poinsettias - 2,495,000 sq. ft.; Lilies - 402,000 sq. ft.; and Others - 1,025,000 sq. ft. for a total of 10,444,000 sq. ft. (3) Bedding Plants: including Flowering - 5,938,000 sq. ft. and Vegetable - 1,681,000 sq. ft. for a total of 7,619,000 sq. ft. and a grand total for commercial floriculture of 22,701,000 sq. ft. of crop area. Addition of poinsettia, geranium, and chrysanthemum growers with less than $10,000 in gross sales increased the crop area to 22,982,000 sq. ft. Of the total crop area, cut flowers accounted for 20.4 percent, potted plants — 46.0 percent, and bedding plants - 33.6 percent.

Pesticide chemicals were applied one or more times during the growing season by 94.8 percent of the growers on 98.2 percent of the crop acreage. Survey results indicated that the small operator has the least tendency to use pesticides probably because much of his operation may have been only as a retail outlet. Forty-three percent of the growers with greenhouse operations of less than 2500 sq. ft., 10 percent of those whose size was between 2500 and 5000 sq. ft., and 7.1 percent of the size between 25,000 and 50,000 sq. ft. used no pesticide chemicals (Table 2).

Greenhouse floral growers used a total of 28,026.3 pounds active ingredient of pesticides during the 1978 growing season (Table 3). Fungicides accounted for 41.4 percent of the total, insecticides - 35.5, fumigants - 10.2, miticides - 7.5, growth regulators - 3.9, and herbicides - 1.3 percent. The quantity of each pesticide calculated as active ingredient including the area of treatment is listed in Table 3 according to pesticide use classification. Data for the area treated are recorded for each individual pesticide and in some cases may reflect more than one application of the pesticide over the same area during a growing season in conformance with pest control recommendations. More than one pesticide in each classification and more than one type of pesticide may have also been applied to the same area, thus making the summation of the area treated far exceed the total greenhouse area in the state.

Aldicarb was the major insecticide used on greenhouse floral crops constituting 79.4 percent of the total. Acephate and Malathion accounted for 4.6 and 4.2 percent, respectively. Of the miticides used, Dienchlor accounted for 42.9, Pirimicarb - 26.8, and Dicofol - 20.1 percent of the total. Five chemicals constituted 92.6 percent of the fungicides used with PCNB - 28.7, Fenaminosulf - 26.9, Banrot - 20.5, Benomyl - 10.5, and Ethazol - 6.1 percent of the total. Sodium arsenite was the principal herbicide used, amounting to 72.4 percent of the total. Aminozide and Chlormequat chloride accounted for 76.8 and 21.3 percent of the quantity of growth regulators used. Methyl bromide was the principal pesticide used for fumigation followed by Dichlorvos with 88.0 and 10.9 percent, respectively, of the total.

The use of pesticide chemicals in relation to the cropping system for greenhouse floricultue in Ohio is listed in Table 4. Table 5 provides information on the percent of growers who used certain pesticide chemicals in relation to their size of operation. It was noted that the use of pesticide chemicals was more prevalent with growers whose operation exceeded 10,000 sq. ft. than with those of less space. The choice and use of pesticides by those growers with less than 5000 sq. ft. of crop space appeared to be limited and somewhat infrequent. It was also noted that greenhouse floriculturalists used quite a diversity of pesticides with only Aldicarb being used by more than 50 percent of the growers. Those pesticides that were used by more than 20 percent of the growers were Aldicarb - 63.9, Dienchlor - 37.1, Benomyl - 36.1, Dicofol - 29.9, Fenmaminosulf - 21.7, Malathion - 20.6, and PCNB - 20.6 percent.

The prevalent pest problems in greenhouse floriculture and the pesticides used to control those pests relative to the types of floral crops as indicated by the growers who responded are recorded in Table 6. The table provides data on the percent of growers who use the specific pesticide listed for pest control in that crop and the response, on a percentage basis, of the pests for which that particular chemical was used. The data indicated that the major insect pest problems in greenhouse floriculture are aphid, spider mite, and white fly, with botrytis and root-stem-crown rot as the most prevalent disease problems. However, based upon the knowledge of Research and Extension personnel, it is evident that the response to the survey is not entirely reflective of the scope and extent of pest probelms confronting the greenhouse floral industry in Ohio.

The survey responses indicate that as a group the greenhouse floriculturalists are quite conscious of the hazards associate with pesticide application in confined areas and generally provide for personal protection. The data recorded in Table 7 indicate that 87.8 percent of the applicators wore rubber or neoprene gloves, 81.1 percent used a respirator or gas mask, 67.8 percent used eye or face protection, and 54.4 percent used rubber or neoprene boots. The major deficiencies noted may have been in body covering. This same observation is evident also with the data in Table 8 regarding the use of protective devices as related to the hands and the facial area, the latter indicating concern both

from dermal and inhalation exposure. However, review of the toxicity and the personal hazards of the pesticides involved could indicate that the normal work clothing is ample for body protection. The data in Table 8 indicate that there is more tendency to utilize protective equipment in general with the larger greenhouse areas, due very likely to the greater quantities and more types of pesticide products involved which in turn would contribute to greater potential exposure.

Evaluation of the data in Table 9 indicates that the size of the operation had a definite relationship to the need for the grower to qualify for certification in pesticide application and the availability of facilities for steam sterilization. Only a small percentage of the growers with less than 5000 sq. ft. of greenhouse operation were certified applicators, whereas the percentage increased with each larger category of greenhouse operation approaching 100 percent certification for growers exceeding 50,000 sq. ft. of operation. This characteristic correlates with the data in Table 5 which indicate that the use of "Restricted Use" pesticides, requiring applicator certification, was generally associated with and, on a relative basis, pesticide use was more common with the larger operations. It is also possible that growers with the larger acreages recognized more fully the advantages of being a certified Pesticide Applicator. The availability of facilities for steam sterilization appeared also to be related to the size of operation and the subsequent utilization of pesticides, although in this case the percent of growers whose greenhouses were so equipped did not vary appreciably over the range of 5000 to 100,000 sq. ft.

Greenhouse floriculturalists seldom utilize the services of custom applicators in the application of pesticides. Only 8.2 percent of the growers used some custom application. Most pesticides were applied by the grower himself or someone working under his supervision associated with the operation. This phenomenon also shows close correlation with the percentage of growers who are certificated applicators and the nature of the pesticide chemicals generally used.

As indicated in Table 10, approximately 12 percent of the growers have separate storage buildings for pesticides. Sixty-one percent store pesticides in conjunction with other materials, although 54 percent indicate barriers in the building to separate the pesticides from the other materials. Forty-one percent of the growers incorporate the practice of separating and/or segregating the different pesticide materials in their storage facilities. In regards to security, about 47 percent keep the pesticide storage area locked and 44 percent restrict the access to authorized personnel only. Approximately 97 percent of the growers maintain storage of pesticides in the original containers.

Probably because of the types of pesticide products used and the limited quantities purchased, the requirements for surplus pesticide disposal seem to be minimal. Eighty percent of the growers retain surplus pesticides for use in the next growing season (Table 11). Twenty-one percent used the pesticide on other crops or sites where such use is legal. The small amounts that must be disposed of appeared to be about equally divided in use of on-site facilities and public facilities. This same tendency appears to prevail in the disposal of empty containers where about 40 and 27 percent utilize burning and burying on the premises and 44 and 29 percent utilize public sanitary landfills and commercial waste disposal facilities, respectively (Table 12). Of course, growers may use more than one procedure in disposing of empty pesticide containers as was indicated in the survey returns. The data in Table 12 indicate that disposal procedures used by greenhouse growers were satisfactory for the most part, although only about one-third of them decontaminated the container prior to disposal.

