PESTICIDE USE ON POTATOES GROWN IN INDIANA

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Potatoes, like many vegetable crops, compete with weeds for moisture, sunlight, and nutrients, and are attacked by a wide variety of diseases and insects. Most commercial potato growers rely largely on herbicides, fungicides, and insecticides to control these pests. While Indiana is not a major potato producing state, there are several potato production areas in the state, where production is an important enterprise to some growers. USDA estimates that in 1991, there were 4100 acres of potatoes grown in Indiana. The purpose of this study was to survey potato growers in Indiana to determine the amounts and types of pesticides used on potatoes and to determine some grower attitudes toward their use of pesticides, their use of IPM practices, and some related issues.

MATERIALS AND METHODS

On November 8, 1991, survey questionnaires (Appendix A) were mailed to 75 people who had been identified to us as potato growers by county extension agents or other sources. A number of these individuals later were found either to not grow potatoes or to grow them only for personal use. Each person on the mailing list was contacted at least once by telephone to determine whether he or she was a commercial potato grower, and if the survey questionnaire had been returned. Several growers chose to complete the survey over the telephone rather than in writing. Two additional potato growers were later identified and survey questionnaires were completed by these growers.

A total of 20 commercial growers, with acreages ranging from 0.2 to 900 acres completed the questionnaire. These twenty growers represented 3166.95 acres, or 77.2% of the estimated acreage. The USDA estimate of 4100 is most likely too high by at least 500 acres. Most growers were able and willing to answer all the questions asked. Several growers were unable to provide some of the information requested and a few chose not to answer particular questions.

RESULTS

Figure 1 shows the distribution of the potato acreage grown by each grower. There were a number of rather small growers and relatively few large growers. The 5 largest growers accounted for about 75% of the potato acreage included in the survey. Approximately 2/3 of the potatoes grown in Indiana are grown for processing (Figure 2). Only a very small percentage was saved for seed.

Relatively few growers hired outside firms to apply their pesticides. Therefore, we combined Questions 5 and 6 to determine how growers apply their pesticides (Figure 3). Almost all growers used a boom type sprayer. Of the four who did not use a boom sprayer, three used air blast sprayers and one used a Solo mist type sprayer. Three of those growers had very small acreages. Surprisingly, only 4 growers used granular applicators, even though the application of a granular insecticide at planting is usually considered to be a standard practice for systemic control of several

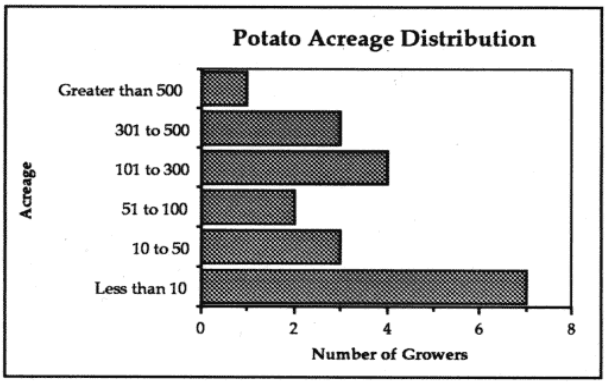

FIGURE 1.

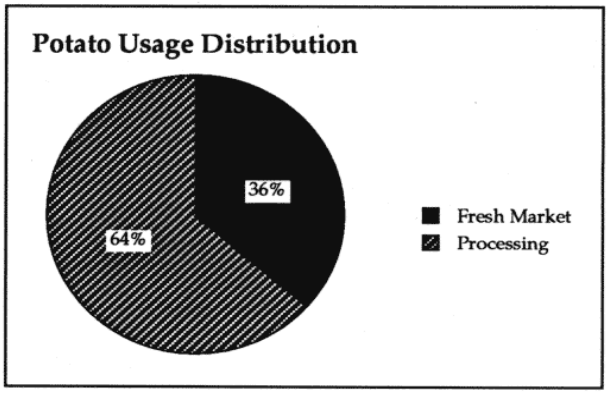

FIGURE 2.

pest insects. Almost all growers used waterproof gloves but only about half of the growers used waterproof boots, coveralls, and respirators as safety equipment when applying pesticides (Figure 4). The growers who did not used gloves were all very small growers. Most of the larger growers tended to use waterproof boots and respirators. There was no discernible trend in the use of coveralls. Several growers indicated that they used additional safety equipment such as protective glasses or goggles and hats.

