Pesticide Use on Processing Tomatoes Grown in Indiana

R. E. Foster, Entomologist; R. X. Latin, Plant Pathologist; and S. C. Weller, Horticulturalist

Indiana currently ranks third nationally in the production of tomatoes for processing, with an annual production of over 186,000 tons and a value of $14.9 million. In 1991, approximately 8800 acres in Indiana were planted to tomatoes for processing. Like most other vegetables, tomatoes must compete with weeds for nutrients, sunlight, and moisture and are attacked by a wide variety of insect and disease pests. Food and Drug Administration standards require that processed food have a minimal amount of insect, bacterial, or fungal contamination. As a result, most commercial processing tomato growers rely heavily on herbicides, insecticides, and fungicides for managing pests.

The purpose of this study was to determine the amounts and types of pesticides used on tomatoes and to determine growers' attitudes toward their use of pesticides, their use of IPM practices, and some related issues.

MATERIALS AND METHODS

On November 15, 1991, survey questionnaires (Appendix A) were mailed to 47 people who had been identified to us as processing tomato growers by county Extension agents and processing companies. A few of these individuals later were found not to grow tomatoes. Several were found to be in business with another family member who was also on the list. Each person on the mailing list was contacted at least once by telephone to determine whether he or she was a commercial tomato grower and if the survey questionnaire had been returned. Several growers chose to complete the survey over the telephone rather than in writing.

A total of 35 commercial growers, with acreages ranging from 25 to 760 acres, completed the questionnaire. These 35 growers represented 6497 acres, or 73.8% of the estimated acreage. 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 tomato acreage grown by each grower. Most growers

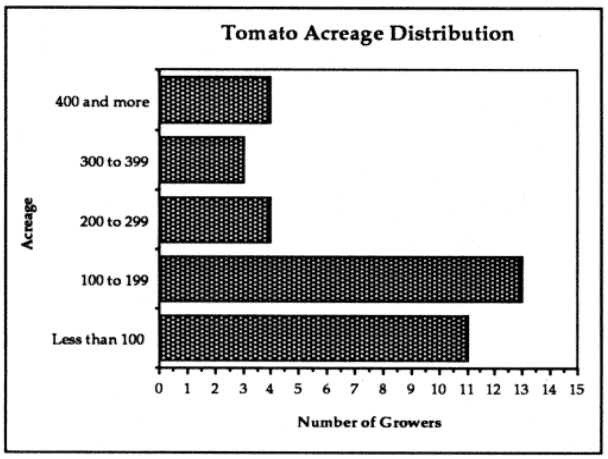

FIGURE 1.

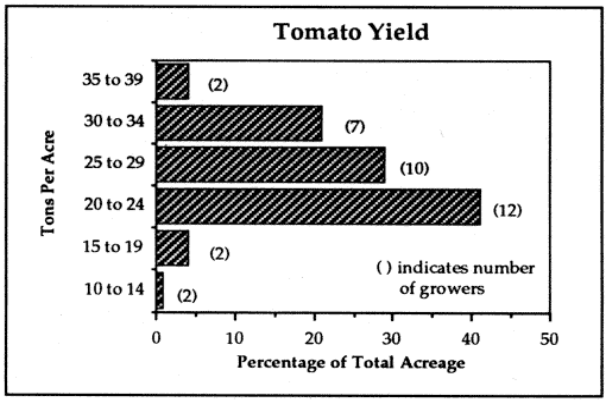

FIGURE 2.

grew less than 200 acres of tomatoes. The average grower in the study grew 185 acres and had an average yield of 26.15 tons per acre. The distribution of average yields is shown in Figure 2. A few growers produced less than 20 tons per acre, and a few yielded more than 35 tons, but most were between 20 and 30 tons.

Relatively few of the growers hired outside firms to apply their pesticides. Therefore, we combined Questions 3 and 4 to determine how the various growers applied their pesticides (Figure 3).

Almost all growers used a boom type sprayer. The three who did not used air blast sprayers. Almost all pesticides were applied with ground equipment. Less than 10% of the acreage had

pesticides applied either with a fixed wing aircraft or a helicopter. Almost all growers used waterproof gloves, but less than half of the growers used respirators or coveralls as safety equipment when applying pesticides (Figure 4). Very few growers used waterproof boots. The growers who did not use gloves were mostly small growers. Several growers indicated that they used additional safety equipment such as enclosed cabs, protective glasses or goggles, and facemasks.