Approximately half of the greenhouse floriculturalists in Ohio rely on the Cooperative Extension Service personnel as the initial primary source of information for pest control (Table 13). Twenty-six percent indicated that they made pesticide use decisions based upon their own personal experience and approximately 23 percent relied upon recommendations of pesticide dealers, who in turn may have contacted the Extension Specialists for pest control advice. Consensus also indicates that after the initial contact for pest control information, many growers generally rely upon their own personal experience for the subsequent growing seasons. The utilization of recommendations from neighbors or from advertisements in determining suitable pest control practices was very minimal. Almost two-thirds of the growers who responded indicated that their selection of pesticides was based upon the facilities they had for applying such rather than on the costs involved. They also indicated the major factors in choice of pesticide chemicals selected for use were lower toxicity (35 percent), satisfactory pest control with toxicity of secondary consideration (28 percent), and prolonged control (18 percent). Less than 10 percent felt that the need for wearing protective clothing and equipment was a deciding factor in the selection of pesticides.

Discussion

A general conclusion in summarizing the results of this pesticide use survey is that many greenhouse floriculturalists are perhaps not as knowledgeable in the use of pesticides as is desirable. It appeared that in general pesticide use record keeping was very lax and in many cases the grower didn't remember what or how much was used. Several survey questionnaires that were returned were non-usable because of the scarcity of information. Many others indicated the use of particular pesticide products, but information on the quantities or rates of application was not noted in the returned survey except occasionally a notation that application was in accordance with recommendations by the Cooperative Extension Service and label directions. The survey enumerators thus were required to search labels and recommendation bulletins and to consult with Extension Specialists in order to determine the quantities of pesticides involved. It appeared that the majority of growers were probably reluctant to provide information, which was partially evidenced by the ratio of survey responses to the number that were mailed out.

Because floral and nursery crops are classified with non-food crop agriculture, the availability of EPA registered pesticide products for use in this industry has been a problem during the years since 1972 with the Amended FIFRA. Growers had experienced the satisfactory use of pesticides registered for food crops on ornamental and floral crops also with no major difficulty. But under the Amended FIFRA such uses became illegal as "Use inconsistent with the label" and until appropriate pesticide registrations for ornamen-

tal and floral crops were obtained, the floriculturalist was faced with the problem of either using illegally those materials he knew would work or not having available the satisfactory pest control methods. Although now many pesticide materials have federal and state registration for use on non-food crops, the grower is still somewhat negligent in maintaining accurate records of pesticide use in pest control practices.

As a grower group and as indicated in an earlier survey report on pesticide use on greenhouse vegetables, the greenhouse floriculturalists have fewer problems in complying to safe pesticide practices than perhaps growers in field crop production. There are fewer crops of concern, but the same general pest problems for all floral crops grown in the greenhouse atmosphere. The small acreage involved in greenhouse floriculture, of course, involves relatively small quantities of pesticide materials required. This in turn reduces the magnitude of the handling, storage, and disposal problems and to a certain extent the environmental exposure potential. Undoubtedly, a closed environment causes many growers to be more concerned with their own personal protection during and after pesticide application. On the other hand, however, the small quantities involved and the nature of the pesticide used could contribute to complacency by some growers and thus re-emphasize the need to provide instruction on safe pesticide use practices.

As indicated earlier, the total quantity of pesticides used in the greenhouse floral industry is very minimal compared to other agricultural industries and is related directly to the size and type of operation. According to the survey, in 1978 only 9933 pounds of active ingredient insecticides, 2104 pounds of miticides, 11,604 pounds of fungicides, 374 pounds of herbicide, 1105 pounds of growth regulators, 2872 pounds of fumigants, and 33 pounds of other chemicals for a total of 28,026 pounds were used. A general conclusion could be that pesticide use in greenhouse floriculture is of no significance in relation to the impact on pesticide registrations and sale and consequently to the agricultural community. However, pesticide use is crucial in a successful floriculture operation. Even though it involves only small quantities of materials, there is great necessity to obtain registration of suitable pesticides and maintain the registration of current materials for this minor crop area. Past history has shown that the floriculturalist is going to protect his crop with those chemicals that he knows will do the job and a non-food crop doesn't carry the same concern for the possibility of consumed residues as do food crops. If we are to maintain operation of the industry in compliance with the legalities of Amended FIFRA and still provide for the aesthetic values of life derived from the beauties of flowers and ornamentals, provisions must be available to protect the crops from destructive pests.

Table 1: Listing of Greenhouse Florists in Ohio

Size of Operation (sq. ft.)	Number of Growers		
	On List	Sampled	Responding[1]
0— 2,500	121	32	16
2,501— 5,000	155	46	14
5,001— 10,000	187	53	13
10,001— 20,000	155	52	21
20,001— 40,000	96	47	17
40,001— 65,000	38	31	12
65,000—100,000	19	15	6
100,001—150,000	12	11	6
150,001—200,000	10	10	5
200,001—275,000	6	5	1
> 275,000	9	7	4
Totals	808	309	115[2]

[1] Twenty-four of the 115 responses indicated changes in operation; some having closed their businesses; others having sold to other concerns; and some correspondence returned for lack of forwarding address. Also the survey results showed changes in the size of operation of certain respondents (see Table 2).

[2] Five additional survey questionnaires were returned by respondents to the Greenhouse Vegetable Survey who had changed operations to floriculture.

Table 2: Characteristics of the Greenhouse Floriculture in Ohio

Size of Operation (sq. ft.)	Number of Growers			Area of Produced Crop (sq. ft. x 1000)												
	Listed	Contacted	Responding with Usable Data	Bedding Plants	Bulb Plants	Cut Flowers	Potted Plants	Small Ornamentals	Lilies and Poinsettias	Carnations and Roses	Chrysanthemums	Geraniums	Non-specific	Total	Treated with Pesticides One or More Times During Season
1,000— 2,500	120	32	7	68.23			17.06				37.52	35.44	34.11	192.36	109.84
2,501— 5,000	153	46	10	173.61		49.42	86.04	62.09			15.21	29.15	126.72	542.23	488.01
5,001— 10,000	180	53	8	217.81	9 11	233.90	57.17	46.51	165.88	90.40	262.19		193.78	1,276.74	1,276.74
10,001— 25,000	191	145	23	865.69	78.78	357.00	529.06	297.43	456.14	28.45	351.93	144.94	368.12	3,477.54	3,477.54
25,001— 50,000	90		14	1,000.10	37.25	670.78	523.35	102.64	473.42	732.36	625.76			4,165.65	3,869.89
50,001—100,000	35		15	1,122.05	59.32	197.75	448.02	261.09	549.98	326.90	213.50	185.39		3,363.99	3,363.99
> 100,000	38	33	20	2,777.92	64.31	336.56	1,093.34	1,147.85	1,550.34	807.08	913.44	202.61	2,145.41	11,038.16	11,038.16
TOTALS	807	309	97	6,225.41	248.77	1,845.39	2,754.04	1,916.90	3,195.75	1,985.19	2,419.55	597.52	2,868.15	24,056.63	23,624.12
Percent of Total		38	12	25.9	1.0	7.7	11.4	8.0	13.3	8.2	10.1	2.5	11.9	100.0	98.2
Acreage				142.9	5.7	42.4	63.2	44.0	73.4	45.6	55.5	13.7	65.9	552.3	542.4

Table 3: Quantities of Pesticide Chemicals Used by Ohio Greenhouse Floral Growers in 1978

A. Insecticides

Common Name	Trade Name	Area Treated (sq. ft.)	Area Treated (acres)	Active Ingredient Used
Acephate	Orthene	4,385,988	100.7	461.87 lbs.
Aldicarb	Temik	11,799,343	270.9	7,889.71 lbs.
B. Thuringiensis	Dipel	3,805,600	87.4	10.28 lbs.
Carbaryl	Sevin	1,470,082	33.7	188.87 lbs.
Chlordane	Chlordane	35,647	.8	111.38 lbs.
Chlorpyrifos	Dursban	340,817	7.8	4.85 lbs.
Demeton	Systox	320,431	7.4	43.49 lbs.
Diazinon	Diazinon	2,956,603	67.9	196.22 lbs.
Dieldrin	Dieldrin	79,260	1.8	1.37 lbs.
Dimethoate	Cygon	222,464	5.1	15.88 lbs.
Endosulfan	Thiodan	1,253,462	28.8	100.94 lbs.
Lindane	Lindane	289,035	6.6	4.46 lbs.
Malathion	Malathion	2,793,241	64.1	418.33 lbs.
Methiocarb	Mesurol	165,103	3.8	13.71 lbs.
Methomyl	Lannate	3,315,517	76.1	147.60 lbs.
Naled	Dibrom	527,049	12.1	71.28 lbs.
Nicotine	Nicotine	136,943	3.1	34.52 lbs.
Oxydemeton Methyl	Metasystox-R	1,669,326	38.3	159.85 lbs.
Pyrethrins	Pyrethrins	994,780	22.8	1.32 lbs.
Resmethrin	Resmethrin	1,273,037	29.2	56.10 lbs.
Rotenone	Rotenone	55,433	1.3	.96 lbs.
Totals				9,932.99 lbs.