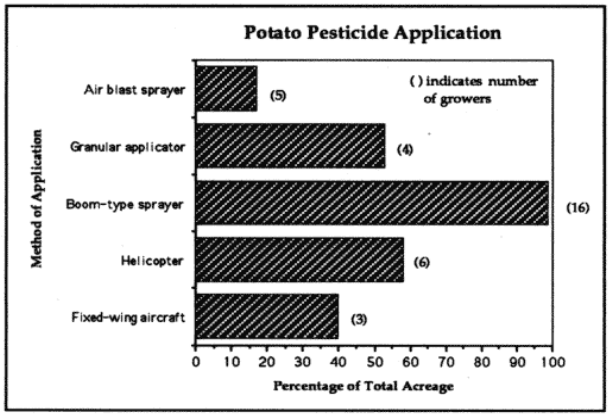

FIGURE 3.

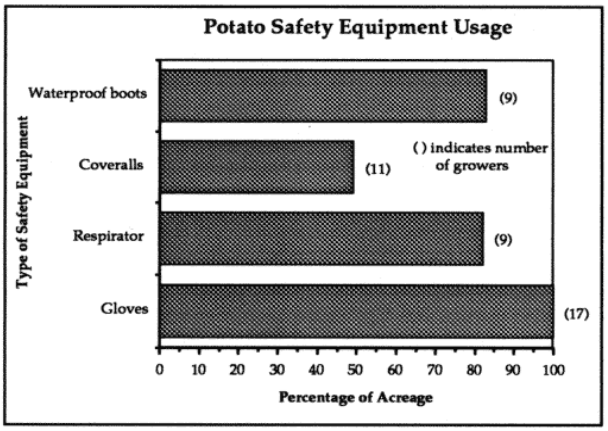

FIGURE 4.

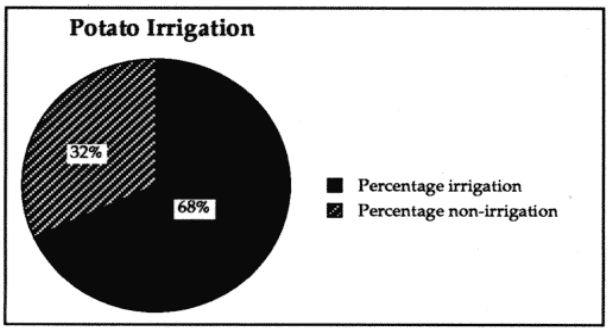

FIGURE 5.

Over 2/3 of the potatoes received overhead irrigation (Figure 5). Because 1991 was a drought year, those growers who had overhead irrigation benefited greatly from it. One cultural practice that is commonly recommended is crop rotation. This practice greatly reduces disease and insect problems. Because Colorado potato beetles are resistant to many insecticides and few alternative controls are available, crop rotation is one of the few tools available to some growers. Over 70% of the potatoes were rotated to other non-related crops for at least two years (Figure 6). Only about a third were rotated for three years and very few were rotated to unrelated crops for four years.

Most fungicides must be applied before infection occurs to be effective. Therefore, spraying in response to observed problems, such as with insects, is not feasible. Most growers apply fungicides either on a regular schedule or based on whether the climatic conditions are suitable for

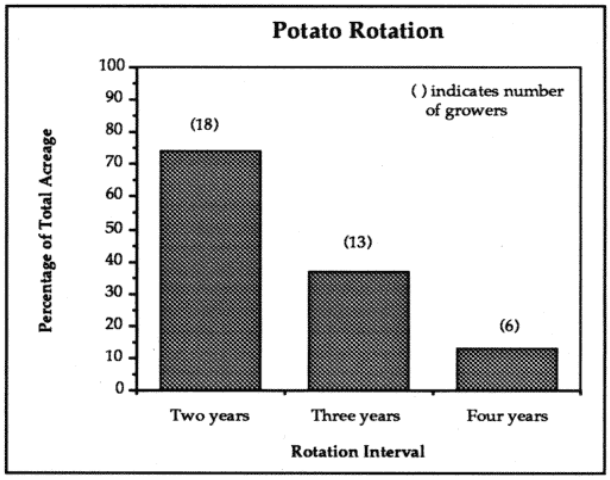

FIGURE 6.

