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COST OF PESTICIDES FOR POTATOES IN UPSTATE NEW YORK, 1981

G.R. Fohner and G.B. White

Department of Agricultural Economics
Cornell University Agricultural Experiment Station
New York State College of Agriculture and Life Sciences
A Statutory College of the State University
Cornell University, Ithaca, New York, 14853

ABSTRACT

The purpose of this study was to collect information about the quantity and costs of pesticides used on potatoes in upstate New York. The objectives for collecting this information were to: 1) provide potato growers with an accounting of the quantity of pesticides they used on their potatoes, and a comparison with the quantities used on other potato farms in their area, and 2) help guide the potato pest management program in upstate New York and provide a baseline for evaluating the program in the future. Records of pesticide use were collected biweekly during the 1981 growing season from 25 potato growers in two areas in upstate New York. Sampling was neither random nor free of bias, but auxiliary information about the target population allowed inferences about the relationship between the sample and that population.

Cost of reported pesticide use ranged from $51 to $173 per acre. Average cost per acre was $144 in one study area and $97 in the other, excluding the cost of application, seed treatment, and vine-killer. Almost all of the difference in average cost between the two areas was from a difference in foliar-applied insecticides. Foliar applications of insecticide occurred throughout the growing season in the high-cost area, while most occurred during early July in the low-cost area. In both areas, average costs per acre for herbicides, fungicides, and in-furrow insecticides were approximately $20, $40, and $35 respectively.

In-furrow, systemic insecticides and aerial application of foliar sprays were both found to be common, and may limit the potential for management practices promoted in the potato pest management program.

ACKNOWLEDGMENTS

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COST OF PESTICIDES FOR POTATOES IN UPSTATE NEW YORK, 1981

by

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INTRODUCTION

Information about pest management on farms is necessary for planning and evaluating pest management programs. Such information may help to identify costly pest problems, successful management practices, and the past and potential impact of management alternatives. The potato pest management program in upstate New York[1] focuses on improving the use of pesticides, so pesticide use is the aspect of pest management about which information is most needed for planning and evaluating the program. This report summarizes the results of a survey in which pesticides used on potatoes grown for tablestock and processing were recorded for two areas in upstate New York.

The survey described in this report was conducted during the 1981 growing season. The results of a smaller survey conducted in 1980 are cited for comparison. The results of a mail survey conducted between tween the 1980 and 1981 growing seasons have been reported (Fohner and White) but are cited again where they complement the results of this study. The mail survey sought information from all potato growers in the two study areas about potato acreage and varieties, intended market, soil, names of insecticides and herbicides, proportion of acres treated with insecticides, and approximate frequency and method of application of fungicides. Data about number and dates of applications, acres treated, and rates of application were not sought with the mail questionnaire. Collection of these data for a subsample of potato growers was the purpose of the survey described here.

OBJECTIVES

The data about dates, acreage, and rates of application were collected to serve two objectives. The first was to provide potato growers with an accounting of the quantity of pesticides they used on their potatoes, and a comparison with the quantities used on other potato farms in their area. The second objective was to help guide the potato pest management program, and provide a baseline for evaluating the program in the future.

METHODS

Description of the Sample

The survey was conducted in two areas in upstate New York: the Wayne Study Area centered around Wayne County, and the Steuben Study Area centered around Steuben County. In the Wayne Study Area, the sample of 10 farms was selected with the help of the county Cooperative Extension agent to represent the principal acreage classes (Fohner and White) and locations in the area. In the Steuben Study Area, participation was sought from the 10 growers who had responded to the mail questionnaire, and 10 who had reported their use of pesticides in a survey in 1980. Eighteen of those 20 growers in the Steuben Study Area were contacted and 15 agreed to participate in the

*Research Associate and Assistant Professor, respectively, Department of Agricultural Economics, Cornell University, Ithaca, NY 14853-0398.

study by reporting their use of pesticides through the season. The sampling for the two study areas therefore was neither random nor free of bias. The relationship between farms in the mail survey and all farms in the study areas is known (Fohner and White), however, and can be used to infer the relationship between the subsample and the total population of potato farms in the two areas.

Methods of Collecting Data

Potato growers were visited during late May and early June, after planting and most pre-emergence applications of herbicides, and prior to the beginning of fungicide sparys on most acreage. During these visits information was collected about potato acreage and varieties, machinery and/or hired applicator used to apply pesticides, and names and rates of pesticides used previously in the season. The growers were provided with recording forms formatted like calendars on which to record material, rate, acres treated, and method of application for subsequent pesticide applications. After this initial visit, the farms were visited approximately once every two weeks. If the recording form was up-to-date, it was collected and a carbon copy was left for the grower. If the form appeared not to be up-to- date, the collector sought the grower or employee responsible for applying pesticides and if convenient for them obtained the missing information. After harvest, growers were visited and asked to review and complete records. A final summary of records and results for their area were sent to all participating growers.

RESULTS

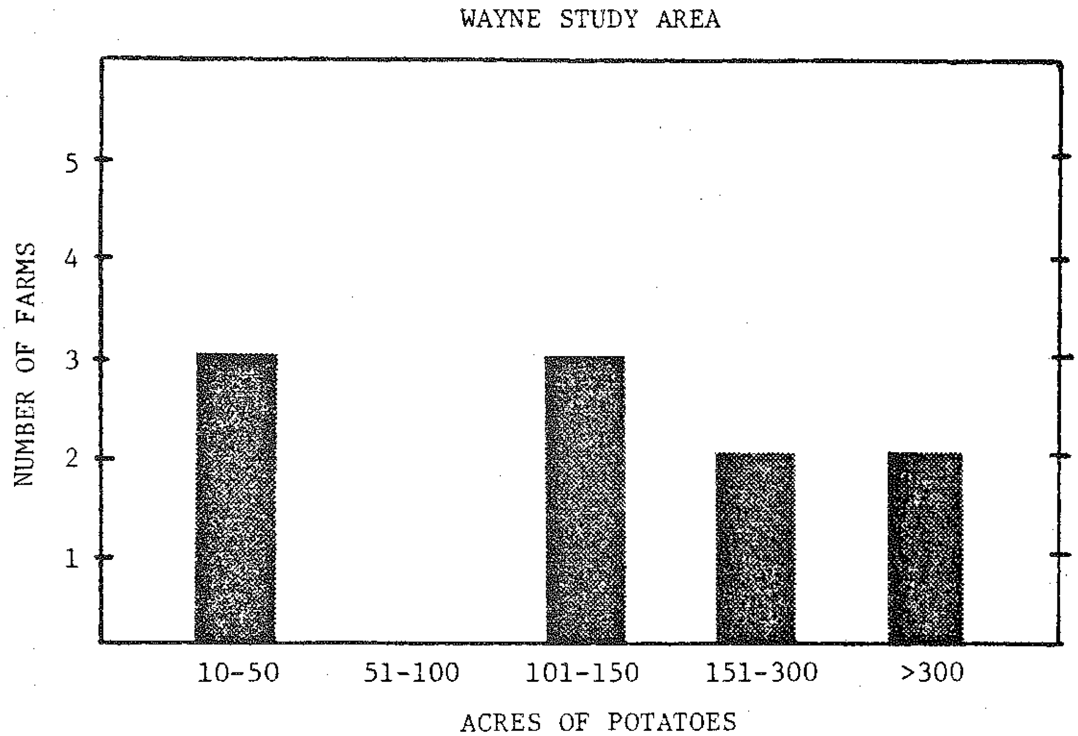
Potato Acreage of Growers in the Study

The acreage distribution among growers who participated in the recordkeeping is shown in Figure 1. The mail survey previously indicated that approximately 50 percent of the commercial growers[2] in the Wayne Study Area have between 10 and 50 acres of potatoes. Of the 10 growers in the 1981 study in the Wayne Study Area, only three had between 10 and 50 acres of potatoes, so farms in this low acreage class were underrepresented in the sample in terms of proportion of farms. However, these farms were overrepresented in the sample in terms of proportion of acres. The sample farms for the Steuben Study Area represent the full range of acreage classes in approximately the same proportions as for the total population of farms in the area.