B. Miticides

Cyhexatin	Plictran	1,370,993	31.5	23.67 lbs.
Dicofol	Kelthane	4,547,913	104.4	422.70 lbs.
Dienchlor	Pentac	7,609,730	174.7	903.69 lbs.
Dinocap	Karathane	578,701	13.3	31.22 lbs.
Fenbutatin oxide	Vendex	1,259,716	28.9	31.69 lbs.
Mexacarbate	Zectran	287,272	6.6	59.81 lbs.
Oxamyl	Vydate	1,588,626	36.5	46.74 lbs.
Oxythioquinox	Morestan	283,252	6.5	7.90 lbs.
Pirimicarb	Pirimor	5,405,678	124.1	564.13 lbs.
Propargite	Omite	321,337	7.4	12.90 lbs.
Total				2,104.45 lbs.

C. Fungicides

Banrot	Banrot	4,933,508	113.3	2,379.10 lbs.
Benomyl	Benlate	9,325,879	214.1	1,215.98 lbs.
Captan	Captan	817,827	18.8	133.20 lbs.
Chlorothalonil	Daconil Termil	1,450,641	33.3	258.81 lbs.
Copper hydroxide	Kocide	712,100	16.3	37.08 lbs.
Copper sulfate	Copper sulfate	41,030	.9	9.54 lbs.
DCNA	Botran	13,511	.3	.45 lbs.
Ethazol	Truban	1,257,852	28.9	706.13 lbs.
Fenaminosulf	Dexon	5,377,512	123.5	3,117.15 lbs.
Ferbam	Ferbam	33,047	.8	1.91 lbs.
Mancozeb	Manzate	222,464	5.1	30.40 lbs.
Maneb	Dithane M-22	740,690	17.0	121.60 lbs.
Parinol	Parnon	432,760	9.9	4.00 lbs.
PCNB	Terrachlor	4,218,455	96.8	3,329.10 lbs.
Piperalin	Pipron	534,843	12.3	102.38 lbs.
Sulfur	Sulfur	63,360	1.5	30.78 lbs.
Triforine	Triforene	496,098	11.4	44.28 lbs.
Zineb	Dithane Z-78	588,766	13.5	82.46 lbs.
Total				11,604.35 lbs.

D. Herbicides

Common Name	Trade Name	Area Treated (sq. ft.)	Area Treated (acres)	Active Ingredient Used
Cacodylic acid	Phytar	174,371	4.0	9.75 lbs.
Diquat	Diquat	97,552	2.2	9.40 lbs.
Glyphosate	Round up	1,160,507	26.2	50.62 lbs.
Paraquat	Paraquat	895,713	20.6	10.85 lbs.
Simazine	Princep	394,015	9.0	22.64 lbs.
Sodium arsenite	Sodium arsenite	270,496	6.2	270.40 lbs.
Total				373.66 lbs.

E. Growth Regulators

Ancymidol	Arest	303,175	7.0	0.70 lbs.
Aminozide	B-Nine	4,429,357	101.7	848.24 lbs.
Chlormequat chloride	Cycocel	2,122,247	48.7	235.19 lbs.
Ethephon	Florel	539,803	12.4	21.06 lbs.
Total				1,105.19 lbs.

F. Fumigants

Calcium cyanide	Cyanogas	63,360	1.5	2.06 lbs.
Dichlorvos	GH-19	1,955,560	44.9	298.55 lbs.
Dichlorvos	GH-21	256,837	5.9	14.52 lbs.
Dicofol	GH-21	256,832	5.9	18.16 lbs.
Methyl bromide	Methyl bromide	274,593	6.3	2,529.00 lbs.
Sulfotepp	Plant Fume	317,035	7.3	10.12 lbs.
Total				2,872.41 lbs.

G. Other Chemicals

Metaldehyde	Bug Geta	336,825	7.7	25.72 lbs.
Piperonyl butoxide	Piperonyl butoxide	994,780	22.8	3.25 lbs.
Streptomycin sulfate	Strep-tomycin	242,155	5.6	1.17 lbs.
Warfarin	D-con	31,308	.7	3.13 lbs.
Total				33.27 lbs.
Total (all chemicals)				28,026.32 lbs.

Table 4: Quantities of Pesticide Chemicals Used on Greenhouse Floriculture Crops in Ohio — 1978

Crop: Bedding Plants (6,225,408 sq. ft.)

Chemical	Area Treated (sq. ft.)	Active Ingredient (pounds)	Chemical	Area Treated (sq. ft.)	Active Ingredient (pounds)
Acephate	1,362,903	73.70	Fenaminosulf	1,323,102	691.35
Aldicarb	2,384,598	570.03	Glyphosate	632,523	29.64
Aminozide	1,602,628	292.04	Lindane	159,726	2.47
Ancymidol	83,362	1,432.83	Malathion	678,738	46.58
Banrot	2,283,390	701.55	Methiocarb	134,507	2.69
Benomyl	3,201,734	91.43	Metaldehyde	156,842	9.12
B. thuringiensis	1,161,734	2.35	Methomyl	759,735	33.39
Cacodylic acid	174,371	9.75	Methyl bromide	103,143	1,031.00
Captan	214,561	24.80	Naled	25,344	12.75
Carbaryl	22,229	0.44	Nicotine	69,695	15.00
Chlormequat chloride	301,095	63.53	Oxydemeton methyl	444,835	61.35
Chlorothalonil	131,338	10.26	Paraquat	367,729	4.20
Cyhexatin	169,583	2.87	PCNB	1,497,908	574.50
Diazinon	535,946	22.41	Piperonyl butoxide	61,795	0.33
Dichlorvos	170,905	39.04	Pirimicarb	1,134,502	53.89
Dicofol	490,888	27.33	Pyrethrins	61,795	0.17
Dienchlor	1,340,205	44.15	Resmethrin	243,078	16.74
Endosulfan	139,165	8.00	Sodium arsenite	111,146	111.20
Ethazol	403,833	236.63	Sulfotepp	34,113	0.56

Crop: Bulb Plants (248,711 sq. ft.)

Aldicarb	40,785	12.75	Malathion	18,539	3.25
Ancymidol	36,640	11.43	Metaldehyde	3,090	0.29
Banrot	3,194	1.20	Methomyl	13,595	2.25
Benomyl	47,107	10.73	Oxydemeton methyl	7,416	0.38
Dichlorvos	6,373	1.81	PCNB	13,871	12.75
Dicofol	24,852	1.23	Piperonyl butoxide	3,090	0.02
Dienchlor	25,954	1.88	Pirimicarb	3,090	2.00
Ethazol	3,581	0.66	Pyrethrins	3,090	0.01
Fenaminosulf	45,519	35.35	Resmethrin	21,144	1.48

Crop: Cut Flowers (1,845,394 sq. ft.)

Acephate	157,461	29.62	Fenbutatin oxide	15,207	0.52
Aldicarb	607,696	603.34	Ferbam	28,778	0.65
Aminozide	506,899	80.96	Malathion	156,355	58.63
Benomyl	101,022	9.50	Metaldehyde	77,244	7.51
Captan	23,778	3.55	Methomyl	244,984	16.42
Chlorpyrifos	340,817	4.85	Methyl bromide	53,350	533.00
Cyhexatin	80,025	1.03	Nicotine	54,576	16.88
Demeton	67,371	18.00	Oxydemeton methyl	220,738	9.38
Diazinon	420,842	14.28	PCNB	68,408	300.00
Dichlorvos	85,453	22.73	Piperonyl butoxide	77,244	0.41
Dicofol	456,251	53.91	Pirimicarb	167,648	86.95
Dienchlor	477,202	64.10	Pyrethrins	77,244	0.21
Endosulfan	67,824	0.95	Zineb	39,630	25.50
Fenaminosulf	77,244	203.00			

Crop: Potted Plants (2,754,043 sq. ft.)