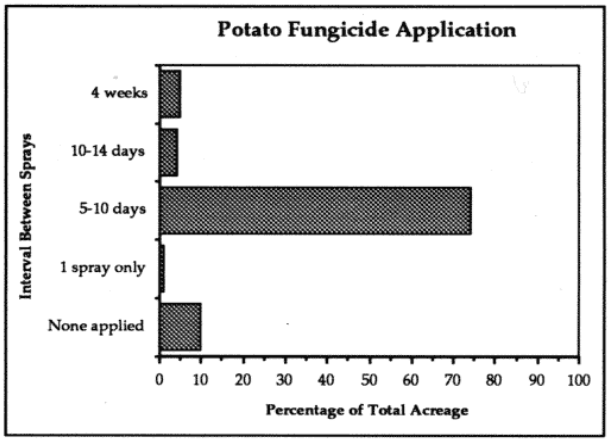

FIGURE 7.

infection to take place. The vast majority of the potato acreage in 1991 was treated with fungicides on a 5-10 day schedule (Figure 7). A number of growers indicated that they sprayed every 7 days. Ten percent of the acreage received no fungicide applications, and a few growers used longer spray intervals or only applied a fungicide once.

Figure 8 shows the number of growers and acreages that employed various pest management practices. Almost all growers used crop rotation on at least a portion of their acreage. Most growers used some form of scouting to determine the necessity for managing pests. Several of the large growers selected varieties that were less susceptible to pests. Relatively few growers used either vine killing or modification of planting date as a pest management practice.

Most growers did not believe that their yields would be devastated if herbicides were not available for control of weeds (Figure 9a). Only four of 19 respondents believed that they would lose over half their yield without herbicides. This may be because they think that potatoes compete relatively well with weeds, or because they have some effective alternative control practices, such as tillage.

There was a relatively even distribution of acreage represented in the four categories when growers were asked what portion of their yield they would lose without fungicides (Figure 9b). Over half the growers believed that they would lose less than 25% of their yield if no fungicides were available. However, 6 growers thought that they would lose over half their yield. All the growers with less than 10 acres of potatoes believed that they would lose less than half their yield without fungicides.

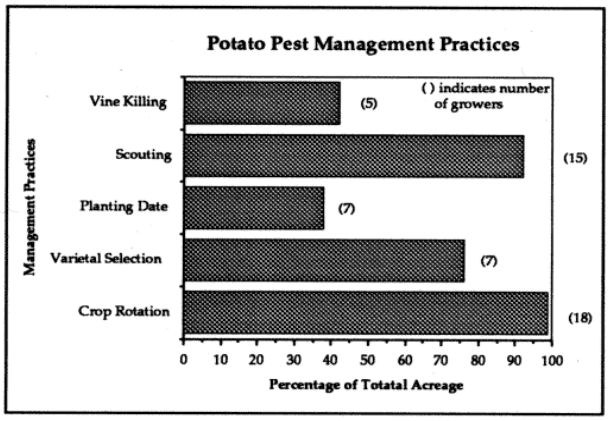

FIGURE 8.

Based on the responses to this series of questions, most growers believe that it is most important to maintain the availability of insecticides (Figure 9c). Fifteen of 19 respondents representing over 70% of the acreage believed that they would lose over half their yield without insecti-

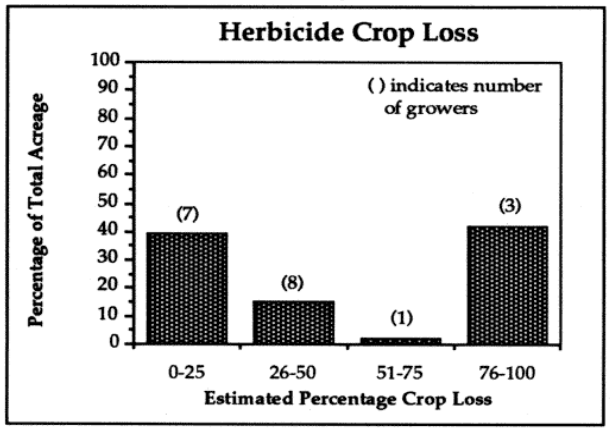

FIGURE 9a.

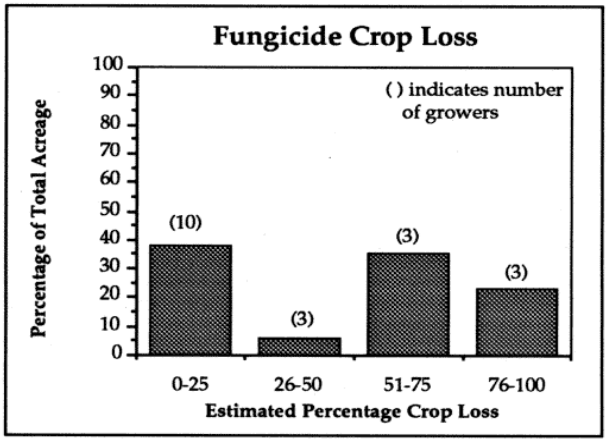

FIGURE 9b.

