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PESTICIDE USE ON POTATOES IN UPSTATE NEW YORK

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ABSTRACT

Potato growers in two areas in Upstate New York were surveyed by mail about their pest control practices during the 1980 growing season. Information about acreage, varieties, intended market, land type, herbicides, systemic and foliar insecticides, frequency of fungicide sprays, and method of pesticide application was received from 38 growers having ten or more acres of potatoes. These 38 respondents constitute 81% of the sample population.

The purpose of the survey was to describe the pest control practices of potato growers in the two study areas and to provide a basis for a later in-depth field survey designed to estimate the cost of control practices. Except for information about acreage, approximate frequency of fungicide applications, and specifications of spray equipment, the information sought with the mail questionnaire was qualitative, indicating the names but not amounts of the pesticides that were used.

The results of the survey are summarized and discussed, and implications for the New York State Potato Pest Management Program are suggested. The potential for field scouting, the relationship between aerial application and frequency of sprays, and a comparison between the two study areas are discussed. An implication of the study is that different producing areas may require different types of recommendations and different methods of delivering information.

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PESTICIDE USE ON POTATOES IN UPSTATE NEW YORK

by

G. R. Fohner and G. B. White*

INTRODUCTION

This report summarizes the results of a mail questionnaire sent to potato growers in two study areas in Upstate New York, the Wayne Study Area encompassing Wayne and Ontario Counties and the Steuben Study Area containing Steuben County and a small part of Livingston County. This survey of pesticide use on potatoes grown for tablestock and processing 1/ is intended to contribute to the Potato Pest Management Program being developed by personnel at Cornell University and the New York State Agricultural Experiment Station at Geneva. The two study areas were selected because of their contrasting resource, marketing, and acreage characteristics and because the Extension agents from the study areas are actively involved in the Potato Pest Management Program.

OBJECTIVES

The mail questionnaire provided information about potato acreage and varieties, intended market, soil, use of systemic and foliar insecticides, choice of herbicides, fungicide spray schedules and methods of pesticide application. Data about exact number of applications, acres treated, and rates of application were not sought on the mail questionnaire. Field studies in which pesticide use on commercial farms was monitored suggest that accurate quantitative data is difficult to obtain for many farms, even when collected during the growing season. It was believed that seeking detailed quantitative records by mail would reduce the rate of response while providing questionable results. Consequently, the questionnaire was designed to obtain a high rate of response to questions that could be answered accurately. The information obtained is useful, and also can guide the

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1/ Acreage of potatoes grown for seed was reported but no questions were asked about pesticide use on this relatively small acreage.

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collection and analysis of more quantitative data. Together, the qualitative and quantitative data will help determine the feasibility of alternative recommendations and strategies that might be developed by the Potato Pest Management Program.

METHODS

Sixty-four potato growers were surveyed, 39 in the Wayne Study Area and 25 in the Steuben Study Area. Lists believed to include all commercial 2/ potato growers in the study areas were provided by county Cooperative Extension agents. The questionnaires were mailed on November 25, 1980. Reminder cards were mailed on December 11 to the 34 growers who had not yet responded. A second mailing of the questionnaire was sent on January 8, 1981. County Extension agents provided estimates of the potato acreage of growers who had not responded by February 1. The results have been updated to include responses received up through February 14.

The information from the mail questionnaire was relatively inexpensive to obtain compared to the cost of collecting quantitative data in the field. By describing subgroups, or "strata", of potato farms having similar pest management practices and indicating the number of farms in each of these strata, the information from the questionnaire provides a basis for selecting a stratified random sample of potato farms for which records of pesticide use will be kept during the summer of 1981. The information from the questionnaire also aids in the interpretation of quantitative data collected from a nonrandom sample of potato farms in the Steuben Study Area during the 1980 growing season.

RESULTS

Response to the Questionnaire

Table 1 summarizes the rates of response. In addition to responses to the survey, ten other growers in Steuben County participated in a field study conducted during the 1980 season. Data for these participants are included in the results except where noted.

Figure 1 shows the acreage distribution among the respondents. The distribution of acreage in the Wayne Study Area is bimodal, with the majority of responses being from growers having between 10 and 50 acres of potatoes. The two size classes of acreage represent two groups of growers that in some respects have different pest management practices and needs. Accordingly, the data for these two groups are summarized separately in this report. The overall mean acreage for the Wayne Study Area is 146 acres; the median is

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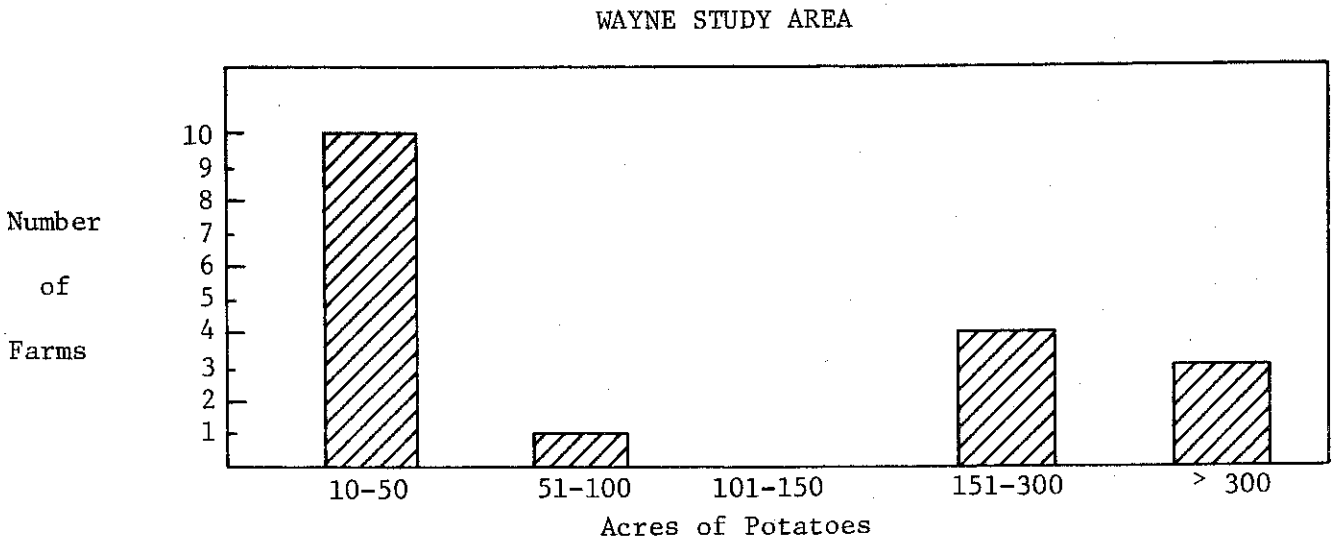
2/ A commercial potato grower is here defined as one who grows and sells potatoes. The acreages reported by respondents (Table 1 and Figure 1) suggest that the full range of commercial producers were surveyed.