For farms in the study, the proportions of muck and mineral soils correspond to the proportions reported in the mail survey for the two study areas. In the Wayne Study Area 90 percent of the 1959 acres in the study were muck compared to 88 percent reported in the mail survey. In the Steuben Study Area 5.5 percent of the 3,319 acres in the study were muck compared to four percent reported in the mail survey.

Combined Cost for All Pesticides

The total and per acre costs for pesticides for the two study areas are reported in Table 1. The cost of applying pesticides is not included. The costs were calculated using prices charged by a major distributor of



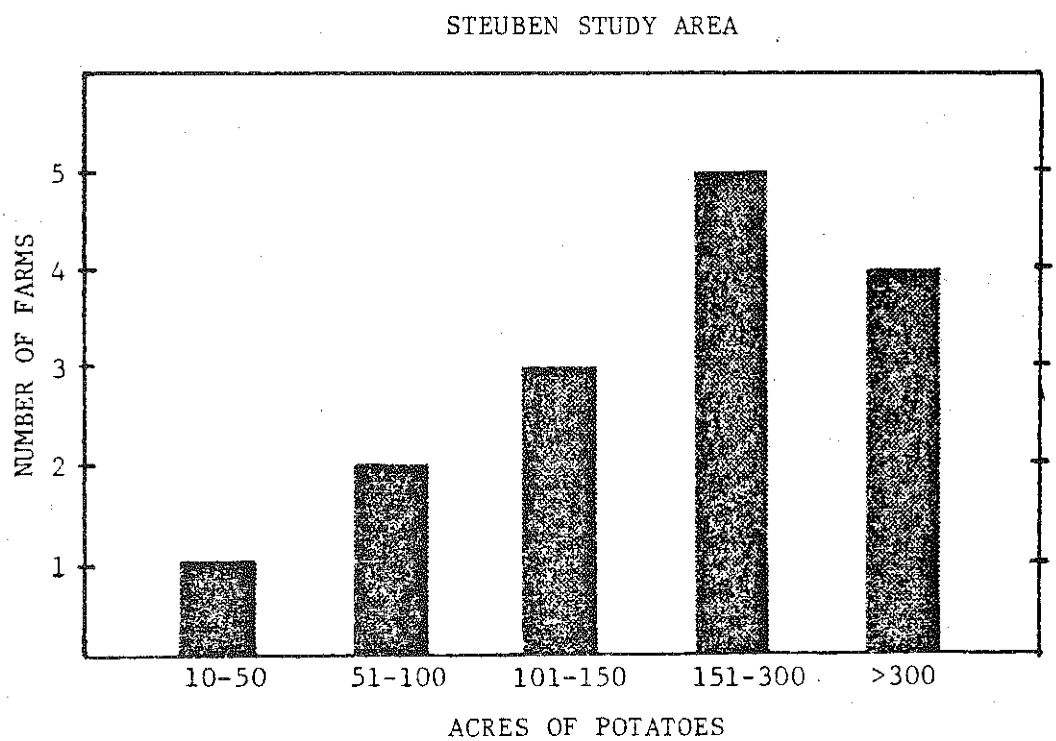


Figure 1. Potato Acreage of Growers in the Study
Upstate New York, 1981

pesticides serving upstate New York. By using the same prices for all growers rather than the prices they each paid, the cost estimates better reflect amounts of pesticides used. Some growers reported paying as much as 20 percent less than the prices used to calculate costs. The reported average costs per acre were calculated by dividing the sum of costs for all growers in the study by total acres, so pesticide use on the large farms had the strongest effect on the averages.

The number and acreage of farms grouped according to cost are presented in Figure 2. The range of costs reflects differences due to potato variety, location, and length of growing season, as well as differences in pest pressures and growers' objectives, perspectives, and practices. Total cost of pesticides ranged in the Wayne Study Area between $106 and $173 per acre. The range in the Steuben Study Area was $51 to $143 per acre.

<u>Excluded Costs: Seed Treatment and Vine-killer</u>

Potato growers in the two study areas routinely treat potato seed with a chemical seed treatment to reduce losses from pathogens in the soil and on the surface of the seed. The amount of seed treatment used by growers in the study was not reported. At the recommendation rate (Sieczka and Tingey) of seed treatment and a planting rate of 20 hundredweight of seed per acre, seed treatment would cost approximately $9 per acre.

For most potatoes in the two study areas, potato foliage is killed with chemicals prior to harvest to hasten maturation of tubers and facilitate harvesting. Although control of pests is not the principal objective of using vine-killers, they can influence the incidence and consequences of late blight and Colorado potato beetle (Sieczka and Tingey). Also, many potato growers include the cost of vine-killer when assessing their expenditures for spraying and chemicals, so an awareness of the cost of vine-killer can help researchers when they discuss pesticide costs with growers.

Obtaining records about applications of vine-killers is difficult for two reasons. First, these applications occur during a time in the season when growers are extremely busy; second, a field may receive from none to three applications of vine-killer, so omissions in the records are difficult to identify. Because of these problems and the indirect role of vine-killers in pest management, complete records of the use of vine-killers were not sought from the growers in the study. However, some growers provided these records and others described in general their use of vine-killers.

The most common chemical application for killing potato foliage was two quarts of dinoseb and one quart of nontoxic oil per acre. The cost of this combination ranged from $8 to $12 per acre depending on the type of oil and brand of dinoseb. The cool, wet conditions at the end of the 1981 season resulted in more vigorous potato foliage and less effective vine-killing than usually prevails in the study areas. Many growers responded to these conditions by increasing the number and rates of applications of vine-killer. Single applications cost up to $25 per acre, and some potatoes were sprayed three times for a total cost for vine-killing of up to $40 per acre. Still, as in other years, some potatoes were harvested early and for immediate sale without destruction of the foliage prior to harvest. On other potatoes as little as $3 per acre was spent for vine-killing. Some potatoes

TABLE 1.