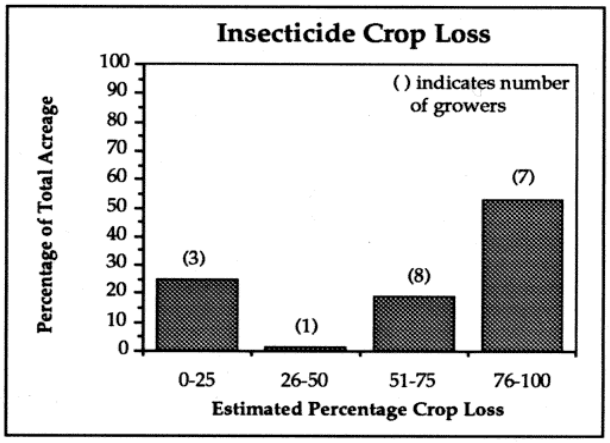

FIGURE 9c.

cides. Seven growers representing over half the acreage believed that without insecticides they would lose over 75% of their yield.

The next series of graphs represents growers' reactions to several statements. In response to the statement regarding availability of pesticides, there was a fairly even distribution of responses, with the larger growers tending to suggest that there were not enough pesticides available to use on potatoes (Figure 10a).

Most growers thought that resistance to insecticides made pest management more difficult (Fig 10b). Many growers in Indiana are having an increasingly difficult time controlling Colorado potato beetles because of resistance.

Only one very small grower agreed with the statement that the pesticides they use might contaminate the groundwater on their farm (Figure 10c). All the other growers were either unsure or believed that their pesticide use practices were not a threat to their groundwater. Most growers also disagreed with the statement that they could modify their production practices to reduce soil erosion (Figure 10d). Apparently most growers either believed that there were no alternative practices available or that they had already adopted those erosion reducing practices. By far the most adamant response to the statements was regarding whether the pesticides the grower used could result in harmful residues on the potatoes (Figure 10e). The same small grower who strongly agreed with the groundwater question strongly agreed that his/her pesticide use might contaminate the finished product. It is interesting that this grower used no herbicides or fungicides and used a minute quantity of the organic insecticides Pyrethrum, Rotenone, and M-One (a *Bacillus thuringiensis* based material), and yet the grower still believed

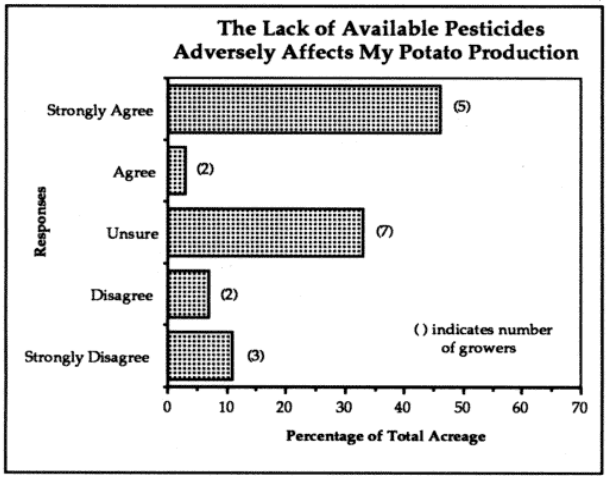

FIGURE 10a.

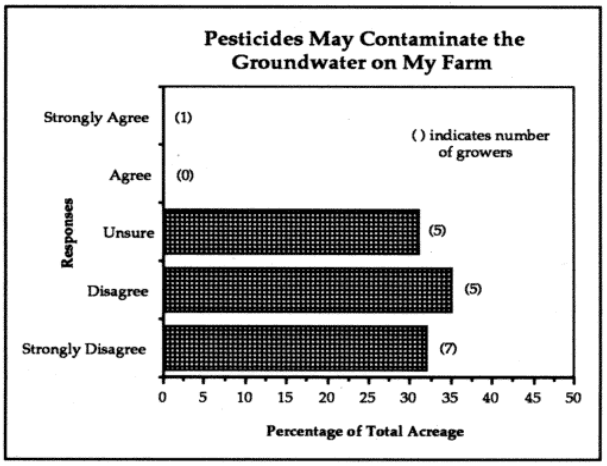

FIGURE 10c.