Table 1. Response to the Potato Pest Management Survey, Upstate New York, 1980.

	Wayne Study Area Number of Growers	Steuben Study Area Number of Growers*
Growers Surveyed	39	25
Growers Responding	33	17
Growers Reporting No Potatoes in 1980	10	3
Growers Reporting Less Than 10 Acres of Potatoes in 1980	5	3
Incomplete Response	0	1
Responses Used in the Analysis	18	10*

* Data for an additional 10 growers was obtained with a field study conducted in Steuben County during the 1980 season.

Figure 1. Potato Acreage of Responding Growers. Upstate New York, 1980.



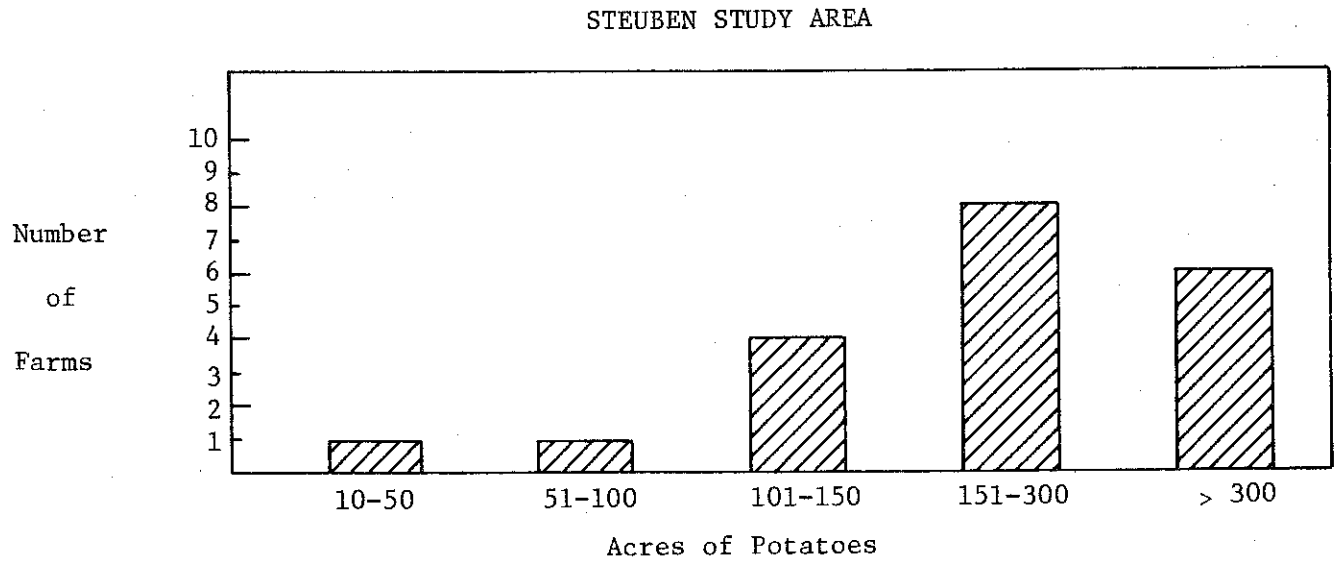
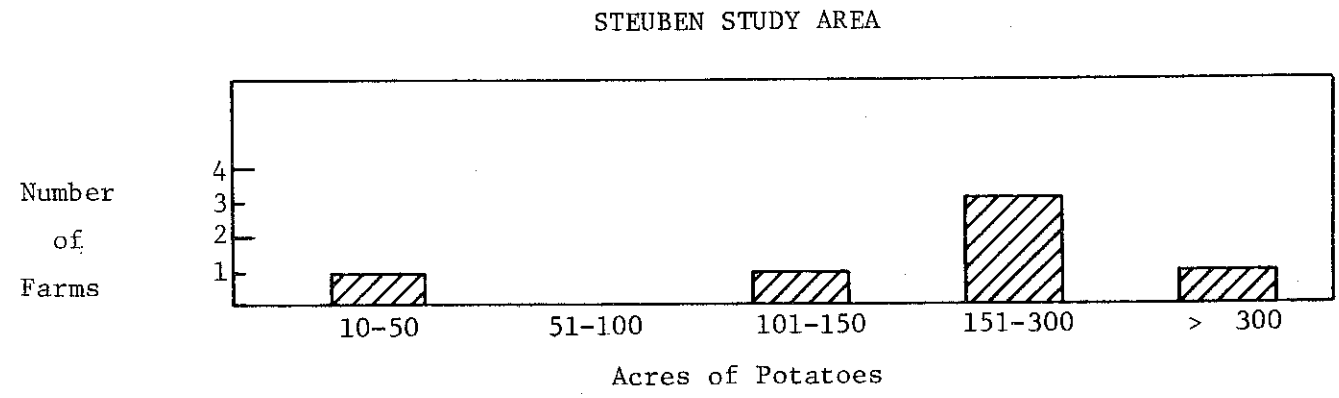


Figure 2. Potato Acreage of Nonrespondents.



45 acres. For the small acreage class, farms with between 10 and 50 acres of potatoes, the mean acreage is 27; the median is 22 acres. For the large acreage class, farms with more than 50 acres of potatoes, the mean is 295 acres; the median is 273 acres. The distribution of acreage in the Steuben Area is unimodal, with mean 238 acres and median 198 acres.

Description of Nonrespondents

To determine whether respondents represent an unbiased subsample of the total population of growers in the study areas, the Extension agents were asked about the growers who did not respond to the questionnaire. In the Wayne Study Area, the six nonrespondents included a partnership of two growers so only five potato farms were not represented in the survey. Of these five farms, two had approximately 50 acres of potatoes, one had approximately 150 acres, and the acreage of the other two farms was unknown but presumed to be small. In the Steuben Area, the eight nonrespondents included two growers with less than ten acres of potatoes; the approximate potato acreage of the other six growers is described in Figure 2.