Total and Per Acre Costs for Pesticides

Upstate New York, 1981

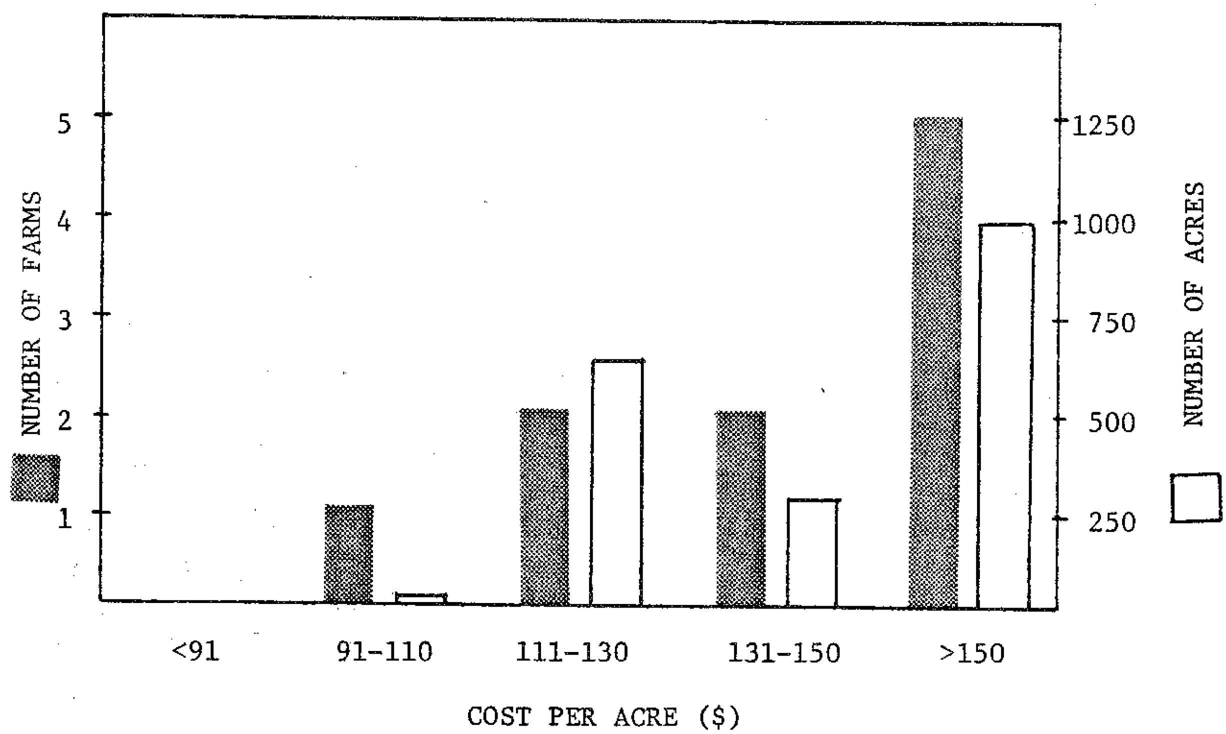
	Wayne Study Area 10 farms, 1,959 acres		Steuben Study Area 15 farms, 3,319 acres	
	Total Cost	Ave. Cost per Acre	Total Cost	Ave. Cost per Acre
Herbicides*	$ 42,940	$ 22	$ 57,749	$ 17
Fungicides**	85,612	44	119,043	36
Foliar Insecticides	87,057	44	21,097	6
In-furrow Insecticides	66,517	34	126,302	38
Totals†	$282,126	$144	$324,191	$ 97

*Cost of vine-killer and herbicides used in rotation not included.

**Cost of seed treatment not included.

†Cost of applying pesticides is not included.

WAYNE STUDY AREA



STEUBEN STUDY AREA

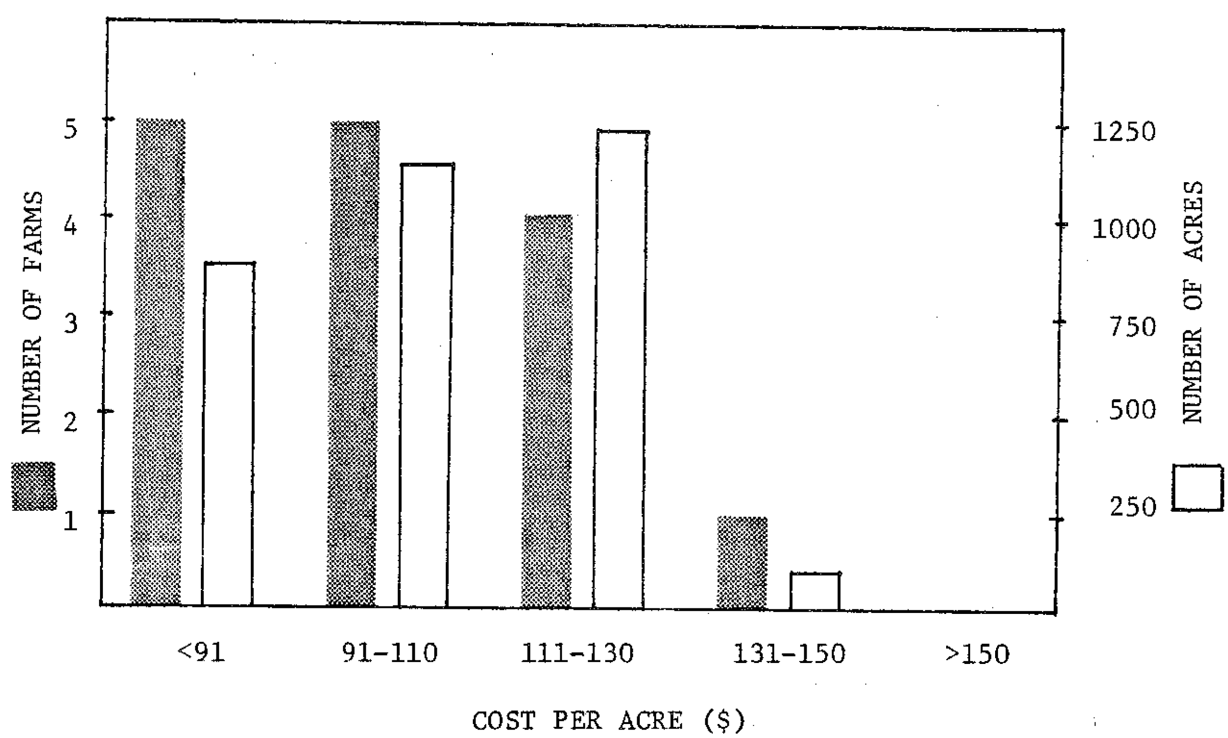


Figure 2. Average Pesticide Cost Per Acre
Upstate New York, 1981

were sprayed first with a slow desiccant such as ametryn costing from $4 to $12 per acre depending on rate, and then again later with chemicals such as dinoseb for rapid desiccation.

Information collected for the 1980 and 1981 growing seasons suggests that in most years $15 per acre is a representative average cost for chemical vine-killing in the two study areas. This average cost may reach $20 to $25 per acre in years such as 1981.