Twenty percent of the tomatoes received overhead irrigation (Figure 5). Because 1991 was a drought year, those growers who had overhead irrigation benefited greatly from it. Growers who had 100% of their acreage with overhead irrigation averaged 31.0 tons per acre, versus 24.98 tons for those growers who had no irrigation.

One cultural practice that is commonly recommended is crop rotation. This practice will greatly reduce disease and insect problems. Almost 90% of the tomatoes were rotated to other non-related crops for at least two years (Figure 6).

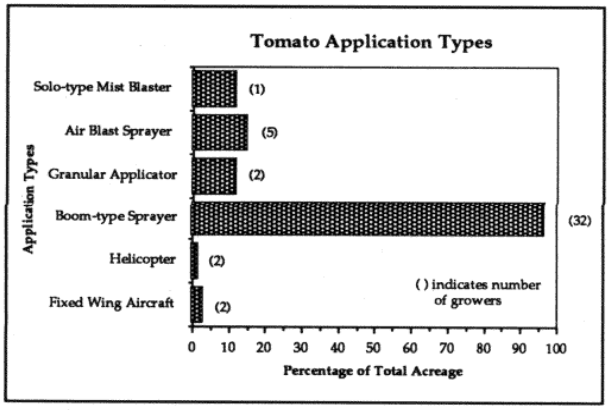

FIGURE 3.

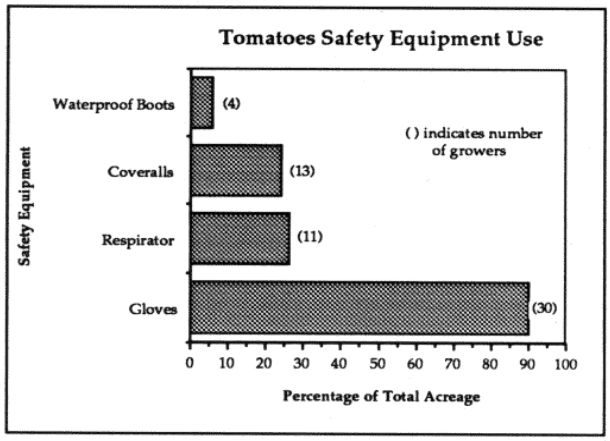

FIGURE 4.

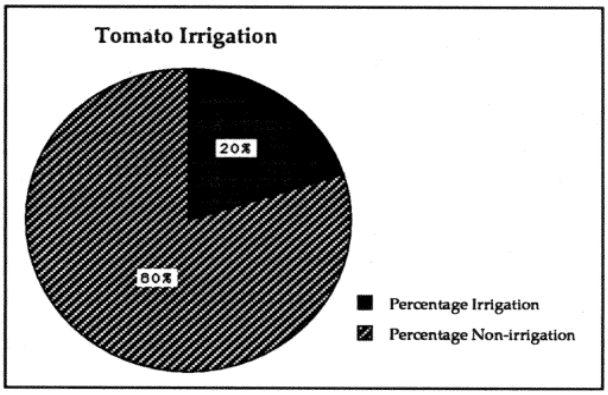

FIGURE 5.

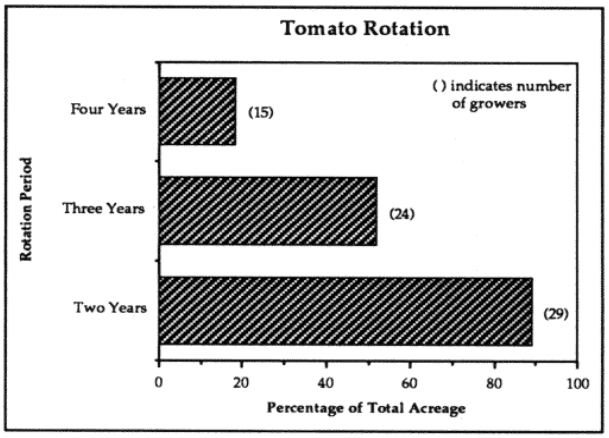

FIGURE 6.

About half were rotated for three years, but relatively few were rotated to unrelated crops for four years.