The similarity between the size distribution of respondents and nonrespondents (Figures 1 and 2), and other information provided by the Extension agents, suggest that the respondents provide an unbiased characterization of the total group of potato growers in the study areas. Based on the supplementary data about nonrespondents, (18/21) = 86% of the growers having ten or more acres of potatoes responded to the questionnaire from the Wayne Study Area and (20/26) = 77% responded from the Steuben Area, including the participants in the field study. The responding growers accounted for 91% of the potato acreage in the Wayne Study Area and 83% of the acreage of the Steuben Study Area.

Markets and Potato Varieties

Table 2 indicates the markets for which the farms in the survey grew potatoes. Potatoes grown in the Wayne Study Area are grown primarily for tablestock while those grown in Steuben are primarily for chips. Farms in the small acreage class in Wayne grow exclusively for tablestock; farms in the large acreage class market almost one-third of their potatoes for chips or other processing. Although growers were not surveyed about other crops on their farm, some farms in the small acreage class are likely to be diversified, fresh-market vegetable producers.

Table 2 also indicates the type of soil on which the potatoes were grown. The muck soils are level soils composed primarily of organic matter. These soils can be very productive potato lands but generally require stronger measures to control insects and foliar diseases than are needed on mineral soils. In the Wayne Study Area, almost 90% of the potato acreage is on muck soil; in Steuben, less than 5% is on muck.

Potato varieties differ in their suitability for fresh market and processing, and in length of growing season and susceptibility to disease. Although some varieties are similar enough to be managed identically, the differences among others may require different management practices,

Table 2. Potato Acreage Included in the Survey, Upstate New York, 1980. (For farms with at least 10 acres of potatoes)

	Wayne Study Area			
	Small Acreage Class[1/]		Large Acreage Class[1/]	
	Number of Acres	% of Acres	Number of Acres	% of Acres
Acres for Tablestock	265	99%	1612	68%
Acres for Seed (for sale or own use)	2	1%	0	0%
Acres for Chips or Other Processing	0	0%	748	32%
Total Acres	267		2360	
Acres on Muck Soil	230	86%	2072	88%

[1/] Small Acreage Class: 10 to 50 acres of potatoes. Large Acreage Class: more than 50 acres of potatoes.

	Steuben Study Area All Farms*	
	Number of Acres	% of Acres
Acres for Tablestock	347	7%
Acres for Seed (for sale or own use)	289	6%
Acres for Chips or Other Processing	4129	87%
Total Acres	4765	
Acres on Muck Soil	202	4%

* Includes ten participants in field study and ten respondents.

including different efforts to control pests. Figure 3 indicates the number of varieties grown on each farm. For both acreage classes in the Wayne Study Area, the median number of varieties is three. In the Steuben Study Area the median is four, which is the number of varieties grown on 50% of the farms. Table 3 reports the number and percentage of farms growing each particular variety. These data reflect the markets to which the potatoes are sold: the importance of tablestock for the Wayne growers, especially those in the small size class, and the emphasis on production of potatoes for chips by the Steuben growers.

Systemic Insecticides

Table 4 summarizes the use of systemic insecticides, those applied into the soil at planting and subsequently taken up by the plant. The pattern of use was different for all three groups of farms. Use of systemic insecticide was least common in the small acreage class of the Wayne Study Area. On each farm in the small acreage class, all acreage on the farm was treated identically, either all acreage was treated with systemic or none of it was. Among growers in the large acreage class in the Wayne Study Area, only one did not apply systemic on any acreage, but one-half of the group applied systemic on only part of their acreage. In the Steuben Study Area, systemic insecticide was used on all farms, and only one grower did not treat all of his acreage with systemic.

Table 5 indicates which systemic insecticides were used in the study areas. Although use of systemic insecticides was less common in the Wayne Study Area, those growers who used a systemic used Temik, the most effective and expensive ($43 per acre at recommended rate) among the four systemics used on potatoes. In the Steuben Study Area, the most commonly used systemic was DiSyston, the least expensive systemic insecticide ($18 per acre at the recommended rate).

Foliar Insecticides

All growers in the Wayne Study Area sprayed all their potato acreage with insecticide at least once during the season. In the Steuben Study Area three-fourths of the growers sprayed all of their potato acreage with insecticide; only two growers did not spray insecticide on any of their potato acreage. The other three growers sprayed insecticide on less than one-half of their potato acreage.

The growers were not asked how many times insecticides were sprayed nor were they asked how many acres were sprayed with a particular insecticide. They were asked to indicate which insecticides they used on potatoes in 1980. Figure 4 indicates the number of different foliar insecticides per farm applied on potatoes. The number of different foliar insecticides applied on the farm may not equal the number of applications since (1) the same insecticide may have been applied more than once on the same acreage, (2) different insecticides may have been used on different acreage and (3) tank mixtures of more than one insecticide may have been applied. In the Wayne Study Area, the frequency distribution for the number of different foliar insecticides for farms in the small acreage class is similar to that

Figure 3. Number of Potato Varieties Grown on Each Farm. Upstate New York, 1980.