Herbicides

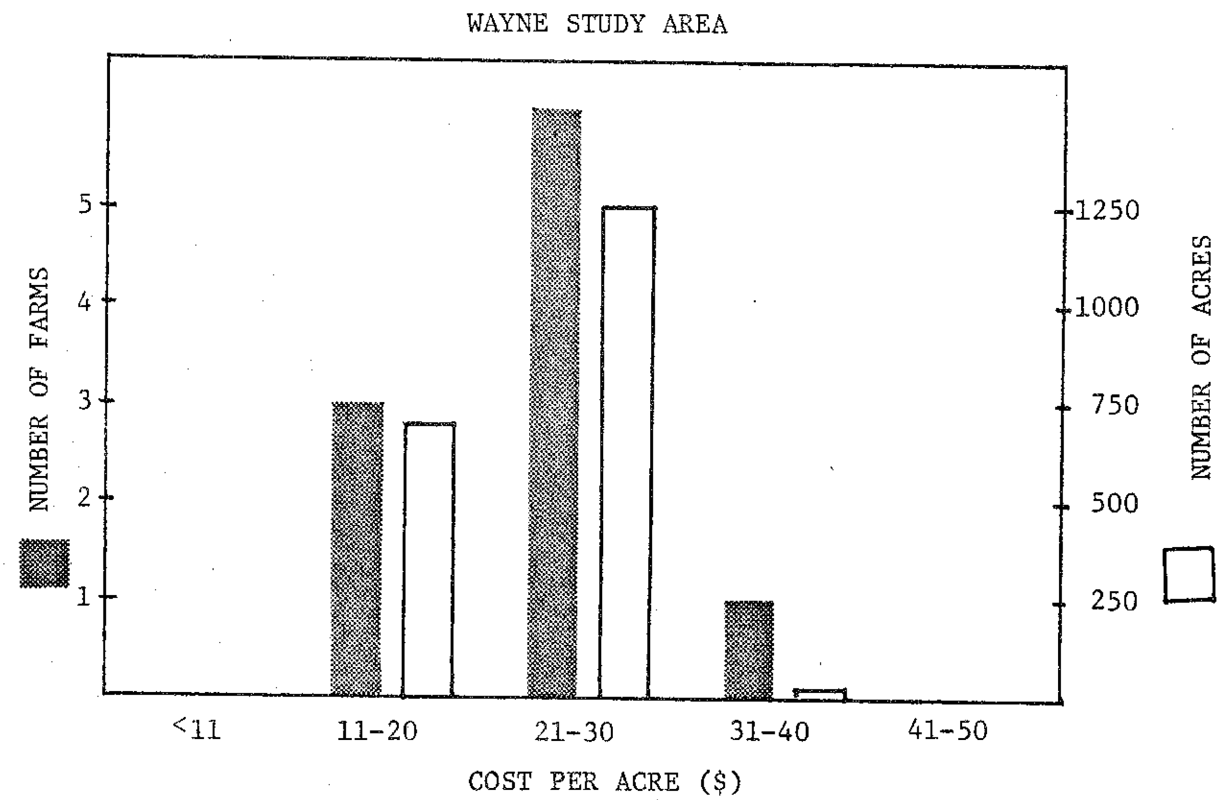
The number and acreage of farms grouped by herbicide cost are reported in Figure 3. The costs ranged from $12 to $32 per acre in the Wayne Study Area and from $7 to $50 in the Steuben Study Area. Interpretation of these herbicide data is complicated by herbicide use in previous years and by the other methods used to control weeds. The mail survey indicated that many growers in the Steuben area use the herbicide Roundup (glyphosate) at some time during the potato-oat rotation that is common in that area. The benefits of these applications carry over for several years and may reduce the need for subsequent herbicides. The herbicide costs reported in this study do not include expenditures for Roundup. To include these expenditures would require proportioning the cost between oats and potatoes, and perhaps among successive crops of each depending on when the Roundup was applied. Another difficulty in determining average annual expenditures for Roundup is the variability among years in the amount of Roundup applied. For example, the wet weather and late harvest in 1981 prevented some growers from applying Roundup on as many acres as they usually would.

The interpretation of herbicide costs is further complicated by the role of cultivation and hilling of potatoes for controlling weeds. The costs of these two operations were not included in the study. Fields in the study area generally were cultivated and/or hilled between one and three times depending on field conditions, availability of labor, and days until the potatoes closed together between the rows. During the 1980 growing season, records of cultivation proved to be difficult to obtain and were of questionable accuracy so those records were not sought in 1981.

The herbicides that were used in each of the study areas are shown in Table 2. Conversion of amounts into total dosage equivalents, the total amount used divided by the recommended rate (Appendix A), allows more meaningful comparisons than pounds or gallons. Most herbicides were applied prior to emergence of the potato plants. In addition to pre-emergence applications, growers in the Wayne Study Area commonly applied Sencor and Lexone (metribuzin) at low rates after emergence of potatoes. Of the cumulative total of 3,035 acres of applications of Sencor and Lexone in the Wayne Study Area, 2,176 acres of applications were post emergence. Some acres were treated more than once with post-emergence herbicide applications. The latest application of herbicide for weed control occurred on 21 July.

Fungicides

The number and acreage of farms grouped by fungicide cost are presented in Figure 4. The costs ranged from $24 to $68 per acre in the Wayne Study



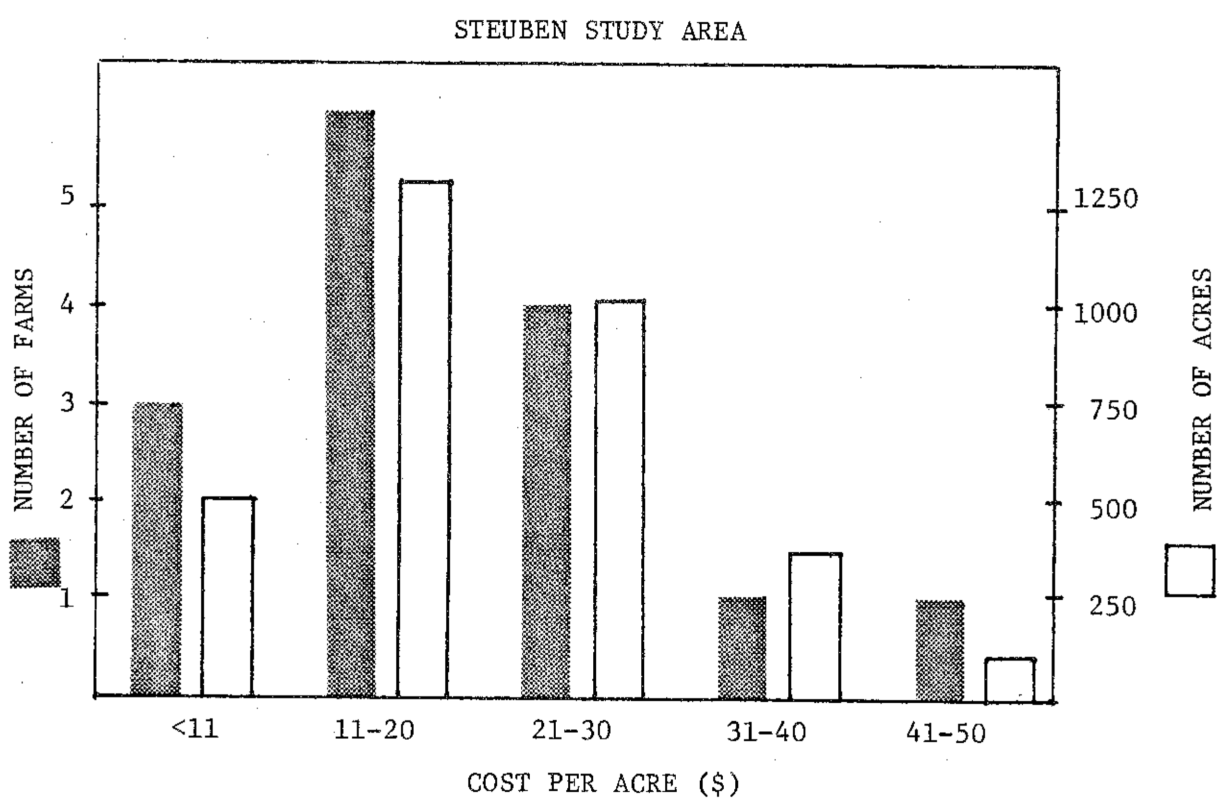


Figure 3. Average Herbicide Cost Per Acre for Weed Control
Upstate New York, 1981

TABLE 2.

Amount and Cost of Herbicides for Weed Control

Upstate New York, 1981

Wayne Study Area
10 farms, 1,959 acres

Material	Acres Treated	Total Dosage Equivalents*	Total Cost**
Sencor†	3,009	1,166	$12,831
Lorox	1,317	2,392	27,556
Paraquat	195	41	472
Lasso	122	122	1,220
Eptam	40	35	756
Lexone†	26	10	105
	4,709	3,766	$42,940

Average cost per acre for herbicides: $22

Steuben Study Area
15 farms, 3,319 acres

Material	Acres Treated	Total Dosage Equivalents*	Total Cost**
Lexone†	1,138	1,210	$13,374
Dowpon	847	597	14,447
Lorox	675	621	7,153
Sencor†	544	711	7,823
Eptam	495	640	9,774
Paraquat	432	219	2,494
Premerge	389	289	2,684
	4,520	4,287	$57,749

Average cost per acre for herbicides: $17

*Amount used divided by recommended rate.

**Does not include vine-killer or herbicides used in rotation.

†Sencor and Lexone have the same active ingredient.