Most fungicides must be applied before infection occurs to be effective. It is not uncommon for there to be a two-week lag time between infection and the presence of symptoms. The result is that spraying fungicides in response to observed problems, such as with insects, is usually not feasible. Therefore, most growers apply fungicides of fixed intervals (7-14 days) or according to a weather-based schedule. Almost all the growers indicated that their fungicide spray interval was somewhere between 7 and 14 days. Relatively few growers were on a strict 7-day spray schedule, at least partially as a result of the dry weather conditions in 1991. Most growers indicated a range in their spray intervals, signalling that they were applying fungicides based on their perception of need rather than on the calendar.

Figure 7 shows the number of growers and acreages that employed various pest management

practices. Every growers used crop rotation on at least a portion of their acreage, accounting for about 98% of the total tomato acreage. Most growers used some form of scouting to determine the necessity for managing pests. The majority of the growers selected varieties that were less susceptible to pests. A few growers manipulated their planting date to avoid certain pests. Relatively few growers used either vine killing or trickle irrigation as pest management practices.

Most growers believed that their yields would be reduced by 26-50% if herbicides were not available for control of weeds (Figure 8a). Only eight of 34 respondents believed that they would lose over half their yield without herbicides. This may be because most growers think that tomatoes compete relatively well with weeds, or because they have some effective alternative control practices, such as tillage. Three relatively small growers did not think the loss of herbicides would have much effect on their yields (<25%).

Most growers believed that they would lose more than half of their yield if fungicides were not available to control diseases (Figure 8b). Only eight growers thought that they would lose less than half their yield without fungicides. The growers who responded to this survey believed that diseases were the most serious pest threatening their crops. This is an indication of the severity of the disease problems that tomato growers face in Indiana.

Based on the responses to this series of questions, most growers believe that insects are the least important pest of the three pest threats to profitable tomato production (Figure 8c). Twenty-five of 35 respondents representing about 65% of

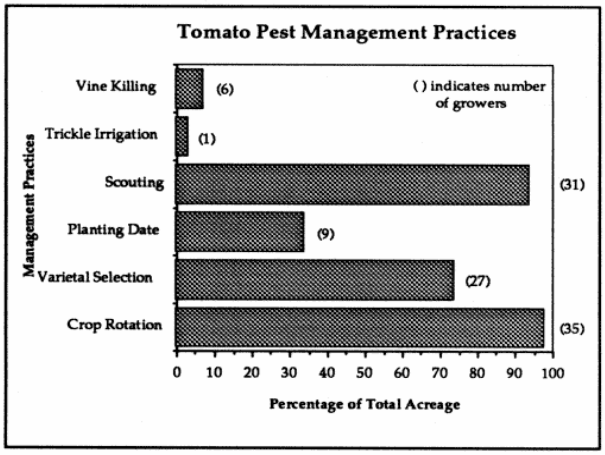

FIGURE 7.

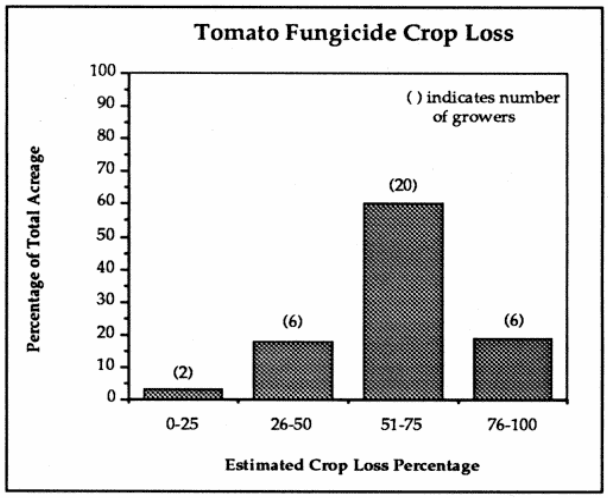

FIGURE 8b.

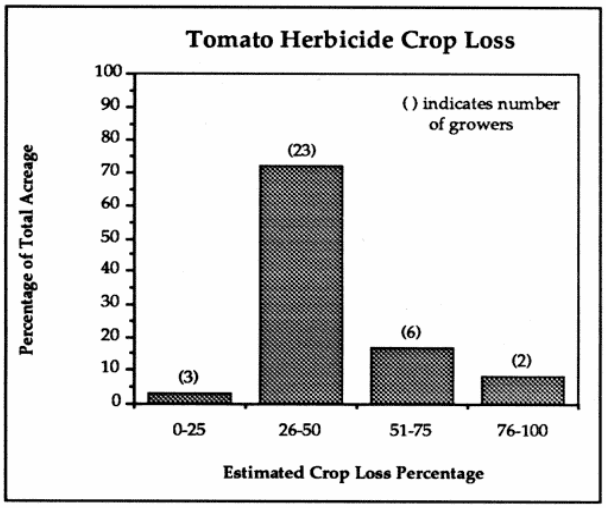

FIGURE 8a.