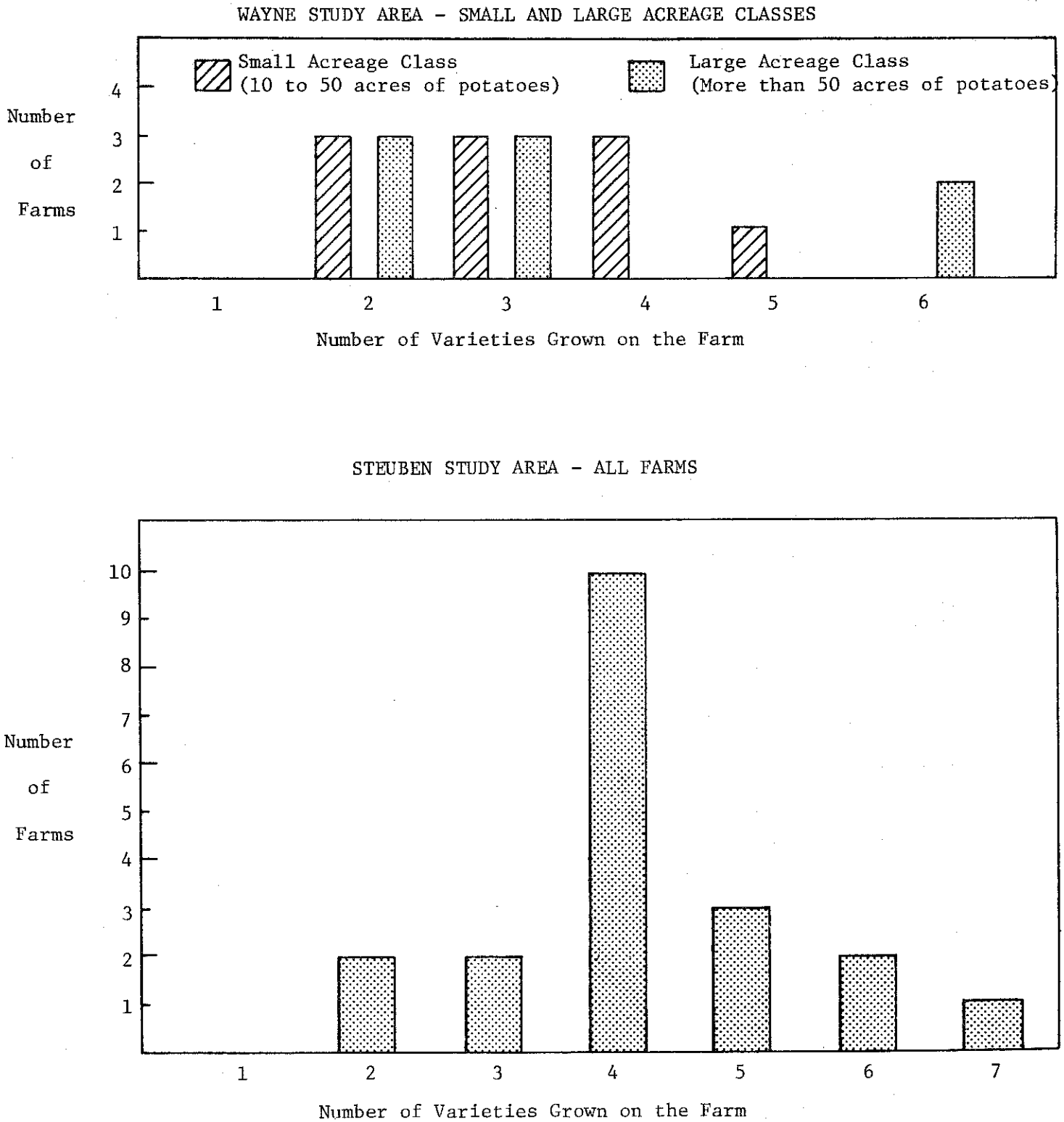


Table 3. Potato Varieties Grown in the Study Areas, Upstate New York, 1980.

Wayne Study Area					
Small Acreage Class[1]			Large Acreage Class[1]		
Variety	Number of Farms	% of Farms	Variety	Number of Farms	% of Farms
Katahdin	10	100%	Monona	7	88%
Superior	8	80%	Superior	7	88%
Chieftain	6	60%	Katahdin	3	38%
Norland	4	40%	Belrus	2	25%
Belrus	1	10%	Norchip	2	25%
Irish Cobbler	1	10%	Ontario	2	25%
Sebago	1	10%	Atlantic	1	13%
Wauseon	1	10%	Chieftain	1	13%
			Norland	1	13%
			Wauseon	1	13%

[1] Small Acreage Class: 10 to 50 acres of potatoes. Large Acreage Class: more than 50 acres of potatoes.

Steuben Study Area					
All Farms					
Variety	Number of Farms	% of Farms	Variety	Number of Farms	% of Farms
Norchip	17	85%	Norland	4	20%
Monona	13	65%	Belchip	2	10%
Kennebec	10	50%	Belrus	2	10%
FL 657	9	45%	FL 774	2	10%
Superior	9	45%	Campbell 13	1	5%
Atlantic	4	20%	Cent. Russet	1	5%
Chieftain	4	20%	FL 2	1	5%
Katahdin	4	20%	FL 945	1	5%

Table 4. Use of Systemic Insecticides on Chipping and Tablestock Potatoes, Upstate New York, 1980.

	Wayne Study Area			
	Small Acreage Class[1]		Large Acreage Class[1]	
	Number of Farms	% of Farms	Number of Farms	% of Farms
Not Applied on Any Potato Acreage	7	70%	1	12%
Applied on All Potato Acreage	3	30%	3	38%
Applied on More Than Half of Potato Acreage	0	0%	4	50%
Applied on Less Than Half of Potato Acreage	0	0%	0	0%

[1] Small Acreage Class: 10 to 50 acres of potatoes. Large Acreage Class: more than 50 acres of potatoes.