Acephate	840,624	119.25	Glyphosate	474,349	18.47
Aldicarb	1,416,355	698.84	Lindane	101,986	1.79
Banrot	181,068	275.48	Malathion	383,007	96.83
Benomyl	863,419	39.48	Methiocarb	30,596	11.02
B. thuringiensis	579,191	0.74	Metaldehyde	62,573	5.24
Captan	394,015	59.10	Methomyl	223,737	10.95
Carbaryl	84,163	37.52	Naled	44,868	2.85
Chlordane	80	2.00	Oxamyl	694,189	14.88
Chlormequat chloride	165,578	10.35	Oxydemeton methyl	133,593	24.58
Chlorothalonil	504,575	60.90	Paraquat	474,349	6.40
Copper hydroxide	394,015	23.22	PCNB	58,675	55.05
Cyhexatin	290,462	6.05	Piperonyl butoxide	37,077	0.20
Demeton	30,596	2.18	Pirimicarb	517,722	37.00
Diazinon	158,222	7.53	Pyrethrins	37,077	0.10
Dichlorvos	585,487	75.68	Resmethrin	201,366	22.58
Dicofol	1,112,153	56.97	Rotenone	55,433	0.96
Dienchlor	912,020	57.35	Simazine	394,015	22.64
Dinocap	239,684	10.59	Sodium arsenite	159,350	159.20
Endosulfan	500,617	11.75	Sulfotepp	123,935	4.06
Ethephon	539,803	21.06	Warfarin	23,778	2.03
Fenaminosulf	463,500	471.10	Zineb	47,556	3.00
Fenbutatin oxide	15,434	0.50			

Table 4: Quantities of Pesticide Chemicals Used on Greenhouse Floriculture Crops in Ohio — 1978

Crop: Geraniums (597,516 sq. ft.)

Chemical	Area Treated (sq. ft.)	Active Ingredient (pounds)	Chemical	Area Treated (sq. ft.)	Active Ingredient (pounds)
Acephate	92,693	6.64	Dicofol	123,591	6.56
Aldicarb	302,375	150.40	Dienchlor	302,375	10.79
Banrot	178,784	100.56	Endosulfan	14,365	2.40
Benomyl	178,784	2.55	Ethazol	61,795	43.40
B. thuringiensis	333,272	1.14	Fenaminosulf	32,010	11.59
Captan	6,823	0.80	Malathion	6,832	0.66
Carbyl	192,296	27.25	Methomyl	60,240	10.39
Chlormequat chloride	15,449	1.15	Naled	29,145	12.75
Chlorothalonil	14,365	8.10	PCNB	32,010	75.00
Cyhexatin	271,477	6.01	Pirimicarb	13,511	0.05
DCNA	13,511	0.45	Zineb	57,969	9.63
Dichlorvos	185,386	8.66			

Crop: Small Ornamentals (1,893,212 sq. ft.)

Acephate	428,095	39.69	Fenaminosulf	45,064	106.58
Aldicarb	1,029,415	1,156.52	Fenbutatin oxide	937,601	19.54
Ancymidol	15,449	265.50	Malathion	775,755	58.25
Banrot	55,079	50.93	Mancozeb	222,464	30.40
Benomyl	265,356	31.50	Metaldehyde	9,269	0.88
B. thuringiensis	399,395	3.20	Methomyl	145,990	14.83
Captan	16,417	2.45	Naled	63,954	5.31
Carbaryl	301,462	19.35	Nicotine	12,672	2.64
Chlordane	35,567	109.38	Oxamyl	222,464	7.95
Chlorothalonil	222,464	37.50	Oxydemeton methyl	319,887	35.81
Copper hydroxide	318,085	13.86	Oxythioquinox	231,733	6.25
Cyhexatin	322,272	5.28	PCNB	257,291	472.80
Demeton	222,464	23.75	Piperonyl butoxide	724,406	1.32
Diazinon	117,460	5.00	Pirimicarb	828,266	28.73
Dichlorvos	724,406	31.50	Propargite	222,464	11.85
Dicofol	191,414	21.31	Pyrethrins	724,406	0.65
Dienchlor	1,259,421	68.91	Resmethrin	7,530	0.50
Dimethoate	222,464	15.88	Streptomycin sulfate	242,155	1.17
Endosulfan	41,289	9.14	Sulfotepp	14,534	0.47
Ethazol	222,464	62.55	Warfarin	7,530	1.09

Crop: Lilies and Poinsettias (3,195,755 sq. ft.)

Acephate	76,555	7.09	Fenaminosulf	1,648,506	1,087.90
Aldicarb	2,273,917	1,529.64	Fenbutatin oxide	79,260	0.84
Ancymidol	83,362	468.87	Lindane	27,323	0.20
Banrot	829,965	854.53	Malathion	187,210	37.44
Benomyl	1,342,659	60.50	Metaldehyde	18,539	1.80
B. thuringiensis	94,736	0.16	Methomyl	218,462	8.35
Captan	98,873	14.00	Methyl bromide	60,908	609.00
Carbaryl	105,892	12.70	Naled	29,067	1.81
Chlormequat chloride	1,640,125	160.16	Oxydemeton methyl	87,866	9.64
Cyhexatin	98,873	0.44	PCNB	1,331,198	1,378.50
Diazinon	258,510	6.37	Piperonyl butoxide	18,539	0.10
Dichlorvos	84,208	25.28	Pirimicarb	41,989	13.39
Dicofol	277,137	10.34	Propargite	98,873	1.05
Dieldrin	79,260	1.37	Pyrethrins	18,539	0.05
Dienchlor	357,538	18.09	Resmethrin	231,196	3.03
Endofulfan	8,209	0.20	Sulfotepp	29,067	0.96
Ethazol	187,939	274.24			

Crop: Carnations and Roses (1,985,185 sq. ft.)

Acephate	526,904	105.53	Maneb	237,779	32.32
Aldicarb	304,996	111.88	Metaldehyde	9,269	0.88
Banrot	16,005	9.00	Methomyl	209,367	11.79
Benomyl	516,038	394.99	Mexacarbate	235,753	58.91
B. thuringiensis	235,765	1.32	Naled	276,536	32.18
Chlorothalonil	536,869	73.80	Oxamyl	299,090	10.68
Diazinon	235,753	70.63	Oxydemeton methyl	93,963	6.58
Dichlorvos	247,048	32.04	Parinol	432,760	4.00
Dicofol	897,140	154.68	Piperalin	534,843	102.38
Dienchlor	1,419,882	305.35	Piperonyl butoxide	9,269	0.10
Dinocap	339,017	20.63	Pririmicarb	409,586	265.50
Fenaminosulf	19,940	25.44	Pyrethrins	9,269	0.05
Fenbutatin oxide	197,008	9.80	Sulftotepp	38,757	1.28
Malathion	12,826	2.38	Triforene	496,098	44.28

Table 4: Quantities of Pesticide Chemicals Used on Greenhouse Floriculture Crops in Ohio — 1978—Cont.

Crop: Chrysanthemums (2,419,552 sq. ft.)