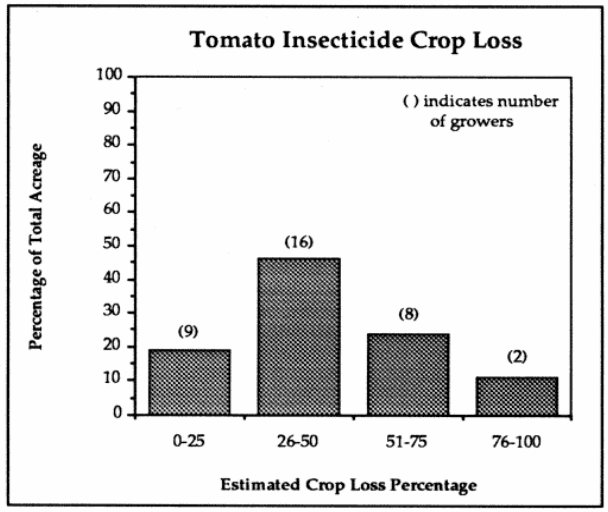

FIGURE 8c.

the acreage believed that they would lose less than half their yield without insecticides. Only two growers believed that they would lose 76-100% of their yield to insects if insecticides were not available.

The next series of graphs represents growers' reactions to several statements. In response to the statement regarding availability of pesticides, there was an even distribution of growers, with a slight tendency toward agreeing that there is a lack of available pesticides (Figure 9a). However, there was certainly no consensus that the lack of pesticides was a major constraint to tomato production.

A few growers thought that resistance to insecticides made pest management more difficult (Figure 9b). This is likely a reflection of the belief that insects are less important than weeds or diseases and the lack of heavy insecticide use in the past.

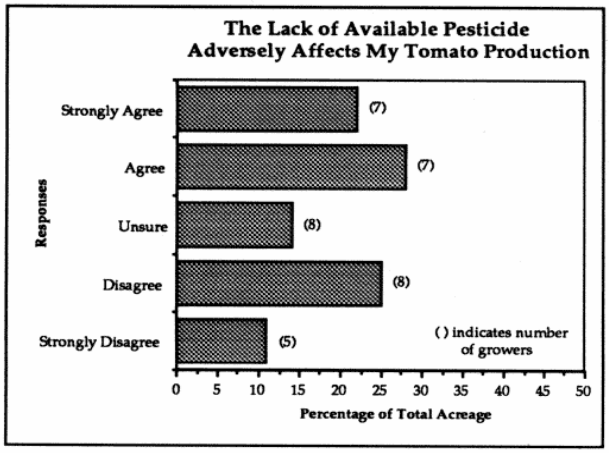

FIGURE 9a.

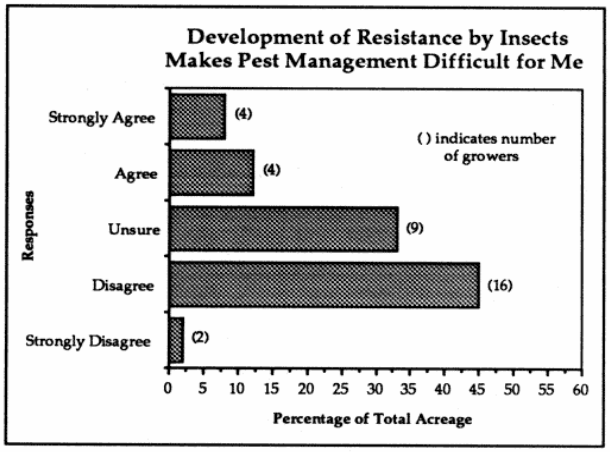

FIGURE 9b.