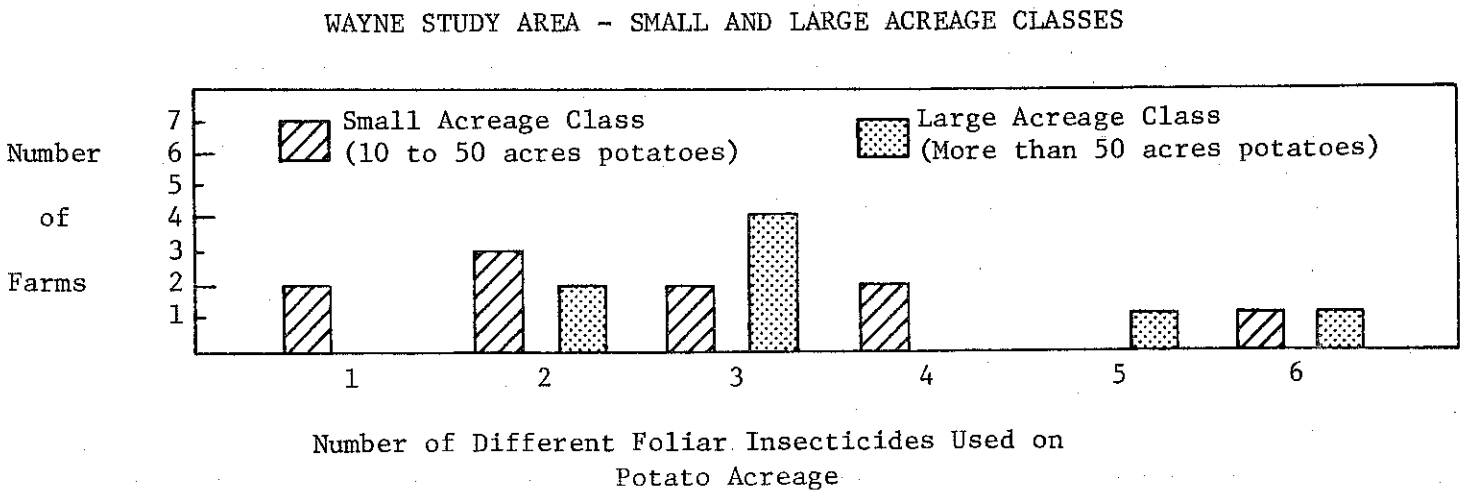
	Steuben Study Area	
	All Farms	
	Number of Farms	% of Farms
Not Applied on Any Potato Acreage	0	0%
Applied on All Potato Acreage	19	95%
Applied on More Than Half of Potato Acreage	0	0%
Applied on Less Than Half of Potato Acreage	1	5%

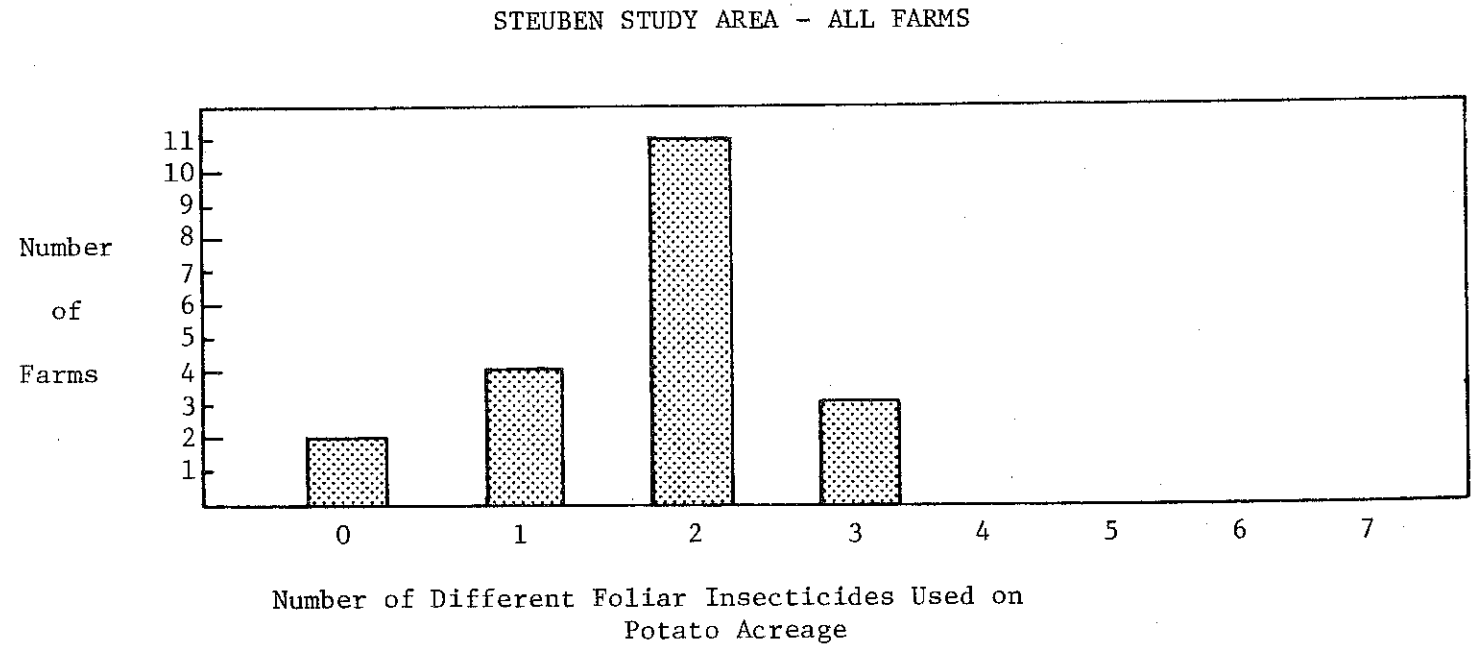
Table 5. Systemic Insecticides on Chipping and Tablestock Potatoes, Upstate New York, 1980.

	Wayne Study Area - All Farms		Steuben Study Area - All Farms	
	Number of Farms	% of the Farms Using Systemics	Number of Farms*	% of the Farms Using Systemics
DiSyston	0	0%	14	70%
Furadan	0	0%	3	15%
Temik	10	100%	4	20%
Thimet	0	0%	2	10%

* On three farms, two different systemics were used.

Figure 4. Use of Foliar Insecticides on Chipping and Tablestock Potatoes. Upstate New York, 1980.





for farms in the large acreage class, although the farms in the large acreage class tended to use a slightly greater number of different insecticides. Both groups in the Wayne Study Area tended to use more different foliar insecticides than did the growers in the Steuben Study Area, for which the frequency distribution was sharply peaked at two different foliar insecticides per farm. Table 6 indicates the number and percentage of farms using various foliar insecticides.

Herbicides for Weed Control

Growers were asked to indicate which herbicides they used for weed control on their potatoes in 1980. They were not asked how many acres were treated with each herbicide, nor were they asked about chemicals used to kill the potato foliage at the end of the season. Figure 5 shows the frequency distributions of the number of different herbicides used per farm in the two study areas. The distributions are very similar for the small and large acreage classes in the Wayne Study Area. Growers in the Steuben Study Area tended to use a greater number of different herbicides than did those in the Wayne Study Area. Table 7 indicates the number and percentage of farms using various herbicides. A major difference between the herbicides used in the two study areas is the large number of farms in the Steuben Study Area that reported using Roundup in 1980 on land on which potatoes are rotated.