Chemical	Area Treated (sq. ft.)	Active Ingredient (pounds)	Chemical	Area Treated (sq. ft.)	Active Ingredient (pounds)
Acephate	210,153	21.25	Fenbutatin oxide	15,206	0.49
Aldicarb	1,763,243	1,946.01	Ferbam	9,269	1.26
Aminozide	660,270	210.54	Glyphosate	53,635	2.51
Ancymidol	84,362	474.50	Maneb	41,030	42.00
Benomyl	566,587	80.00	Methyl bromide	57,192	356.00
Carbaryl	402,382	50.61	Mexacarbate	51,519	0.90
Chlorothalonil	41,030	68.25	Oxamyl	3,283	0.03
Copper sulfate	41,030	9.54	Oxydemeton methyl	361,028	12.13
Cyhexatin	138,301	1.99	Oxythioquinox	51,519	1.65
Diazinon	100,475	4.35	Paraquat	53,635	0.25
Dichlorvos	123,130	38.44	PCNB	18,494	17.25
Dicofol	564,956	18.87	Pirimicarb	757,326	51.99
Endosulfan	481,993	68.50	Resmethrin	253,528	11.28
Fenaminosulf	146,568	71.14	Sulfotepp	76,629	2.79

Crop: Non Specific (2,868,145 sq. ft.)

Acephate	690,599	59.10	Fenaminosulf	1,576,059	413.70
Aldicarb	1,675,963	1,110.30	Malathion	126,720	7.43
Aminozide	1,659,560	264.70	Maneb	461,881	47.28
Banrot	1,261,255	236.40	Methomyl	898,618	11.88
Benomyl	2,243,223	495.30	Oxamyl	369,600	13.20
Calcium cyanide	63,360	2.06	PCNB	945,600	443.25
Captan	63,360	28.50	Piperonyl butoxide	63,360	0.77
Carbaryl	361,658	41.00	Pirimicarb	1,532,038	24.63
Diazinon	1,129,395	65.65	Pyrethrins	63,360	0.08
Dicofol	663,369	89.66	Resmethrin	315,200	0.49
Dienchlor	948,951	243.47	Sulfur	63,360	30.78
Diquat	97,552	9.40	Zineb	443,611	44.33
Ethazol	378,240	88.65			

Table 5: Use of Pesticide Chemicals in Relation to Size of Greenhouse Operation

	Percent of Growers Who Used the Pesticide							
	Area of Classification of Greenhouse Operation (sq. ft.)							
Pesticide	>2500	2501-5000	5001-10000	10001-25000	25001-50000	50001-100000	Over 100000	Total
A. No Pesticides	42.0	10.0			7.1			5.2
B. Insecticides								
Acephate	14.3	10.0		13.0	14.3	26.7	30.0	17.5
Aldicarb		30.0	50.0	78.3	71.4	80.0	75.0	63.9
B. thuringiensis			12.5	8.7	21.4	20.0	25.0	14.4
Carbaryl				4.3	14.3	6.7	25.0	9.3
Chlordane				8.7				2.1
Chlorpyrifos					7.1			1.0
Demeton				4.3	7.1	6.7		3.1
Diazinon				4.3	42.9	13.3	30.0	15.5
Dieldrin					7.1			1.0
Dimethoate						6.7		1.0
Endosulfan	14.3		12.5	4.3	7.1	6.7	15.0	8.2
Lindane	14.3		12.5	4.3	7.1			4.1
Malathion	14.3	40.0	12.5	30.4	14.3	13.3	15.0	20.6
Methiocarb			12.5	8.7			5.0	4.1
Methomyl				13.0	7.1	20.0	50.0	17.5
Naled		20.0	12.5		7.1			4.1
Nicotine		20.0		4.3				3.1
Oxydemeton methyl			37.5	21.7	14.3	13.3	20.0	16.5
Pyrethrins		20.0			7.1	6.7		4.1
Resmethrin			12.5	8.7	14.3	13.3	10.0	9.3
Rotenone		10.0						1.0

Table 5: Use of Pesticide chemicals in Relation to Size of Greenhouse Operation—Cont.

	Percent of Growers Who Used the Pesticide							
	Area of Classification of Greenhouse Operation (sq. ft.)							
Pesticide	>2500	2501-5000	5001-10000	10001-25000	25001-50000	50001-100000	Over 100000	Total
C. Miticides								
Cyhexatin				4.3	14.3	26.7	10.0	9.3
Dicofol		10.0	25.0	34.8	35.7	26.7	45.0	29.9
Dienchlor		20.0	25.0	30.4	35.7	46.7	65.0	37.1
Dinocap				4.3				2.1
Fenbutatin oxide		10.0				6.7	5.0	4.1
Mexacarbate					7.1		5.0	2.1
Oxamyl						13.3	20.0	6.2
Oxythioquinox					7.1	13.3		3.1
Pirimicarb		10.0	12.5	8.7	21.4	6.7	35.0	15.5
Propargite						6.7		1.0
D. Fungicides								
Banrot				8.7	14.3	20.0	30.0	13.4
Benomyl				26.1	57.1	53.3	65.0	36.1
Captan	14.3	10.0			14.3		15.0	7.2
Chlorothalonil				4.3	14.3	13.3	20.0	9.3
Copper hydroxide							10.0	2.1
Copper sulfate							5.0	1.0
DCNA							5.0	1.0
Ethazol				4.3	7.1	33.3	10.0	9.3
Fenaminosulf			25.0	21.7	14.3	20.0	45.0	21.7
Ferbam					7.1	6.7		2.1
Mancozeb						6.7		1.0
Maneb					7.1		10.0	3.1
Parinol							10.0	2.1
PCNB			25.0	21.7	21.4	26.7	30.0	20.6
Piperalin						6.7	5.0	2.1
Sulfur		10.0						1.0
Triforene						6.7		1.0
Zineb				4.3	14.3		10.0	5.2
E. Herbicides								
Cacodylic acid					7.1			1.0
Diquat						6.7	5.0	2.1
Glyphosate						13.3	15.0	5.2
Paraquat						6.7	25.0	4.1
Simazine							5.0	1.0
Sodium arsenate				4.3				1.0
F. Growth Regulators								
Aminozide			12.5	8.7	14.3	26.7	30.0	15.5
Ancymidol						6.7	10.0	3.1
Chlormequat chloride			12.5	8.7	7.1	20.0	10.0	9.3
Ethephon						6.7		1.0
G. Fumigants								
Calcium cyanide		10.0						1.0
Dichlorvos				4.3	7.1	26.7	5.0	7.2
Dicofol						6.7		1.0
Methyl bromide				4.3			5.0	2.1
Sulfotepp	14.3		12.5	4.3		6.7		4.1
H. Other Chemicals								
Metaldehyde				4.3		6.7		2.1
Piperonyl butoxide		20.0			7.1	6.7		4.1
Streptomycin							5.0	1.0
Warfarin					7.1			1.0

Table 6: Pest Problems for Which Pesticide Were Used in Floral Greenhouses — 1978

Crop and Pesticide	Growers Using Pesticides on Crop (Percent)	Percent of Grower Response That Indicated Use of Specific Pesticide for Pest Problem								
A. Bedding Plants		Aphids	Botrytis	Damping Off	Fungus Gnats	Powdery Mildew	Root, Stem, or Crown Rot	Spider Mite	White Fly	Worms
Acephate	7	42.9						14.3		
Aldicarb	18	47.1			5.9			47.1	29.4	
B. thuringiensis	3									66.7
Banrot	9			33.3			22.2			
Benomyl	14		50.0	14.3		7.1	14.3			
Captan	2		50.0	50.0						
Carbaryl	1	100.0								100.0
Chlorothalonil	1		100.0							
Cyhexatin	3							66.7		
Diazinon	5	80.0			40.0			20.0	20.0	
Dichlorvos	3	66.7						66.7	66.7	
Dicofol	5							60.0		
Dienchlor	7							57.1		
Ethazol	2		50.0	50.0						
Fenaminosulf	5		20.0	60.0			20.0			
Lindane	2				50.0					
Malathion	10	80.0						20.0	30.0	
Methomyl	4	25.0							25.0	
Naled	1	100.0								
Oxydemeton methyl	7	85.7						14.3		
PCNB	5		20.0	60.0			20.0			
Pirimicarb	2	100.0								
Pyrethrins	1								100.0	
Resmethrin	4								75.0	
B. Bulb Plants										
Banrot	1						100.0			
Benomyl	6		16.7				50.0			
Dichlorvos	2	50.0						50.0	50.0	
Fenaminosulf	5		20.0				60.0			
PCNB	2		50.0				50.0			

Table 6: Pest Problems for Which Pesticide Were Used in Floral Greenhouses — 1978—Cont.