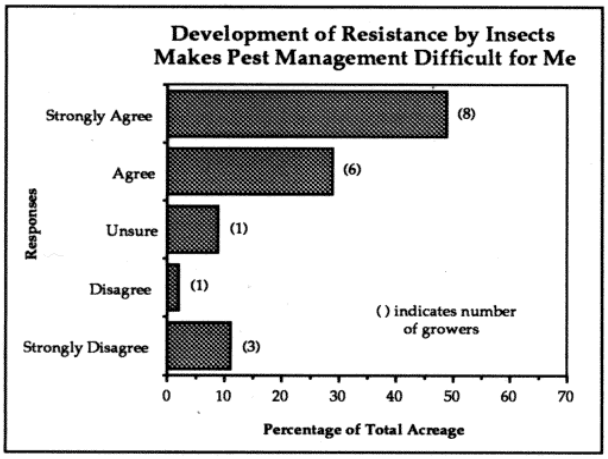

FIGURE 10b.

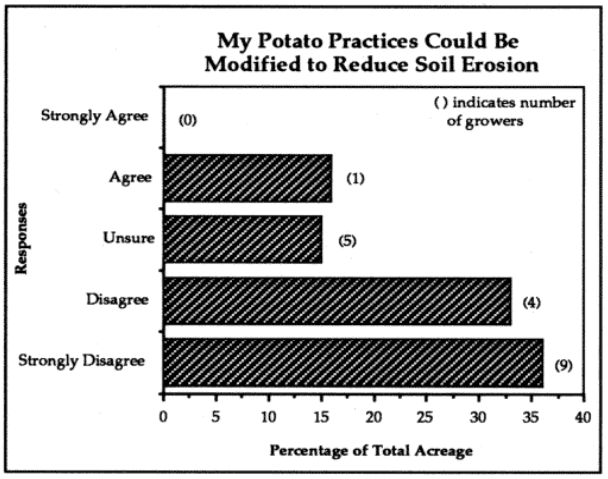

FIGURE 10d.

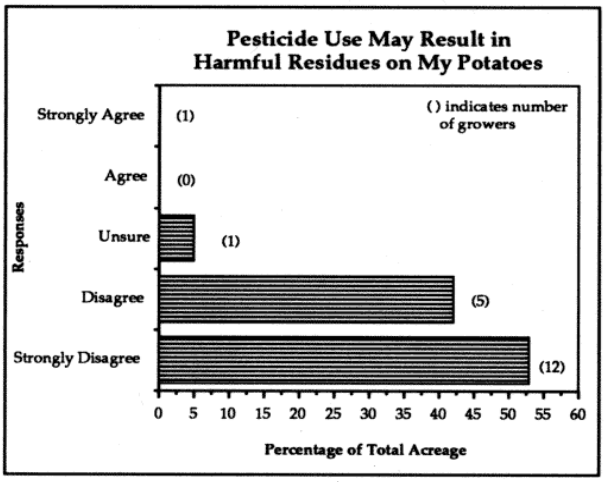

FIGURE 10e.

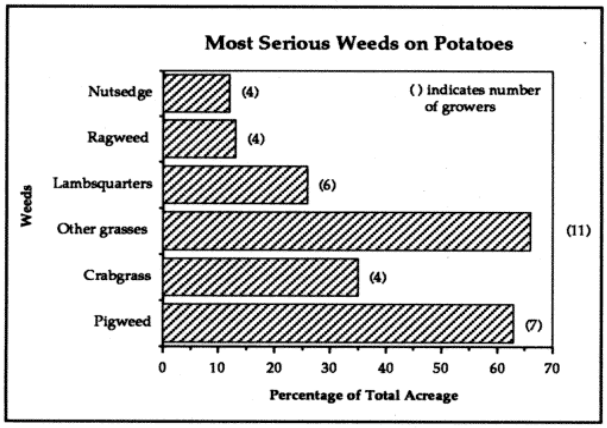

FIGURE 11.

that those pesticides might contaminate both the groundwater and the potatoes. One other grower was unsure about possible contamination, but seventeen of 19 growers disagreed with the statement, 12 strongly.

Figure 11 lists the weeds that were identified by the respondents as being one of their three most serious weed problems. Most growers listed a particular grass or grasses in general as being serious problems. Among the broadleaf weeds, pigweed and lambsquarters were identified as being problems.

Four growers representing about 10% of the acreage reported that they had no serious disease problems on their potatoes (Figure 12). Nine growers indicated that early blight was serious, 7 growers listed late blight, and 4 growers just listed blight without specifying which type. Three fairly large growers indicated that early dieback was a problem. None of the other diseases stood out as being particularly common problems.