Frequency of Fungicide Applications

Growers were asked whether fungicides were sprayed on their potatoes according to an approximately regular schedule. Field studies suggested that growers differ in the extent to which they adhere to a regular spray schedule. The question asked of the growers proved to be poorly designed for detecting such differences in adherence, if they do exist; all growers reported spraying fungicides according to an approximately regular schedule. However, the time intervals at which the growers reportly sprayed did indicate some interesting differences. Table 8 indicates the average number of days between fungicide sprays for farms in the two study areas.3/ Farms in the large acreage class in the Wayne Study Area were sprayed the most frequently, while farms in the small acreage class were sprayed less frequently than farms in either the large acreage class or the Steuben Study Area.

The 1980 growing season was a dry one in many parts of New York State, and, at least in the Steuben Study Area, was regarded as a year unfavorable for late blight disease on potatoes. Five of the ten growers who participated in the 1980 field study in the Steuben Study Area had reported that they were spraying less often than in most previous years. In the mail survey, growers were asked how the number of fungicide sprays they applied

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3/ Data for the ten participants in the field study in the Steuben Study Area are not presented in Table 8 since information about their spray schedule was based on field data rather than on a post-season appraisal by the grower.

Table 6. Foliar Insecticides Used for Chipping and Tablestock Potatoes, Upstate New York, 1980.

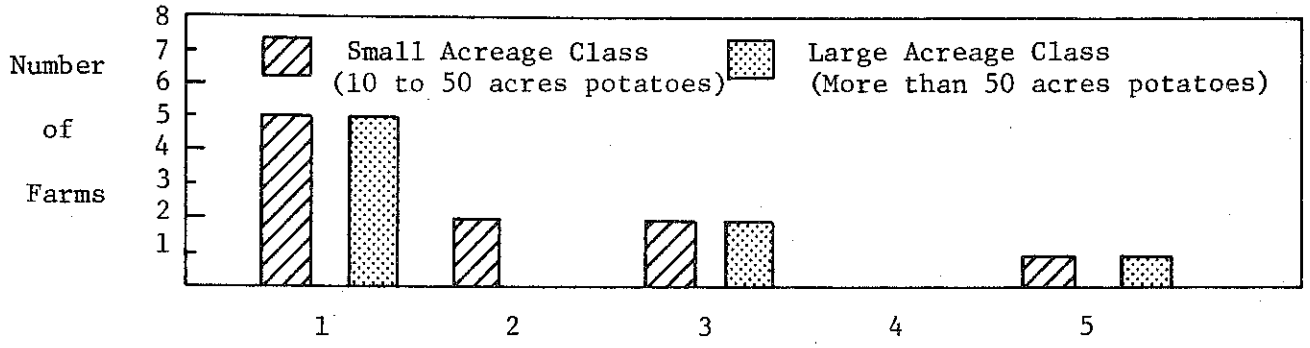
Wayne Study Area					
Small Acreage Class[1/]			Large Acreage Class[1/]		
Insecticide	Number of Farms	% of Farms	Insecticide	Number of Farms	% of Farms
Monitor	9	90%	Monitor	8	100%
Parathion	5	50%	Parathion	7	88%
Sevin	3	30%	Imidan	3	38%
Guthion	2	20%	Penncap	2	25%
Furadan	2	20%	Sevin	2	25%
Lannate	2	20%	Ambush	1	13%
Pydrin	2	20%	Guthion	1	13%
Thiodan	2	20%	Pirimor	1	13%
Penncap	1	10%	Pydrin	1	13%
			Vydate	1	13%

[1/] Small Acreage Class: 10 to 50 acres of potatoes. Large Acreage Class: more than 50 acres of potatoes

Steuben Study Area		
	All Farms	
Insecticide	Number of Farms	% of Farms
Monitor	13	65%
Parathion	10	50%
Imidan	5	25%
Penncap	4	20%
Sevin	1	5%
Guthion	1	5%
Furadan	1	5%

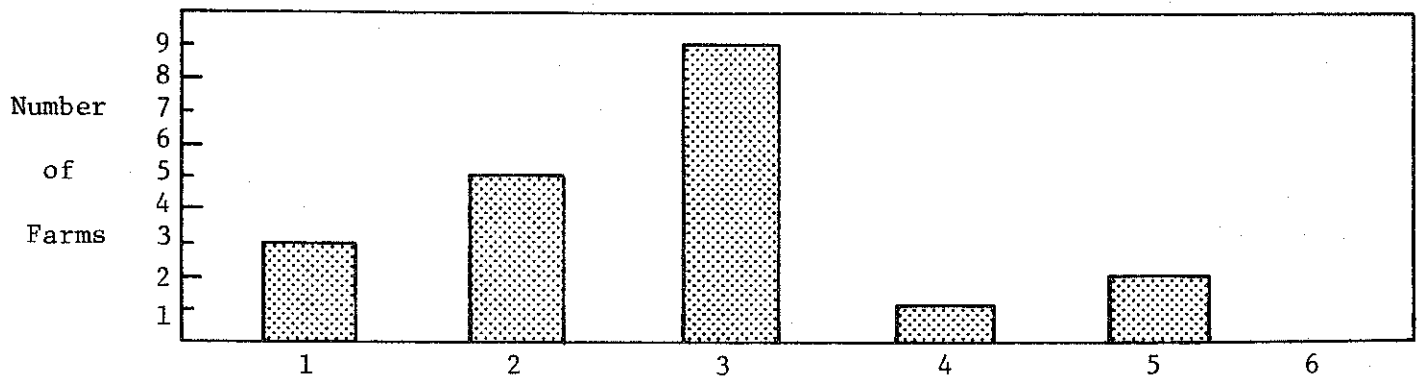
Figure 5. Use of Herbicides for Weed Control for Chipping and Tablestock Potatoes. Upstate New York, 1980.

WAYNE STUDY AREA - SMALL AND LARGE ACREAGE CLASSES



Number of Different Herbicides Used on Some or All Potato Acreage for Weed Control.

STEUBEN STUDY AREA - ALL FARMS



Number of Different Herbicides Used on Some or All Potato Acreage for Weed Control.

Table 7. Herbicides Used for Weed Control for Chipping and Tablestock Potatoes, Upstate New York, 1980.