Crop and Pesticide	Growers Using Pesticides on Crop (Percent)	Percent of Grower Response That Indicated Use of Specific Pesticide for Pest Problem												
C. Cut Flowers		Aphids	Armyworm	Cabbage Looper	Cutworms	Leaf Miner	Nematodes	Powdery Mildew	Root, Stem or Crown Rot	Spider Mites	Thrips	White Fly	Wilt	Worms
Acephate	2	50.0			50.0									
Aldicarb	11	54.5				9.1				54.5		36.4		
Benomyl	2							50.0	50.0				50.0	
Captan	1												100.0	
Chlorpyrifos	1									100.0				
Cyhexatin	1									100.0				
Demeton	1	100.0					100.0							
Diazinon	2	50.0								100.0		50.0		
Dichlorvos	2	100.0								100.0		100.0		
Dicofol	4									25.0				
Dienchlor	6									50.0		16.7		
Fenbutatin oxide	1									100.0				
Ferbam	1												100.0	
Malathion	2	50.0								100.0		50.0		50.0
Methomyl	4		50.0	25.0							25.0			
Nicotine	2	50.0												
Oxydemeton methyl	4	100.0								50.0	25.0			
PCNB	1								100.0					
Pirimicarb	3	33.3								33.3				
Pyrethrins	1											100.0		

Crop and Pesticide	Growers Using Pesticides on Crop (Percent)	Percent of Grower Response That Indicated Use of Specific Pesticide for Pest Problem														
D. Potted Plants		Aphids	Botrytis	Cutworms	Cyclamen Mite	Fungus Gnat	Leaf Miner	Leaf spot & Blight	Mealy Bug	Nematodes	Powdery Mildew	Root, Stem or Crown Rot	Scale	Spider Mites	Thrips	White Fly	Worms
Acephate	5	60.0		20.0											20.0		20.0
Aldicarb	20	68.4				10.5	5.3		5.3					47.4	10.5	38.6	5.3
B. thuringiensis	4																50.0
Banrot	4											50.0					
Benomyl	6		50.0					16.7			16.7	16.7					
Captan	1		100.0														
Carbaryl	2																50.0
Chlorothalonil	4		50.0														

Table 6: Pest Problems for Which Pesticide Were Used in Floral Greenhouses — 1978—Cont.

Crop and Pesticide	Growers Using Pesticides on Crop (Percent)	Percent of Grower Response That Indicated Use of Specific Pesticide for Pest Problem															
D. Potted Plants—continued		Aphids	Botrytis	Cutworms	Cyclamen Mite	Fungus Gnat	Leaf Miner	Leaf spot & Blight	Mealy Bug	Nematodes	Powdery Mildew	Root, Stem or Crown Rot	Scale	Spider Mites	Thrips	White Fly	Worms
Copper hydroxide	1							100.0									
Cyhexatin	3													66.7			
Demeton	1													100.0			
Diazinon	1	100.0												100.0		100.0	
Dichlorvos	4	75.0				25.0								75.0	25.0	75.0	
Dicofol	12	8.3			8.3									75.0			
Dienchlor	8													75.0			
Dinocap	1										100.0			100.0			
Endosulfan	1	100.0												100.0		100.0	
Fenaminosulf	2											50.0					
Fenbutatin oxide	1													100.0			
Malathion	6	66.7											33.3	50.0		50.0	
Methomyl	5			20.0											20.0		20.0
Naled	2	50.0														50.0	
Oxamyl	3									33.3					66.7		
Oxydemeton methyl	4	33.3												33.3			
Oxythioquinox	1													100.0			
PCNB	2											50.0					
Pirimicarb	5	60.0															
Pyrethrins	1															100.0	
Resmethrin	4															75.0	
Sulfotepp	2	50.0				50.0								50.0		50.0	

Crop and Pesticide	Growers Using Pesticides on Crop (Percent)	Percent of Grower Response That Indicated Use of Specific Pesticide for Pest Problem													
E. Small Ornamentals		Aphids	Botrytis	Cyclamen Mites	Leaf Miner	Mealy Bug	Powdery Mildew	Root, Stem or Crown Rot	Scale	Spider Mite	Thrips	White Fly	Wilt	Worms	
Acephate	5	20.0												20.0	
Aldicarb	7	57.1				28.6				71.4	14.3	42.9			
B. thuringiensis	4													75.0	
Banrot	1							100.0							
Benomyl	4		25.0				25.0	50.0					25.0		
Captan	1							100.0							
Carbaryl	1													100.0	
Chlordane	1									100.0					

Table 6: Pest Problems for Which Pesticide Were Used in Floral Greenhouses — 1978—Cont.

Crop and Pesticide	Growers Using Pesticides on Crop (Percent)	Percent of Grower Response That Indicated Use of Specific Pesticide for Pest Problem												
E. Small Ornamentals—continued		Aphids	Botrytis	Cyclamen Mites	Leaf Miner	Mealy Bug	Powdery Mildew	Root, Stem or Crown Rot	Scale	Spider Mite	Thrips	White Fly	Wilt	Worms
Cyhexatin	2									100.0				
Diazinon	1	100.0			100.0	100.0			100.0					100.0
Dichlorvos	3	33.3								33.3		33.3		
Dicofol	5			20.0						20.0				
Dienchlor	9									87.5				
Ensosulfan	3			33.3										
Ethazol	1							100.0						
Fenaminosulf	3							33.3						
Fenbutatin oxide	2									100.0				
Malathion	4	25.0				25.0			25.0	25.0		25.0		
Oxydemeton methyl	5	20.0		20.0										
Oxythioquinox	1									100.0				
PCNB	3							33.3						
Pirimicarb	5	80.0												
Propargite	1									100.0				
Pyrethrins	1											100.0		
Resmethrin	1											100.0		

Crop and Pesticide	Growers Using Pesticides on Crop (Percent)	Percent of Grower Response That Indicated Use of Specific Pesticide for Pest Problem										
F. Lilies, Poinsettias, etc.		Aphids	Botrytis	Leaf Miner[1]	Loopers	Mealy Bug	Powdery Mildew	Root, Stem or Crown Rot	Spider Mite	Thrips	White fly	Worms
Acephate	3								33.3			33.3
Aldicarb	28	40.7		11.1		3.7			33.3	3.7	55.6	
Banrot	3							100.0				
Benomyl	12		16.7				16.7	66.7				
Carbaryl	1											100.0
Diazinon	4	25.0		25.0	25.0					25.0	25.0	25.0
Dichlorvos	2	100.0							100.0		100.0	
Dicofol	5								20.0			
Dienchlor	6								33.3			
Ethazol	4							100.0				
Fenaminosulf	15		6.7					73.3				
Fenbutatin oxide	1								100.0			
Malathion	5	40.0				20.0			40.0		20.0	
Methomyl	4				25.0					25.0		25.0

[1]Pest does not occur on lilies and poinsettias, but may be found on other flower crops included in the grouping.

Table 6: Pest Problems for Which Pesticide Were Used in Floral Greenhouses — 1978—Cont.

Crop and Pesticide	Growers Using Pesticides on Crop (Percent)	Percent of Grower Response That Indicated Use of Specific Pesticide for Pest Problem										
F. Lilies, Poinsettias, etc.—continued		Aphids	Botrytis	Leaf Miner[1]	Loopers	Mealy Bug	Powdery Mildew	Root, Stem or Crown Rot	Spider Mite	Thrips	White fly	Worms
Oxydemeton methyl	4	50.0							25.0			
PCNB	12		8.3					66.7				
Pirimicarb	3	66.7										
Pyrethrins	1										100.0	
Resmethrin	2										50.0	

[1] Pest does not occur on lilies and poinsettias, but may be found on other flower crops included in the grouping.