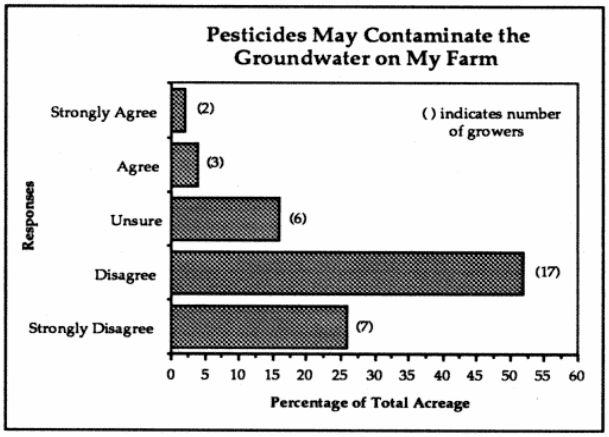

FIGURE 9c.

Few growers agreed with the statement that the pesticides they use might contaminate the groundwater on their farm (Figure 9c). These growers tended to be smaller growers. Most growers 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 9d). 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 strongest reaction to the statements was regarding whether the pesticides the grower used could result in harmful residues in the tomato products (Figure 9e). Thirty-one of the 35 respondents disagreed with this statement, 15 (representing half the acreage) disagreed strongly. The response to this question is most likely the

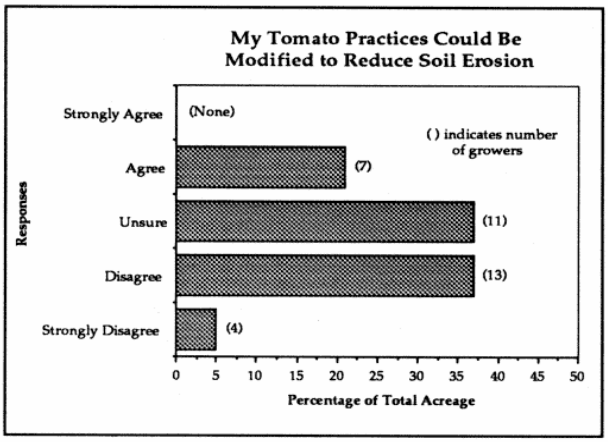

FIGURE 9d.

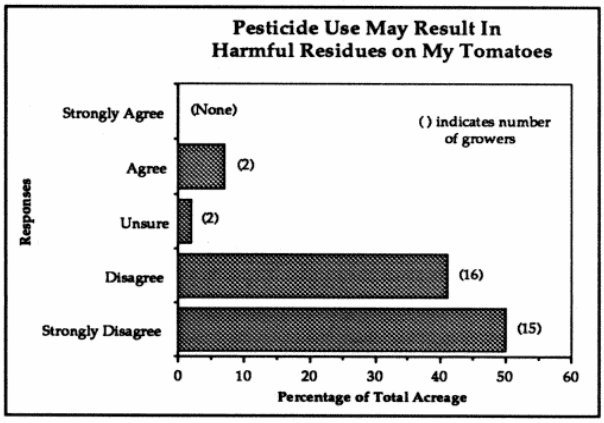

FIGURE 9e.

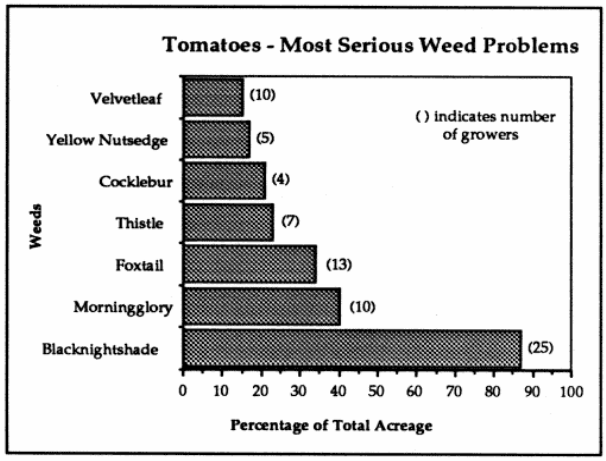

FIGURE 10.