Wayne Study Area					
Small Acreage Class[1]			Large Acreage Class[1]		
Herbicide	Number of Farms	% of Farms	Herbicide	Number of Farms	% of Farms
Lorox	9	90%	Lorox	6	75%
Sencor	4	40%	Sencor[2]	5	63%
Roundup*	3	30%	Lasso	2	25%
Paraquat	2	20%	Eptam	1	13%
Eptam	1	10%	Lexone[2]	1	13%
Lasso	1	10%	Paraquat	1	13%

[1] Small Acreage Class: 10 to 50 acres of potatoes. Large Acreage Class: more than 50 acres of potates.

[2] Same active ingredient.

* Roundup used on land planted to potatoes in future years.

Steuben Study Area All Farms		
Herbicide	Number of Farms	% of Farms
Roundup*	12	60%
Sencor[2]	10	50%
Premerge	8	40%
Lorox	7	35%
Dowpon	6	30%
Paraquat	4	20%
Eptam	3	15%
Lexone[2]	3	15%
Lasso	1	5%

[2] Same active ingredient

* Roundup used on land planted to potatoes in future years.

Table 8. Frequency of Fungicide Applications on Chipping and Tablestock Potatoes, Upstate New York, 1980.

Average Number of Days Between Sprays	Wayne Study Area Small Acreage Class[1] Number of Farms	% of Farms	Large Acreage Class[1] Number of Farms	% of Farms
Less than 7 days	0	0%	2	25%
7 days	2	20%	5	63%
More than 7 days	8	80%	1	12%

[1] Small Acreage Class: 10 to 50 acres of potatoes. Large Acreage Class: more than 50 acres of potatoes.

Average Number of Days Between Sprays	Steuben Study Area* Number of Farms	% of Farms
Less than 7 days	0	0%
7 days	4	40%
More than 7 days	6	60%

* Does not include participants in Field Study.

in 1980 compared to the number applied in most other years. Somewhat surprisingly, only two of the growers surveyed by mail in the Steuben Area reported using fewer fungicide sprays in 1980 and one reported using more sprays. In the Wayne Study Area, one grower reported using fewer sprays and one reported using more sprays; all others reported that the number of fungicide sprays in 1980 was "about the same" as in most previous years.

Methods of Applying Pesticide Sprays

On potatoes in Upstate New York, foliar sprays of fungicides and insecticides are applied by both ground sprayers and aircraft, Table 9. One-half of the growers in the small acreage class in the Wayne Study Area applied all sprays by ground; the other half used both ground and aerial application at some time in the season. All of the growers in the large acreage class in the Wayne Study Area applied at least some sprays by air and half of these growers relied solely on aerial application for fungicides and insecticides. Over half of the growers in the Steuben Study Area used both ground and aerial application; only 10% relied solely on aerial application. Table 10 summarizes the types of ground and aerial sprayers used in the two study areas. A major difference between the machinery used in the two areas is the number of boomless, or "airblast", sprayers used in the Steuben Study Area, perhaps reflecting the irregular shape and uneven terrain of many potato fields in the Steuben area compared to the Wayne muck lands.

Growers reported the number of rows of potatoes covered by the swath of the ground sprayer they used for fungicides and insecticides. The median swath width was 10 rows for the small acreage class, 16 rows for the large acreage class and 18 rows for the Steuben Study Area. Growers also reported the spray tank capacity of their ground sprayers and the approximate number of acres sprayed on one tankful of spray. This data provided estimates of the gallons of spray mixture applied per acre. Table 11 reports these estimates. The gallons of water per acre with which a pesticide is applied is believed to effect the coverage attained by the spray.

Interest in the Potato Pest Management Program

All growers except four, two in each study area, requested more information about the Potato Pest Management Program.

DISCUSSION AND SUMMARY

Comparison with Past Surveys of Pesticide Use on Potatoes in Upstate New York

Tingey and Bergman, and Muka and Heath surveyed Upstate potato growers about their pesticide use in 1975 and 1978 respectively. The current survey and the two past surveys all differ with respect to sampled population and survey methods. Despite this limitation, comparison does provide a qualitative context in which to view the results of the current survey, especially with respect to insecticide use. Comparisons suggest that systemic insecticides are now being used more widely than in the past. Also, Monitor and

Table 9. Methods of Applying Foliar Pesticide Sprays, Upstate New York, 1980.

	Wayne Study Area			
	Small Acreage Class[1]		Large Acreage Class[1]	
	Number of Farms	% of Farms	Number of Farms	% of Farms
Ground Rig Only	5	50%	0	0%
Aerial Application Only	0	0%	4	50%
Both Ground and Aerial	5	50%	4	50%

[1] Small Acreage Class: 10 to 50 acres of potatoes. Large Acreage Class: more than 50 acres of potatoes.

	Steuben Study Area	
	All Farms	
	Number of Farms	% of Farms
Ground Rig Only	6	30%
Aerial Application Only	2	10%
Both Ground and Aerial	12	60%

Table 10. Machinery Used to Apply Foliar Pesticide Sprays, Upstate New York, 1980.

	Wayne Study Area - Aerial Application			
	Small Acreage Class		Large Acreage Class	
	Number of Farms	% of Farms in Acreage Class	Number of Farms	% of Farms in Acreage Class
Airplane only	2	20%	8	100%
Helicopter only	0	0%	0	0%
Both Airplane and Helicopter	3	30%	0	0%

	Steuben Study Area - Aerial Application	
	All Farms	
	Number of Farms	% of Farms in Study Area
Airplane only	8	40%
Helicopter only	6	30%
Both Airplane and Helicopter	0	0%

	Wayne Study Area - Application by Ground Rig			
	Small Acreage Class		Large Acreage Class	
	Number of Farms	% of Farms in Acreage Class	Number of Farms	% of Farms in Acreage Class
Boom sprayer	10	100%	4	50%
Boomless sprayer	0	0%	0	0%

	Steuben Study Area - Application by Ground Rig	
	All Farms	
	Number of Farms	% of Farms in Study Area
Boom sprayer	9	45%
Boomless sprayer	9	45%

Table 11. Gallons of Water Per Acre for Foliar Sprays, Upstate New York, 1980.