Crop and Pesticide	Growers Using Pesticides on Crop (Percent)	Percent of Grower Response That Indicated Use of Specific Pesticide for Pest Problem								
G. Carnations Roses, etc.		Aphids	Botrytis	Nematodes	Powdery Mildew	Spider Mites	Thrips	White Fly	Wilt	Worms
Acephate	4	50.0				25.0				25.0
Aldicarb	6	83.3				66.7	33.3			
B. thuringiensis	2									50.0
Benomyl	5				60.0					
Chlorothalonil	2		50.0						50.0	
Diazinon	1	100.0						100.0		
Dichlorvos	2	100.0				50.0		50.0		
Dicofol	6					66.7				
Dienchlor	11					81.8				
Dinocap	1				16.7					
Fenbutatin oxide	1					100.0				
Malathion	2	50.0				100.0		50.0		
Maneb	1								100.0	
Methomyl	2									50.0
Mexacarbate	1									100.0
Naled	2	50.0				50.0				
Oxamyl	1			100.0						
Oxydemeton methyl	5	20.0				60.0				
Parinol	2				100.0					
Piperalin	2				100.0					
Pirimicarb	4	75.0								
Pyrethrins	1							100.0		
Triforene	1				100.0					

Table 6: Pest Problems for Which Pesticide Were Used in Floral Greenhouses — 1978—Cont.

Crop and Pesticide	Growers Using Pesticides on Crop (Percent)	Percent of Grower Response That Indicated Use of Specific Pesticide for Pest Problem														
H. Chrysanthemums		Aphids	Botrytis	Cabbage Looper	Damping Off	Flea Beetles	Leaf Miner	Leaf Roller	Leaf spot & Blight	Nematodes	Powdery Mildew	Root, Stem & Crown Rot	Spider Mites	Symphylans	Thrips	White Fly	Worms
Acephate	6	33.3															16.7
Aldicarb	28	51.9					7.4			3.7			44.4		4.1	14.8	
B. thuringiensis	6																66.7
Benomyl	6		50.0								16.7						
Carbaryl	3					33.3											66.7
Chlorothalonil	1		100.0														
Copper sulfate	1								100.0								
Cyhexatin	4												75.0				
Diazinon	3	33.3					33.3							33.3			
Dichlorvos	1	100.0											100.0			100.0	
Dicofol	9												66.7				
Dienchlor	10												60.0				
Endosulfan	3	33.3														66.7	33.3
Fenaminosulf	3		33.3									33.3					
Ferbam	1				100.0												
Malathion	2	100.0														50.0	50.0
Maneb	1								100.0								
Methomyl	8	12.5		12.5		12.5		12.5									37.5
Mexacarbate	1	100.0											100.0				
Oxamyl	1									100.0							
Oxydemeton methyl	8	50.0											37.5				
Oxythioquinox	1												100.0				
PCNB	1		100.0									100.0					
Pirimicarb	10	70.0															
Resmethrin	5															80.0	20.0
Sulfotepp	2	50.0											50.0				

Table 6: Pest Problems for Which Pesticide Were Used in Floral Greenhouses — 1978—Cont.

Crop and Pesticide	Growers Using Pesticides on Crop (Percent)	Percent of Grower Response That Indicated Use of Specific Pesticide for Pest Problem										
I. Geraniums		Aphids	Botrytis	Fungus Gnat	Leaf Roller	Leaf Spot & Blight	Looper	Root, Stem & Crown Rot	Spider Mites	White Fly	Wilt	Worms
Acephate	1									100.0		
Aldicarb	4	25.0		25.0					25.0			
B. thuringiensis	4						25.0					25.0
Benomyl	1							100.0				
Captan	1		100.0									
Carbaryl	2						50.0					50.0
Chlorothalonil	1		100.0									
Cyhexatin	2								50.0			
DCNA	1		100.0									
Dienchlor	3								33.3			
Endosulfan	1									100.0		
Fenaminosulf	2		50.0					50.0			50.0	
Malathion	1	100.0								100.0		
Methomyl	2				50.0							
PCNB	2		50.0					100.0			50.0	
Pirimicarb	1	100.0										
Zineb	2					50.0						

Crop and Pesticide	Growers Using Pesticides on Crop (Percent)	Percent of Grower Response That Indicated Use of Specific Pesticide for Pest Problem							
J. Other Non-Specific		Aphids	Botrytis	Fungus Gnat	Mealy Bugs	Powdery Mildew	Spider Mites	White Fly	Worms
Acephate	1	100.0					100.0	100.0	
Aldicarb	5	40.0					80.0		
B. thuringiensis	1								100.0
Benomyl	2		50.0			50.0			
Calcium cyanide	1							100.0	
Diazinon	1	100.0							
Dicofol	2						100.0		
Dienchlor	3						100.0		
Malathion	2				50.0				
Methomyl	1								100.0
Pirimicarb	1	100.0							
Resmethrin	1			100.0				100.0	
Sulfur	1					100.0			

Table 7: Use of Protective Clothing by Greenhouse Growers

Protective Clothing or Equipment	Percent of Growers Who Used Protective Clothing in Relation to Size of Greenhouse Operation							
	>2500 sq. ft.	2501- to 5000 sq. ft.	5001 to 10000 sq. ft.	10001 to 25000 sq. ft.	25001 to 50000 sq. ft.	50001 to 100000 sq. ft.	Over 100000 sq. ft.	Total
Goggles or Face Shield	50.0	42.9	12.5	65.2	84.6	80.0	85.0	67.8
Rubber or Neoprene Gloves	75.0	57.1	87.5	82.6	100.0	86.7	100.0	87.8
Rubber or Plastic Apron		14.3	25.0	43.5	46.2	26.7	10.0	27.8
Water Resistant Spray Suit		28.6	12.5	21.7	15.4	33.3	70.0	32.2
Rubber or Neoprene Boots		28.6	37.5	60.9	61.5	46.7	75.0	54.4
Respirator or Gas Mask	25.0	42.9	75.0	87.0	92.3	93.3	85.0	81.9
Washable Head Covering	25.0	42.9		39.1	23.1	66.7	25.0	34.4

Table 8: Use of Protective Clothing Relative to the Pesticide Applied by Greenhouse Growers

Pesticide	Number of Growers Responding Who Used the Pesticides[1]	Percent of growers Who Used Specific Items of Protective Clothing with Use of Pesticide						
		Goggles or Face Shield	Rubber or Neoprene Gloves	Rubber or Plastic Apron	Water Resistant Spray Suit	Rubber or Neoprene Boots	Respirator or Gas Mask	Washable Head Covering
A. Insecticides								
Acephate	17	38.9	55.6	16.7	27.8	38.9	44.4	16.7
Aldicarb	62	59.0	83.6	26.2	23.0	42.6	63.9	31.1
B. thuringiensis	14	7.1	14.3		14.3	14.3	14.3	7.1
Carbaryl	9	33.3	66.7	11.1	33.3			
Chlordane	2		50.0	50.0				
Chlorpyrifos	1		100.0				100.0	
Demeton	3	100.0	100.0	100.0	33.3	66.7	100.0	33.3
Diazinon	15	53.3	80.0	13.3	20.0	53.3	60.0	26.7
Dieldrin	1							
Dimethoate	1	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Endosulfan	8	87.5	100.0	12.5	37.5	37.5	62.5	37.5
Lindane	4	33.3	66.7				33.3	
Malathion	20	27.8	50.0	27.8	22.2	27.8	50.0	11.1
Methiocarb	4		25.0					
Methomyl	17	52.9	82.4	29.4	47.1	47.1	70.0	23.5
Naled	4	25.0	25.0					
Nicotine	3						33.3	
Oxydemeton methyl	16	50.0	68.8	31.3	37.5	50.0	56.0	31.3
Pyrethrins	4							
Resmethrin	9	33.3	66.7	33.3		11.1	55.6	
Rotenone	1							

Table 8: Use of Protective Clothing Relative to the Pesticide Applied by Greenhouse Growers—Cont.