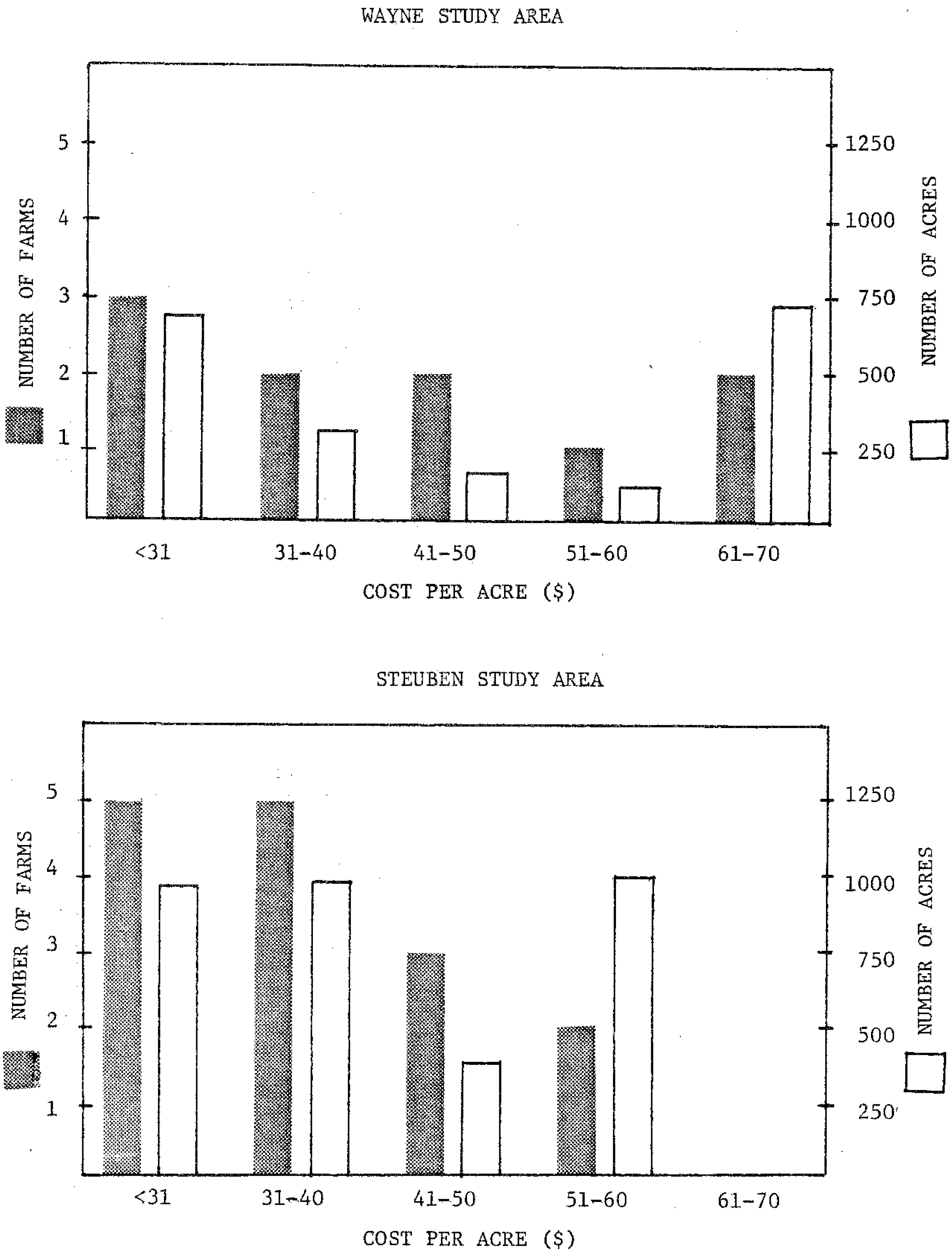


Figure 4. Average Fungicide Cost Per Acre
Upstate New York, 1981

Area, and from $18 to $52 per acre in the Steuben Study Area. The range of fungicide costs in 1981 was probably wider than in most years because of the wet weather in the later half of the season. Growers who were able to spray regularly despite the wet conditions adhered to a weekly schedule using high rates of fungicides, while those who less successfully contended with the wet conditions fell behind in their spray schedules.

Records for the 1980 and 1981 seasons indicate that fungicide use on some potato farms varies according to the weather. The 1980 season in upstate New York was dry and unfavorable for the development of late blight disease. During that season some growers skipped some weekly sprays or sprayed at a less than normal pace in response to the dry conditions. In 1981, which was favorable for the development of late blight, growers tried to adhere more closely to a weekly spray schedule. For the eight Steuben farms for which pesticide use was recorded for both 1980 and 1981, the average increase from 1980 to 1981 in fungicide cost per acre was approximately $10 after costs were adjusted for differences in fungicide prices, an increase of approximately 30 percent.

The fungicides used by growers in the study are listed in Table 3. Eight Steuben growers used more than one fungicide material during the season; five Wayne growers did so. Duter and Kocide, used primarily in the Wayne Study Area, were usually applied in mixtures with other fungicides. The average cost of materials per acre for one application of fungicides was approximately $4 for both study areas.

Insecticides

As previously indicated in Table 1, the principal difference between pesticide costs in the two study areas is insecticides applied as foliar sprays. This difference is reflected in Figure 5, which presents numbers of farms and acres grouped by cost of insecticide. The higher expenditure for insecticides in the Wayne Study Area was primarily the result of greater problems with Colorado potato beetle, perhaps due to less crop rotation, larger areas of contiguous potato fields, and warmer temperatures. In both areas the systemic insecticide Temik was commonly used (Table 4). The extensive use of Temik by Steuben growers in 1981 is a change from 1980, in which DiSyston was the most commonly used in-furrow, systemic insecticide. The sharp increase in the use of Temik in 1981 was related to the problem in parts of the Steuben Study Area with the golden nematode. Depending on the outcome of this problem, some Steuben growers may return to using DiSyston as a less expensive alternative to Temik.

Number of Pesticide Applications

Fungicides are the most frequently applied pesticides on potatoes in upstate New York. Except on a few acres sprayed early in the season for Colorado potato beetle, all foliar sprays prior to vine-killing included fungicide. Consequently, records of fungicide applications also indicate total foliar applications of pesticides. The date on which fungicides are first applied on a potato field varies among growers and according to potato variety, planting date, rate of plant growth, and favorability of weather for disease. In 1981, these first sprays were applied most often in May and early June in the Wayne Study Area and in mid and late June in the Steuben

TABLE 3.