There are relatively few insects that cause a problem on potatoes. However, several of these are very common problems. Every grower except one listed the Colorado potato beetle as being a serious problem (Figure 13). This is not surprising because Colorado potato beetles are commonly recognized as the most serious insect pests of potatoes east of the Rocky Mountains. Aphids and potato leafhoppers each were listed as serious problems by eight growers representing about 75% of the total acreage. Flea beetles were listed by 7 growers, but most of these growers tended to have small acreages. Other insects listed as problems included European corn borers, wireworms, grasshoppers, and Japanese beetles.

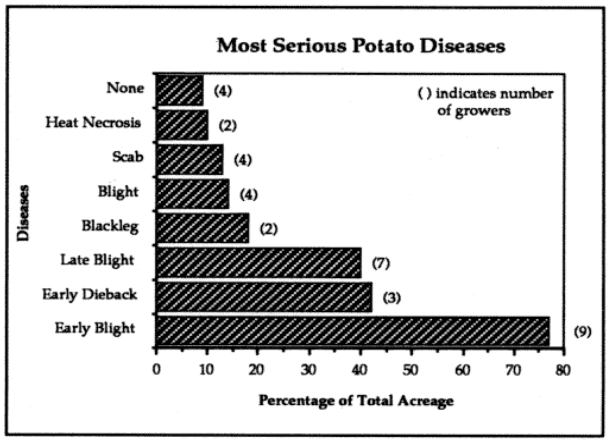

FIGURE 12.

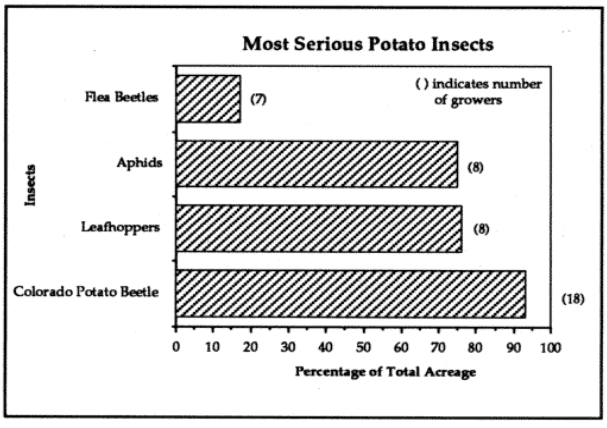

FIGURE 13.

Eighteen of the 20 respondents reported using herbicides. The only two who did not were very small growers, raising 1 and 0.2 acres of potatoes each. The most commonly used herbicides were Lexone/Sencor, Poast, Dual, and Linex/ Lorox (Table 1). If the growers had always used the maximum recommended rate for each herbicide they used, the equivalent of 4000.6 acres would have been treated, for an average of 1.36 applications per acre (Table 4).

TABLE 1. Herbicides used on potatoes in Indiana in 1991.

Herbicide	# Growers	Amount Use	Max. Rate	Treated Acres
Dacthal	1	8.0 lb	8.0 lb	1.0
Dual	9	307.4 gal	3.0 pt	819.7
Eptam	1	87.0 gal	3.5 pt	99.4
Lasso	1	20.0 gal	3.5 qt	22.9
Lexone/Sencor	4	17.4 gal	2.0 pt	69.6
Lexone/Sencor	10	1517.8 lb	1.33 lb	1141.2
Linex/Lorox	4	335.8 gal	4.0 pt	671.6
Prowl	1	55.0 gal	3.0 pt	146.7
Poast	6	180.1 gal	1.5 pt	960.5
Roundup	3	51.0 gal	3.0 qt	68.0
Total				4000.6

TABLE 2. Fungicides used on potatoes in Indiana in 1991.

Fungicide	# Growers	Amount Use	Max. Rate	Treated Acres
Bravo 720	7	568.5 gal	1.5 pt	3832.0
Bravo 90DG	3	9.0 lb	1.25 lb	7.2
Dithane DF	1	450.0 lb	2.0 lb	225.0
Dithane F45	1	220.0 gal	1.6 qt	550.0
Dithane M45	5	5480.0 lb	2.0 lb	2740.0
Kocide	1	3000.0 lb	4.0 lb	750.0
Manzate 200DF	2	6000.0 lb	2.0 lb	3000.0
Penncozeb	1	11000.0 lb	2.0 lb	5500.0
Penncozeb DF	2	18050.0 lb	2.0 lb	9025.0
Ridomil 2E	1	10.0 gal	8.0 pt	10.0
Ridomil Bravo 81W	1	320.0 lb	2.0 lb	160.0
Total				24999.2

Seventeen of the 20 respondents reported using some fungicides. Two of the three who used no fungicides were very small growers, but one grower who raised 300 acres of potatoes also did not use fungicides. The most commonly used fungicides were the EBDC type materials, which accounted for 84% of the fungicide use (Table 2). Bravo and Ridomil were also used in substantial amounts. If growers always used the maximum recommended rate when applying a fungicide, the equivalent of 24,999.2 acres would have been treated with fungicides, for an average of 7.90 applications per acre.