Pesticide	Number of Growers Responding Who Used the Pesticides[1]	Percent of growers Who Used Specific Items of Protective Clothing with Use of Pesticide						
		Goggles or Face Shield	Rubber or Neoprene Gloves	Rubber or Plastic Apron	Water Resistant Spray Suit	Rubber or Neoprene Boots	Respirator or Gas Mask	Washable Head Covering
B. Miticides								
Cyexatin	9	11.1	33.3	11.1	22.2	33.3	33.3	33.3
Dicofol	29	44.8	62.1	20.7	24.1	37.9	55.2	13.8
Dienchlor	36	33.3	55.6	16.7	27.8	33.3	41.7	19.4
Dinocap	3	33.3	33.3		33.3	33.3		66.7
Fenbutatin oxide	4	50.0	50.0	50.0	50.0	50.0	50.0	50.0
Mexacarbate	2	100.0	100.0	50.0	50.0	50.0	100.0	
Oxamyl	6	66.7	100.0	16.7	83.3	83.3	100.0	33.3
Oxythioquinox	3	66.7	66.7	66.7	33.3	33.3	66.7	33.3
Pirimicarb	15	33.3	53.3	13.3	26.7	40.0	46.7	13.3
Propargite	1	100.0	100.0	100.0	100.0	100.0	100.0	100.0
C. Fungicides								
Banrot	13		38.5				15.4	7.7
Benomyl	35	22.9	34.3	8.6	14.3	22.9	25.7	11.4
Captan	7		16.7		16.7	16.7	33.3	
Chlorothalonil	9	44.4	44.4		44.4	33.3	33.3	22.2
Copper hydroxide	2		100.0		100.0	100.0	50.0	
Copper sulfate	1	100.0	100.0		100.0	100.0	100.0	100.0
DCNA	1							
Ethazol	9	11.1	33.3	11.1		11.1	33.3	
Fenaminosulf	21	9.5	28.6	4.8	14.3	14.3	14.3	9.5
Ferbam	2	50.0					50.0	
Mancozeb	1	100.0	100.0				100.0	
Maneb	3	33.3	33.3		33.3	33.3	66.7	33.3
Parinol	2							
PCNB	20		30.0	10.0	5.0	10.0	25.0	5.0
Piperalin	2	50.0	50.0		50.0	50.0	50.0	50.0
Sulfur	1							
Triforene	1	100.0	100.0		100.0	100.0	100.0	100.0
Zineb	5	20.0	40.0		20.0	20.0	40.0	20.0
D. Herbicides								
Cacodylic acid	1							
Diquat	2		50.0	50.0		50.0	50.0	50.0
Glyphosate	5		40.0		20.0	40.0		20.0
Paraquat	4	25.0	50.0		25.0	50.0		25.0
Simazine	1		100.0		100.0	100.0		
Sodium arsenite	1		100.0			100.0		
E. Growth Regulators								
Aminozide	15	6.7	6.7	6.7	6.7	13.3	13.3	6.7
Ancymidol	3							
Chlormequat chloride	9	11.1	11.1		11.1	11.1	22.2	
Ethephon	1							

Table 8: Use of Protective Clothing Relative to the Pesticide Applied by Greenhouse Growers—Cont.

Pesticide	Number of Growers Responding Who Used the Pesticides[1]	Percent of Growers Who Used Specific Items of Protective Clothing with Use of Pesticide						
		Goggles or Face Shield	Rubber or Neoprene Gloves	Rubber or Plastic Apron	Water Resistant Spray Suit	Rubber or Neoprene Boots	Respirator or Gas Mask	Washable Head Covering
F. Fumigants								
Calcium cyanide	1							
Dichlorvos	7	83.3	33.3		33.3	33.3	83.3	50.0
Dicofol	1							
Methyl bromide	2		50.0	50.0				
Sulfotepp	4	33.3					33.3	33.3
G. Other Chemicals								
Metaldehyde	2							
Piperonyl butoxide	4							
Streptomycin	1		100.0			100.0	100.0	
Warfarin	1							

[1]Of the 97 respondents to the survey, 92 recorded the use of one or more pesticide chemicals.

Table 9: Some Characteristics of Greenhouse Floriculturalists

Factors in Pesticide Application	Percent of Growers in Relation to Size of Greenhouse Identified with Factor							
	>2500 sq. ft.	2501 to 5000 sq. ft.	5001 to 10000 sq. ft.	10001 to 25000 sq. ft.	25001 to 50000 sq. ft.	50001 to 100000 sq. ft.	>100000 sq. ft.	Total
Certified Applicator	0.0	14.3	62.5	69.6	76.9	100.0	95.0	73.3
Steam Sterilization	25.0	42.9	75.0	78.3	76.9	80.0	85.0	74.4
Used some Custom Application				17.4	7.1		15.0	8.2

Table 10: Procedures Used by Greenhouse Floriculturalists in Pesticide Storage

	Storage Procedure	Practiced by Growers (percent)*
1.	Stored in a separate building	12.2
2.	Stored in a building housing other materials	61.1
3.	Separated by a barrier from other materials in the building	54.4
4.	Kept under locked storage	46.7
5.	Storage area is fireproof	8.9
6.	Storage area has facilities for fire protection	23.3
7.	Storage area has facilities for temperature control	27.8
8.	Storage area has facilities for air movement	37.8
9.	Storage area has provisions for separation and segregation of different pesticide materials	41.1
10.	Storage area is equipped with isolated drainage system	10.0
11.	Storage area is accessible only to authorized personnel	44.4
12.	Pesticides are sometimes stored in other than the original container	3.3

* The percentage total exceeds 100 percent because more than one procedure may apply to an individual grower's pesticide storage practices.

Table 11: Procedures Used by Greenhouse Floriculturalists in Disposing of Surplus Pesticide

	Procedure	Practiced by Growers (percent)*
1.	Surplus pesticide stored for use in next growing season	80.0
2.	Surplus pesticide returned to dealer	1.1
3.	Surplus pesticide applied for some other labelled use	21.1
4.	Surplus pesticide diluted and sprayed over isolated area	4.4
5.	Surplus pesticide buried in an isolated area	7.8
6.	Surplus pesticide burned or incinerated	5.6
7.	Surplus pesticide disposed of in a landfill operation	7.8
8.	Surplus pesticide disposed of by a commercial waste disposal company	5.6
9.	Surplus pesticide disposed of in environmental, municipal, or public drainage systems	1.1

* The percentage total exceeds 100 percent because the growers may utilize more than one procedure for disposing of surplus pesticide.

Table 12: Procedures Used by Greenhouse Floriculturalists in Disposing of Empty Pesticide Containers

	Procedure	Practiced by Growers (percent)*
1.	Metal and plastic containers are decontaminated by the triple rinse or similar procedure	32.2
2.	Combustible containers are burned on premises	40.0
3.	Containers are buried on premises	26.7
4.	Containers disposed of in sanitary landfill facilities	44.4
5.	Large containers are returned to the dealer or manufacturer	4.4
6.	Containers are disposed of through barrel reclaimers, etc.	0.0
7.	Containers are disposed of through commercial waste disposal companies	28.9
8.	Containers are sometimes used for other purposes on the premises or by others	1.1
9.	Containers accumulate on premises	0.0
10.	Containers are dumped at out-of-the-way places	1.1
11.	Containers are stored for future disposal	5.6
12.	Storage facilities for empty containers are similar to or the same as that for pesticide storage and are kept locked	5.6

* The percentage total exceeds 100 percent because the growers may utilize more than one procedure for disposing of surplus pesticide.

Table 13: Factors Considered Most important by Greenhouse Floriculturalists in Selection of Pesticides

Factors	Grower Response (percent)
1. Information Source	
A. Recommendation of dealer	22.7
B. Recommendation of neighbor	2.8
C. Recommendation of extension agent	48.2
D. Advertisements from companies, radio, TV	0.3
E. Personal experience	26.0
2. Econoomic Factors	
A. Cost per unit treated	37.5
B. Compatibility with existing equipment	62.5
3. Personal Hazard Factors	
Given the choice between two chemicals with equal control potential, indicate the criterion you would use to make your choice:	
A. Choice of chemical with lower toxicity	35.3
B. Choice of chemical requiring less personal protection	9.5
C. Choice of chemical not requiring applicator certification	3.8
D. Deciding factor is satisfactory pest control toxicity of chemical is of secondary consideration	25.7
E. Choice of chemical with short treatment to harvest day-waiting-time	7.6
F. Choice of chemical with prolonged control	18.1