Amount and Cost of Fungicides

Upstate New York, 1981

Wayne Study Area
10 farms, 1,959 acres

Material	Acres Treated	Total Dosage Equivalents*	Total Cost**
Manzate 200†	17,890	22,813	$75,283
Maneb††	2,518	2,343	5,800
Kocide	1,885	300	944
Duter	700	145	1,350
Dithane M45†	611	632	2,018
Bravo 500	28	56	217
	23,632	26,289	$85,612

Average cost per acre for fungicides: $44
Average cost per acre per application: $4.03
Average number of applications per acre: 10.9

Steuben Study Area
15 farms, 3,319 acres

Material	Acres Treated	Total Dosage Equivalents*	Total Cost**
Dithane M45†	12,217	15,152	$ 48,412
Manzate 200†	4,335	5,376	17,741
Maneb††	3,522	4,444	10,999
Polyram††	3,319	4,473	12,210
Bravo 500	3,131	4,877	18,923
Manex	1,780	2,229	8,025
Difolatan	268	342	1,683
Kocide	200	333	1,050
	28,772	37,226	$119,043

Average cost per acre for fungicides: $36
Average cost per acre per application: $4.15
Average number of applications per acre: 8.7

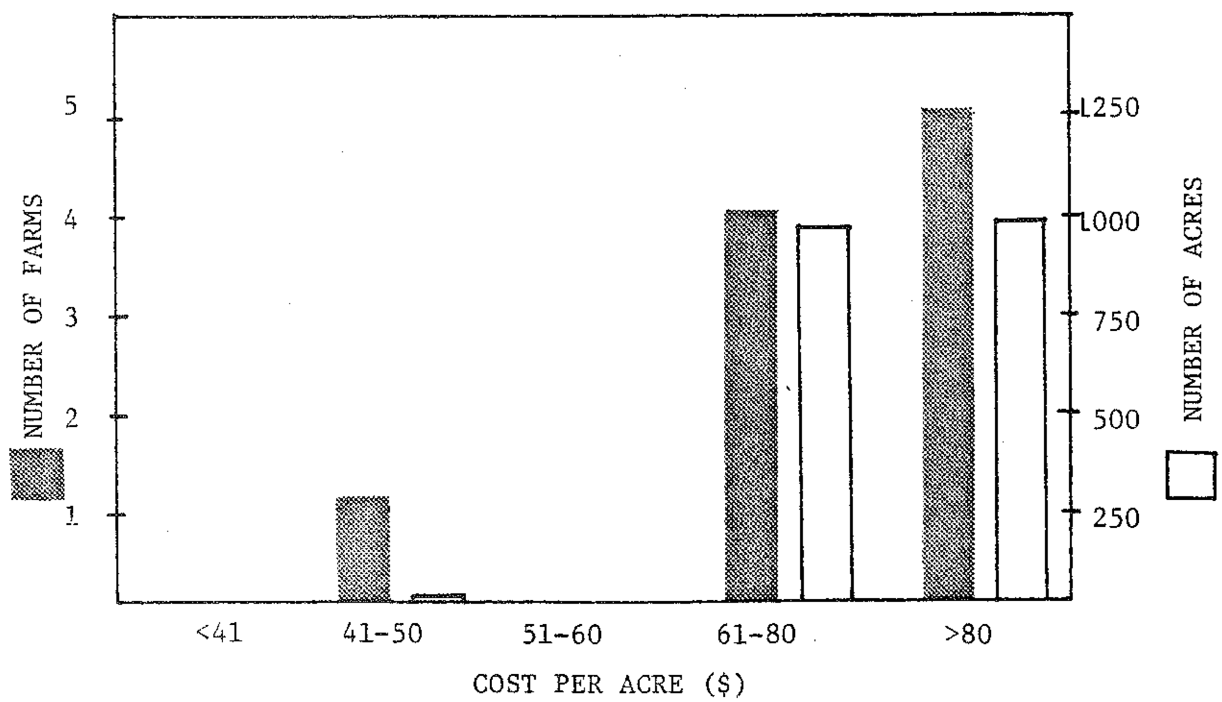
*Amount used divided by recommended rate

**Does not include seed treatment.

†Manzate 200 and Dithane M45 have the same active ingredient and comparable formulations.

††Maneb and Polyram have the same active ingredient and comparable formulations.

WAYNE STUDY AREA



STEUBEN STUDY AREA

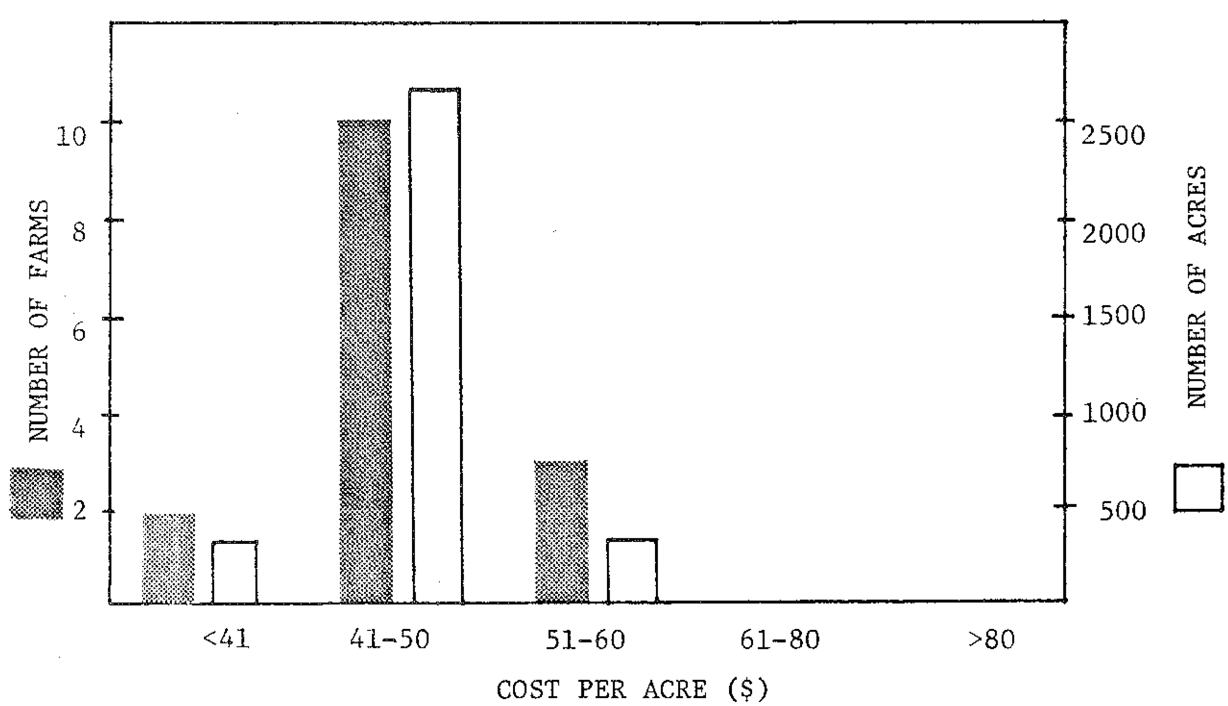


Figure 5. Average Insecticide Cost Per Acre
Upstate New York, 1981

TABLE 4.

Amount and Cost of Insecticides

Upstate New York, 1981

Wayne Study Area
10 farms, 1,959 acres

Material	Acres Treated	Total Dosage Equivalents*	Total Cost
Parathion	5,919	8,081	$ 12,566
Monitor	2,978	2,914	39,100
Pydrin	2,057	3,134	19,537
Sevin	1,367	1,090	4,251
Vydate	800	400	8,278
Guthion	446	446	2,533
Imidan	128	80	410
Pirimor	40	40	382
Temik**	1,412	1,427	66,517
	15,147	17,612	$153,574

Average cost per acre for insecticides: $78

Steuben Study Area
15 farms, 3,319 acres

Material	Acres Treated	Total Dosage Equivalents*	Total Cost
Parathion	1,792	3,678	$ 5,720
Monitor	835	752	10,226
Imidan	496	458	2,344
Lannate	268	327	2,492
Sevin	106	81	315
Vydate	300	450	9,324
Temik**	2,498	2,378	110,791
DiSyston**	500	410	6,187
	6,795	8,534	$147,399

Average cost per acre for insecticides: $44

*Amount used divided by recommended rate.

**Applied in furrow during planting.

Study Area. By early July, fungicides were being applied on all potatoes in the two areas. In mid August the number of acres being sprayed declined as harvesting began on early varieties. Between 5 July and 15 August a weekly average of 80 percent of potato acreage was treated with fungicide in both the Wayne and Steuben Study Area. This proportion corresponds to an average interval between sprays of 8.7 days.