TABLE 3. Insecticides used on potatoes in Indiana in 1991.

Insecticide	# Growers	Amount Use	Max. Rate	Treated Acres
Asana XL	5	114.0 gal.	3.4 fl oz	4291.8
Ambush 2E/ Pounce 3.2 EC	10	264.3 gal.	12.8 fl oz 8.0 fl oz/	3251.7
Ambush 25W/ Pounce 25 WP	1	30.0 lb	12.8 oz	37.5
Cygon	1	168.8 gal.	1.0 pt	1350.0
Diazinon	1	7.0 lb	0.75 lb	9.3
Furadan 4F	2	225.3 gal.	1.0 pt	1802.0
Furadan 15G	1	18000.0 lb	20.0 lb	900.0
Guthion	2	21.0 lb	0.75 lb	28.0
Lannate	1	10.0 gal.	2.0 pt	40.0
Metasystox R	1	112.5 gal.	2.0 pt	500.0
Mocap	1	7760.0 lb	30.0 lb	258.7
M-One	1	Trace		Trace
Monitor	5	561.3 gal.	2.0 pt	2245.2
Parathion	3	636.5 gal.	1.0 pt	5092.0
Phosphamidon	1	337.5 gal.	0.5 pt	5400.0
Pyrethrum/Rotenone	1	Trace		Trace
Sevin 50W/80S	8	3307.5 lb	2/1.25 lb	1980.5
Sevin 4F	1	37.5 gal.	1.0 qt	150.0
Thimet	4	10850.0 lb	15.7 lb	691.1
Thiodan 3EC	2	75.0 gal.	1.33 qt	56.4
Thiodan 50WP	1	34.0 lb	1.0 lb	34.0
Vydate	1	30.0 gal.	2.0 gal.	15.0
Total				28133.2

Every respondent applied insecticides to their potatoes. A wide variety of insecticides were used, partly because there are a variety of insecticides available and partly because some growers were searching for any insecticide that might provide adequate control of the Colorado potato beetle (Table 3). Several growers used the soil insecticides Mocap, Furadan, and Thimet at planting. However, most growers did not. Numerous foliar insecticides were used, with the most common being parathion, phosphamidon, Asana, Ambush/Pounce, and Monitor. Only one grower used the *Bacillus thuringiensis* based insecticide M-One for control of potato beetles. If each grower used the maximum recommended rate for each application of an insecticide, the equivalent of 28,133.2 acres would have been treated, for an average of 9.58 applications of insecticide per acre. There was a wide variety of use patterns among the growers. Some growers used very little insecticide. One large grower used Thimet at planting and no other insecticides. One grower used an average of 16.28 insecticide applications per acre. The primary difference between these growers is the regularity with which they rotate out of potatoes. Lack of rotation results in higher Colorado potato beetle populations, more insecticide use, and more resistance.

TABLE 4. Average number of herbicide, fungicide, and insecticide treatments per acre on potatoes grown in Indiana in 1991.

Pesticide Type	Treated Acres	Reported Acres	Treatments/Acre
Herbicide	4000.6	2936.95	1.36
Fungicide	24999.2	3165.95	7.90
Insecticide	28133.2	2936.95	9.58
Total	57133.0		18.84

Purdue University
Indiana Potato Pesticide Use Survey

Rick Foster, Rick Latin and Steve Weller

1. How many acres of potatoes did you grow in 1991? _____

2. What varieties of potatoes did you grow in 1991? _____
   _____
   _____

3. What was your average yield (cwt) per acre? _____

4. What percentage of your crop was:
   a. sold for fresh market use? _____
   b. sold for processing? _____
   c. saved for seed? _____

5. If you or your employees applied pesticides in 1991, did you use the following on any of your acreage?

a.	fixed-wing aircraft	Yes	No
b.	helicopter	Yes	No
c.	boom-type sprayer	Yes	No
d.	granular applicator	Yes	No
e.	air blast sprayer	Yes	No
f.	solo-type mist blaster	Yes	No
g.	compressed air sprayer	Yes	No
h.	Other (specify)	Yes	No