Gallons Per Acre	Wayne Study Area - Farms with Application by Ground Rig: Small Acreage Class 1/ Number of Farms	Small Acreage Class 1/ % of Farms Using Ground	Large Acreage Class 1/ Number of Farms	Large Acreage Class 1/ % of Farms Using Ground
Less than 40	3	30%	2	50%
41 - 60	2	20%	1	25%
61 - 80	3	30%	1	25%
80 - 100	2	20%	0	0%

1/ Small Acreage Class: 10 to 50 acres of potatoes.
Large Acreage Class: More than 50 acres of potatoes.

Gallons Per Acre	Steuben Study Area - Farms with Application by Ground Rig: All Farms Number of Farms	All Farms % of Farms Using Ground
Less than 40	12	67%
41 - 60	5	28%
61 - 80	1	5%
80 - 100	0	0%

Parathion continue to be commonly used. Additional analysis may suggest other valid and useful comparisons.

Comparison Between the Wayne and Steuben Study Areas

Farms in the Wayne Study Area differ from those in Steuben in terms of potato acreage and varieties, marketing, degree of specialization, and land resources. Compared to Steuben Farms, the Wayne Farms in the small acreage class contain relatively small acreages of potatoes, presumably in combination with acreage of other vegetables. Most potatoes in the Wayne Study Area are grown for tablestock while most of those in Steuben are grown for chipping. This difference in markets is reflected in the varieties of potatoes that are grown in the two areas. Among Wayne Farms in both acreage classes, almost 90% of the potato acreage is on muck soils, while less than 5% of the Steuben acreage is on muck.

Insecticide use differs between the two areas. Steuben growers all use systemic insecticides; most use it on all of their potato acreage. DiSyston, the least expensive material, is the most commonly used. In addition, most of these growers apply foliar insecticides, usually Monitor or Parathion. Monitor and Parathion are even more commonly used among growers in the Wayne Study Area. Each Wayne grower also tends to use a greater number of different foliar insecticides than do the Steuben growers. Use of systemic insecticides is less common in the Wayne Study Area than in Steuben but those Wayne growers who use systemics all use Temik, the most expensive and effective material.

The growers in the Steuben Study Area tend to use a greater number of different herbicides per farm than do the Wayne growers. More than half of the Steuben growers used three or more different herbicides while among the Wayne growers, more than half used only one. Lorox was the most commonly used herbicide in the Wayne Study Area, especially among farms in the small acreage class. Use of Lorox was also fairly common in Steuben but Roundup, Sencor, and Premerge were more common. The extensive use of Roundup as part of the oats-potato rotation is a notable aspect of the pest management practices on the Steuben farms.

On the average, growers in the Steuben Study Area sprayed fungicides less frequently than did Wayne growers in the large acreage class. The environmental differences between the higher elevation and mineral soils of Steuben and the lower muckland of Wayne is a likely explanation for some of this difference in spray frequency. However, Wayne growers in the small acreage class, who also grow almost all of their potatoes on muck land, sprayed fungicides less frequently than the Steuben growers. One potential explanation for the difference in spray frequency between the small and large acreage classes in the Wayne Study Area is the difference in method of application. Half of the growers in both groups spray by both ground and air, but the other half of the small acreage class use only ground while the other half of the large acreage class use only air. Conceivably, the contractual arrangement between grower and aerial applicator may lead growers to maintain a conservative seven-day spray schedule. However, the association between method of application and spray frequency is not clear from a

case by case analysis of the data. For example, one Wayne grower in the large acreage class used only aerial application but on the average sprayed only once every ten days. He was also one of the few growers who reported spraying less often in 1980 than in most other years. Another consideration in the interpretation of the different frequency between the small and large acreage class is the time lag associated with spraying large acreage. Perhaps, since spraying all their acreage by ground would take a considerable amount of time especially in bad weather, growers with large acreage tend toward a more conservative (more frequent) spray schedule. From this perspective, the relationship between aerial application and spray frequency might be viewed in a different light. Another factor potentially affecting spray schedules is the differences in susceptibility to disease between varieties commonly grown by the different size classes. The data from this survey are inadequate for fully addressing these issues.

Only two growers, both in the small acreage class, applied foliar sprays at the commonly recommended rate of 100 gallons of mixture per acre. Of the growers in Steuben who used ground application, two-thirds applied foliar sprays with less than 40 gallons of mixture per acre.

Implications for the Potato Pest Management Program

1. The differences between the study areas in terms of potato acreage per farm, potato varieties grown, marketing, degree of specialization, and land resources suggest that both recommendations and methods of delivering information may have to be different for the different potato-producing areas. From the standpoint of severity of insect problems and emphasis on foliar insecticides, the Wayne Study Area, especially the small acreage class, seems to offer more potential for field scouting than is offerred in the Steuben Study Area. However, the small acreage class in the Wayne Study Area contains less than 350 acres, all distributed in small parcels. Only one grower in the large acreage class did not use a systemic insecticide, but four reported that they did not use systemic on some of their potato acreage. The amount of acreage on these farms that is not treated with a systemic insecticide may strongly effect the potential for field scouting, at least in the near future.

2. To the extent that differences among some potato varieties may warrant different monitoring and management, the frequency distribution for number of varieties per farm may help advisors anticipate scouting requirements.

3. In the Wayne Study Area, the disparate use of systemic insecticides -- some growers using the most expensive and effective, others using none at all, -- and the large number of different foliar insecticides used per farm, suggest that the Wayne Study Area provides opportunities to compare, evaluate, and possibly improve alternative control strategies.

4. The growers in the Steuben Study Area on the average use a greater number of different herbicides per farm than do the Wayne growers. More than half of the Steuben growers used three or more different herbicides for weed control. How are they deciding which herbicides to use

on a particular field, and can these decisions be improved by the Potato Pest Management Program? Most growers in the Wayne Study Area use only one herbicide. Do they differ from Steuben growers in this respect because of differences in acreage, land resources, and rotations, or are the Wayne Growers not taking advantage of the range of available herbicides?

5. The issue of frequency of fungicide sprays has already been discussed. Disease forecasting and adjustable spray schedules are important components of the Potato Pest Management Program. A better understanding of the multiple factors influencing spray frequency is clearly needed if the forecasting systems are to be widely and effectively adopted by growers.

6. Although additional data and analysis are needed before the potential of the Potato Pest Management Program can be rigorously assessed, the results of this survey should help to guide the program and the collection and analysis of field data.

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