The number of fungicide applications during the season depends on the length of growing season and the grower's intended spray schedule and ability to adhere to it. In the Wayne Study Area the average number of fungicide applications per acre was 10.9; in the Steuben Study Area the average was 8.7. The difference between the two averages reflects the earlier start and later termination of fungicide sprays in the Wayne Study Area. The averages include fungicides applied at the end of the season in mixtures with vine-killer. By delaying harvest and favoring late blight, the cool, wet conditions at the end of the 1981 season probably resulted in an increase in the average number of fungicide applications compared to most other years. The average number of fungicide applications per acre ranged between 7.2 and 14.4 among farms in the Wayne Study Area, and between 4.7 and 12.2 in the Steuben Study Area.

Of the cumulative total of acres of fungicide applications over the season, 81 percent of those acre-applications in the Wayne Study Area were applied by air, and 61 percent in the Steuben Study Area were applied by air. The percent applied by air in 1981 may have been higher than usual because rains and wet fields interfered with ground applications. Of the growers in the study, four growers in the Wayne Study Area and one in the Steuben Study Area applied all fungicides by air. Two others in the Steuben Study Area sprayed all by air except for one spray on a small part of their acreage. Two growers in the Wayne Study Area and four in the Steuben Study Area applied all fungicides by ground machinery. The 12 other growers in the study relied on both aerial and ground application. Eight changed method of application according to time of the season (see Weekly Time Profile of Pesticide Use), and four used different methods for different parts of their farm. Proximity to populated areas and obstacles to flight preclude aerial application for some fields, and time required to move ground machinery encourages aerial application for others. Also, partial reliance on both methods of application provides a grower with more flexibility for responding to problems encountered with either of the methods.

Cost of Applying Pesticides

Growers in the two study areas reported paying between \$3.60 and \$5.00 per acre per aerial application in addition to the cost of pesticide, depending on location and acreage. The cost of applying pesticides with ground machinery includes the costs of labor, fuel, machinery, and damage to the crop in wheel tracks. Generalizations about these costs are of limited value for evaluating pest management on an individual farm because the costs will depend heavily on the features of the land, opportunity cost of labor, and the price, age, durability, and performance of machinery. Although cost of ground application will vary among farms, the following discussion suggests the approximate magnitude of this cost.

The cost of labor and fuel for spraying an acre depends on the theoretical field capacity and field efficiency of the machinery (ASAE, Hunt).

The theoretical capacity indicates the number of acres that would be sprayed per hour if a constant ground speed was maintained. Field efficiency indicates the proportion of the theoretical field capacity that is actually sprayed per hour after turning, changes in ground speed, and machinery adjustments reduce the rate of spraying. Data collected in 1980 suggested that the field efficiency[3] of ground sprayers for potatoes in the Steuben Study Area was 0.4. This estimate is lower than the field efficiencies of 0.6 reported for spraying on Maine potato farms (Benson) and the 0.5 to 0.8 cited for ground sprayers in general (Campbell). The lower estimated field efficiency in the Steuben Study Area may reflect the hilly topography and irregular shape of many fields. With a field efficiency of 0.4, maximum ground speed of five miles per hour, and a spray swath of 60 feet, 14 acres would be sprayed in an hour. With an opportunity cost of labor equal to $5 per hour, the labor cost for spraying one acre is $0.36. With diesel fuel costing $1.05 per gallon and a sprayer propelled with a 90 hp tractor using four gallons of fuel per hour (Campbell), then fuel cost for spraying one acre is $0.30.

Estimates of machinery cost per year for spraying potatoes may be useful for comparing the cost of ground and aerial application but machinery cost has little relevance for estimating the marginal cost of a pesticide application. Repair and maintenance costs are likely to depend more on age of the machinery than on marginal differences in numbers of applications per year. Future changes in pest management for potatoes in upstate New York are unlikely to reduce the number of pesticide applications enough to significantly affect annual machinery costs for growers using ground application. Consequently, those machinery costs are not described here.

In addition to costs for labor, fuel, and machinery, application of pesticides with ground machinery results in two costs that are not incurred with aerial application: soil compaction and damage to foliage. This compaction and damage can reduce yield by up to 30 percent in wheel rows (Hooker et al.). These reported losses pertain to the combined effect of repeated pesticide applications through the season; the functional relationship between yield loss and the number and timing of individual applications has not been described. The marginal cost of an additional application might be expected to decline as the total number of applications increases, but the effect of a particular spray is likely to depend on field conditions. When fields are wet, soil compaction in wheel tracks is more severe and machinery is harder to control, resulting in more damage to the potato foliage. Further research on yield loss in wheel rows and on possible differences in the effectiveness of pesticides applied by ground and air is a prerequisite for complete comparison of the two methods of applications.

Weekly Time Profiles of Pesticide Use

In both study areas, weekly totals of acres sprayed with fungicides increased at the beginning of the season to a mid-season plateau, then declined as harvesting progressed in the later half of August. The mid-season plateau was reached in the fourth week of June in the Wayne Study Area, and in the first week of July in the Steuben Study Area.

In both areas the rate of fungicide per acre was generally lower in initial applications than in those later in the season. Six of the 10 growers in the Wayne Study Area increased fungicide rates after one or two sprays, and nine of the 15 growers in the Steuben Study Area did so. Conversely, two growers in the Steuben Study Area applied the highest rate of fungicide on the first spray. Rates in the final sprays varied: some growers further increased the rate of application above that used mid-season, while others reduced it. Most of these late-season applications were mixtures of fungicides and vine-killers. The cool, wet conditions that countered the effect of the vine-killers, favored late blight, and delayed harvest may have led some growers to alter their usual late-season rates and frequency of fungicide and vine-killer applications.