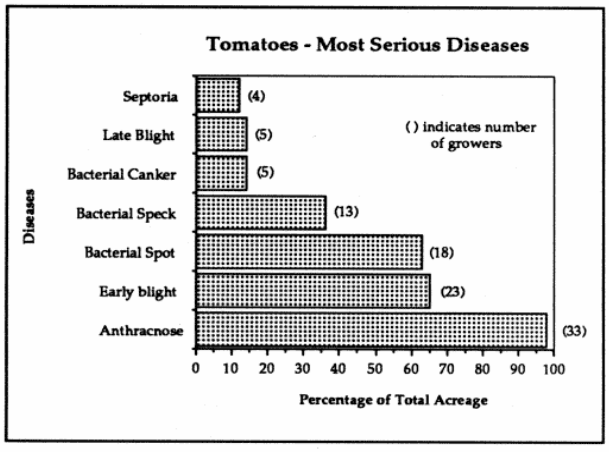

FIGURE 11.

result of the deep concern food processors have regarding pesticide contamination in their products and the manner in which this concern is relayed to the grower.

Figure 10 lists the weeds that were identified by the respondents as being among their three most serious weed problems. By far the most frequently mentioned weed is black nightshade, which is closely related to tomato, and therefore, is difficult to control with herbicides without also harming the tomatoes. Morningglory, foxtail, thistle, and velvetleaf were also commonly mentioned.

There was also a strong consensus regarding the most serious disease pest of tomatoes (Figure 11). Anthracnose was by far the most commonly mentioned disease, being selected by 33 of the 35 respondents. Early blight and bacterial speck and spot were also commonly mentioned.

The most frequently mentioned insect pest was the Colorado potato beetle (Figure 12). The potato beetle was mentioned by 18 growers, but these accounted for less than half of the acreage. This beetle will attack the foliage of tomatoes, but is not nearly as devastating on tomatoes as it is on potatoes. Leafhoppers, aphids, and flea beetle were also mentioned by several growers. This lack of consensus as to the major insect pest reflects the lack of a single severe insect pest of tomatoes. Some other insects that were mentioned include cutworms, stinkbugs, hornworms, loopers, and corn borers.

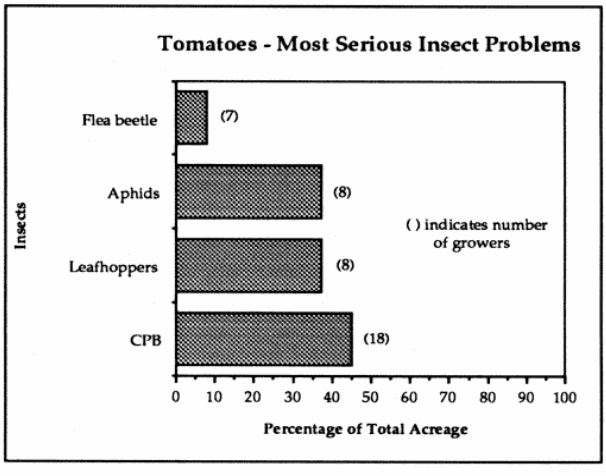

FIGURE 12.

Each one of the respondents reported using herbicides, fungicides, and insecticides. There was not a single grower who failed to use all three types of pesticides. The most commonly used herbicides were Treflan, Lexone/Sencor, and Poast (Table 1). If the growers had always used the maximum recommended rate for each herbicide they used, the equivalent of 22468.9 acres would have been treated, for an average of 3.66 applications per acre (Table 4).

The most commonly used fungicides were the two formulations of Bravo, used primarily for control of Anthracnose and early blight. Smaller amounts of Benlate and Dyrene were also used. A considerable amount of copper was used for controlling bacterial speck and spot. If growers always used the maximum recommended rate when applying a fungicide, the equivalent of 47838.2 acres would have been treated with fungicides, for an average of 7.76 applications per acre.

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

Herbicide	# Growers	Amount Use	Max. Rate	Treated Acres
Amiben	1	200.0 lb	3.0 lb	66.7
Devrinol	8	3785.0 lb	2.0 lb	1892.5
Lexone/Sencor	2	9.5 gal.	2.0 pt	76.0
Lexone/Sencor	29	4192.3 lb	0.66 lb	6352.0
Poast	23	872.1 gal.	1.5 pt	4650.9
Roundup	2	25.0 gal.	3.0 qt	33.3
Tillam	8	965.0 gal	2.7 qt	1429.6
Treflan	1	1300.0 lb	7.5 lb	173.3
Treflan	17	652.8 gal.	.67 pt	7794.6
Total				22468.9