6. If an outside firm applied a pesticide in 1991, did they use the following on any of your acreage?

a.	fixed-wing aircraft	Yes	No
b.	helicopter	Yes	No
c.	boom-type sprayer	Yes	No
d.	air blast sprayer	Yes	No
e.	Other (specify)	Yes	No

7. If you or your employees applied a pesticide in 1991, what protective clothing did you use?

a.	gloves	Yes	No
b.	respirator	Yes	No
c.	coveralls	Yes	No
d.	waterproof boots	Yes	No
e.	Other (specify)	Yes	No

8. What percentage of your crop has overhead irrigation? _____

9. What percentage of your potatoes are planted to unrelated crops for

two years before raising potatoes? _____

three years before raising potatoes? _____

four years before raising potatoes? _____

10 What application interval do you normally use between fungicide sprays?

_____

11. Which of the following practices do you use to more effectively manage diseases, insects, and weeds?

a.	crop rotation	Yes	No
b.	varietal selection	Yes	No
c.	planting date	Yes	No
d.	scouting	Yes	No
e.	vine killing	Yes	No

12. Circle the approximate percentage of your yield would you lose if the following types of pesticides were not available and you had to rely on alternative control practices?

a. Herbicides	0-25%	26-50%	51-75%	76-100%
b. Fungicides	0-25%	26-50%	51-75%	76-100%
c. Insecticides	0-25%	26-50%^	51-75%	76-100%

13. Circle the appropriate number to indicate whether you agree or disagree with the following statements.

	Strongly Disagree	Disagree		Agree	Strongly Agree
a. The lack of available pesticides makes it difficult for me to successfully produce potatoes.	1	2	3	4	5
b. The development of resistance by insects to pesticides is making pest management more difficult on my farm.	1	2	3	4	5
c. The use of pesticides may contaminate the groundwater on my farm.	1	2	3	4	5
d. My potato production practices could be modified to reduce soil erosion.	1	2	3	4	5
e. My use of pesticides may result in harmful pesticide residues on the potatoes I produce.	1	2	3	4	5

14. List the three most serious weed, disease, and insect pests that you have to manage in your potato fields.

Weeds	**Diseases**	**Insects**
1. _____	1. _____	1. _____
2. _____	2. _____	2. _____
3. _____	3. _____	3. _____

15. Please circle the herbicides and record the total amounts (in pounds or gallons) that you used on all your potatoes in 1991.

a. Dacthal amount _____
b. Dual amount _____
c. Eptam amount _____
d. Lexone or Sencor amount _____
e. Linex or Lorox amount _____
f. Prowl amount _____
g. Treflan amount _____
h. Poast amount _____
i. Gramoxone amount _____
j. Roundup amount _____
k. Other amount _____

16. Please circle the fungicides and record the total amounts (in pounds or gallons) that you used on all your potatoes in 1991.

a. Bravo 720 amount _____
b. Bravo 90DG amount _____
c. Bravo W-75 amount _____
d. Dithane DF amount _____
e. Dithane M-45 amount _____
f. Duter amount _____
g. Manzate 200DF amount _____
h. Penncozeb amount _____
i. Penncozeb DF amount _____
j. Polyram amount _____
k. Ridomil Bravo 81W amount _____
l. Rovral amount _____
m. Super Tin amount _____
n. Fixed copper amount _____
o. Other amount _____

17. Please circle the insecticides and record the total amounts (in pounds or gallons) that you used on all your potatoes in 1991.

a.	Asana	amount _____
b.	Ambush or Pounce	amount _____
c.	Cygon	amount _____
d.	Dasanit	amount _____
e.	Diazinon	amount _____
f.	Disyston 15G	amount _____
g.	Dyfonate 20G	amount _____
h.	Furadan 4F	amount _____
i.	Furadan 15G	amount _____
j.	Guthion	amount _____
k.	Lannate or Nudrin	amount _____
l.	Malathion or Cythion	amount _____
m.	Metasystox R	amount _____
n.	Marlate or Methoxychlor	amount _____
o.	Methyl parathion	amount _____
p.	Mocap	amount _____
q.	Monitor	amount _____
r.	Parathion	amount _____
s.	Phosdrin	amount _____
t.	Pyrethrum	amount _____
u.	Rotenone	amount _____
v.	Sevin	amount _____
w.	Thimet	amount _____
x.	Thiodan	amount _____
y.	Vydate	amount _____
z.	Other	amount _____

New 3/93

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