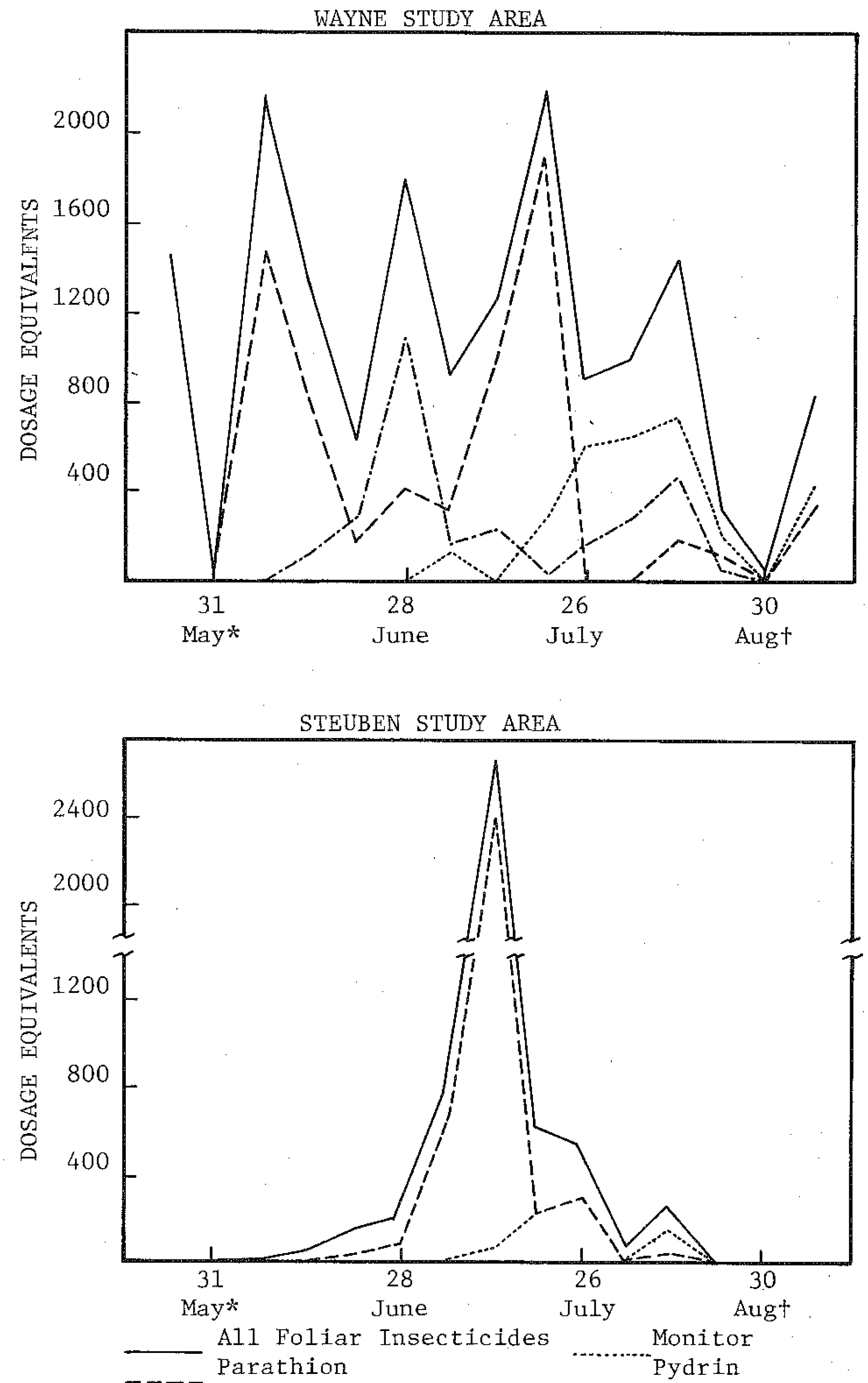
For eight of the 12 growers who relied on both aerial and ground application of pesticides, the proportion of acres sprayed by each of these methods changed as the season progressed. For these eight growers, the first sprays were applied by ground machinery and the later sprays were applied by air. Three growers reverted to ground application for late-season applications of sprout inhibitor or vine-killer on some of their potato acreage.

The timing of foliar applications of insecticide is described in Figure 6. The amount of insecticide applied in each of the time periods is measured in dosage equivalents. In the Wayne Study Area, insecticides were applied frequently throughout the growing season, primarily for Colorado potato beetle and late in the season for aphids. In the Steuben Study Area, most foliar insecticide applications occurred during a single time period and were primarily directed against cutworm.

SUMMARY AND CONCLUSIONS

The expenditures per acre for pesticides and vine-killer for potatoes in the Wayne and Steuben Study Areas are summarized in Table 5. The expenditures for herbicides for weed control, fungicides, and insecticides are the averages per acre calculated from the records kept by growers. The expenditures reported for seed treatment, vine-killer, and applying foliar pesticides are representative of common practices, but were not recorded for all farms in the survey. Estimated expenditures averaged $212 per acre in the Wayne Study Area and $157 per acre in the Steuben Study Area. Since expenditures were estimated using retail prices that exceeded the prices paid by many growers, actual expenditures may be lower than the estimates. The principal difference between the two areas was the greater use of foliar insecticides in the Wayne area: estimated expenditures per acre for foliar insecticides were $44 in Wayne and $6 in Steuben.

In-furrow, systemic insecticides and aerial applications were common in both study areas. Since in-furrow insecticides are applied at planting, their use may limit the potential for the pest management program for potatoes in upstate New York, which emphasizes responsive rather than preventative measures. The potential for the program may be higher in the Wayne Study Area than the Steuben area because insect problems and foliar applications of insecticide are more common there despite the use of in-furrow insecticide. Reliance on aerial application of pesticides may also limit the potential for the pest management program because of constraints and delays affecting the scheduling of aerial applications. Additional implications of the results of this study for the potato pest management program are discussed by Fohner.



* Points before 31 May are totals for all foliar insecticides applied before 31 May.

† Points after 30 August are totals for all foliar insecticides applied after 30 August.

Figure 6: Weekly Time Profile for Foliar Insecticides, Upstate New York, 1981

TABLE 5.

Summary of Expenditures for Pesticides and Vine-killer

Upstate New York, 1981

	Wayne Study Area Cost per Acre*	Steuben Study Area Cost per Acre*
Herbicides	$ 22	$ 17
Fungicides	44	36
Foliar Insecticides	44	6
In-furrow Insecticides	34	38
Aerial Applications**	44	36
Seed Treatment	9	9
Vine-killer	15	15
Totals	$212	$157

*Costs reported for herbicides, fungicides, and insecticides are averages per acre calculated from records kept by growers for the field survey. Costs reported for seed treatment and vine-killer are representative of common practices, but were not recorded for all farms in the survey.

**Cost per acre for the season if all foliar applications of pesticides were made by air.

FOOTNOTES

[1]Cornell University initiated the potato pest management program for upstate New York in 1980 to:

1. inform farmers about the principles of integrated pest management,
2. collect information about the use of pesticides on potatoes,
3. evaluate disease forecasting for scheduling fungicide sprays as an alternative to spraying at regular time intervals,
4. monitor pests and evaluate the methods used to collect and apply this information.

[2]A commercial potato grower is here defined as one who grows and sells at least 10 acres of potatoes.

[3]Field efficiency was estimated to be the average of the field efficiencies for spraying on six farms. The field efficiency for each farm was calculated using reported ground speed, sprayer swath, and records of time spent spraying and acreage sprayed:

$f = (a/t)/c$, where

'f' is field efficiency,

'a' is total acres sprayed,

't' is hours spent spraying, and

'c' is theoretical field capacity indicating number of acres that would be sprayed per hour if maximum ground speed was maintained.

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Appendix A.

RECOMMENDED RATES FOR PESTICIDES*

Herbicides		Fungicides		Insecticides	
Material	Rate	Material	Rate	Material	Rate
Dowpon	10.0 lbs	Bravo 500	1.0 pt	DiSyston 8E	3.0 pts
Eptam 7EC	4.5 pts	Difolatan	1.5 pts	Disyston 15G	20.0 lbs
Eptam 10G	40.0 lbs	Dithane M45	1.5 lbs	Furadan 10G	30.0 lbs
Lasso	4.0 pts	Kocide**	1.5 lbs	Furadan 4F	2.0 pts
Lexone DF	.67 lbs	Maneb**	1.5 lbs	Guthion	2.0 pts
Lexone 50W	1.0 lb	Manex**	2.4 pts	Imidan	2.0 lbs
Lexone 4L	1.0 pt	Manzate 200	1.5 lbs	Lannate	2.0 pts
Lorox	2.0 lbs	Polyram	1.5 lbs	Monitor	2.0 pts
Paraquat	2.0 pts	Duter†	1.0 lb	Parathion	.5 pt
Premerge	8.0 pts			Penncap**	2.0 pts
Sencor 4F	1.0 pt			Pirimor	.5 lb
Sencor 50W	1.0 lb			Pydrin**	.33 pts
				Sevin	2.0 lbs
				Temik	20.0 lbs
				Thimet	20.0 lbs
				Thiodan 50W	2.0 lbs
				Tiodan 3EC	2.6 pts
				Vydate	4.0 pts

*1980 Cornell Recommendations for Commercial Potato Production (Sieczka and Tingey). For materials for which a range of rates are recommended or for which rates vary according to the target pest, the reported value is the lowest recommended rate.

**Rate not given in Cornell Recommendations; cited value is rate used by growers in study.

†Growers in study used Duter in tank mixture with other fungicides. Recommended rate in mixture is five ounces of Duter. To prevent the estimates of total dosage equivalents from being inflated, a nominal rate of one pound was used.