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

Fungicide	# Growers	Amount Use	Max. Rate	Treated Acres
Benlate 50DF	8	1264.0 lb	1.0 lb	1264.0
Bravo 720	23	4456.9 gal.	3.0 pt	11885.1
Bravo 90DG	17	57925.0 lb	2.5 lb	23170.0
Ridomil Bravo 81W	4	2375.0 lb	2.0 lb	1187.5
Copper	20	4048.8 gal.	4.0 pt	8097.5
Copper	9	5775.0 lb	3.0 lb	1925.0
Dyrene	4	1546.0 lb	5.0 lb	309.2
Total				24999.2

Considering the number of insecticides available for use on tomatoes, a relatively small group of insecticides were used on Indiana tomatoes. Two insecticides, Asana and Sevin, accouted for 50 and 36% of the total insecticide use, respectively. Thiodan was used by 10 growers, and lesser amounts of diazinon, parathion, and Lannate were used. If each grower used the maximum recommended rate for each application of an insecticide, the equivalent of 20,220.9 acres would have been treated, for an average of 3.28 applications of insecticide per acre. The relatively low number of insecticide applications reflects the perception of growers that insects are not as serious a problem on tomatoes as are weeds and diseases.

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

Insecticide	# Growers	Amount Use	Max. Rate	Treated Acres
Asana XL	31	762.4 gal.	9.6 fl oz	10165.3
Diazinon	3	264.0 gal.	1.5 pt	1408.0
Lannate	3	98.0 gal.	4.0 pt	196.0
Lannate	1	600.0 lb	2.0 lb	300.0
Parathion	1	32.0 gal.	0.75 pt	341.3
Sevin 50W/80S	20	10108.0 lb	2/1.25 lb	6052.7
Sevin 4F	6	304.0 gal.	1.0 qt	1216.0
Thiodan 3EC	10	720.4 gal.	1.33 qt	541.6
Total				20220.9

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

Pesticide Type	Treated Acres	Reported Acres	Treatments/Acre
Herbicide	22468.9	6132	3.66
Fungicide	47838.2	6167	7.76
Insecticide	20220.9	6167	3.28
Total	90528.0		14.70

Purdue University
Indiana Processing Tomato Pesticide Use Survey

Rick Foster, Rick Latin and Steve Weller

1. How many acres of tomatoes for processing did you grow in 1991? _____

2. What was your average yield (tons) per acre? _____

3. If you or your employers applied pesticides in 1991, did you use the following on any of your tomato 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

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

5. 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

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

7. What percentage of your tomatoes are planted to unrelated crops for

two years before raising tomatoes? _____

three years before raising tomatoes? _____

four years before raising tomatoes? _____

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

_____

9. 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.	trickle irrigation	Yes	No
f.	vine killing	Yes	No

10. Circle the approximate percentage of your yield you would 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%

11. 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 tomatoes.	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 tomato 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 tomatoes I produce.	1	2	3	4	5

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

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

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

a.	Dacthal	amount _____
b.	Devrinol	amount _____
c.	Gramoxone	amount _____
d.	Lexone or Sencor	amount _____
e.	Poast	amount _____
f.	Prefar	amount _____
g.	Roundup	amount _____
h.	Tillam	amount _____
i.	Treflan	amount _____
j.	Other	amount _____

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

a.	Benlate 50 DF	amount _____
b.	Bravo 720	amount _____
c.	Bravo 90DG	amount _____
d.	Bravo W-75	amount _____
e.	Dithane DF	amount _____
f.	Dithane M-45	amount _____
g.	Manzate 200DF	amount _____
h.	Penncozeb	amount _____
i.	Penncozeb DF	amount _____
j.	Polyram	amount _____
k.	Ridomil Bravo 81W	amount _____
l.	Ridomil 2E	amount _____
m.	Fixed copper	amount _____
n.	Other	amount _____

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

a.	Asana	amount	_____
b.	*Bacillus thuringiensis* (MVP, Javelin, Dipel,etc)	amount	_____
c.	Cygon	amount	_____
d.	Dasanit	amount	_____
e.	Diazinon	amount	_____
f.	Disyston 15G	amount	_____
g.	Dibrom	amount	_____
h.	Disyston 15G	amount	_____
i.	Dyfonate 20G	amount	_____
j.	Dylox/Proxol	amount	_____
k.	Guthion	amount	_____
l.	Lannate or Nudrin	amount	_____
m.	Lindane	amount	_____
n.	Malathion or Cythion	amount	_____
o.	Marlate or Methoxychlor	amount	_____
p.	Methyl parathion	amount	_____
q.	Parathion	amount	_____
r.	Phosdrin	amount	_____
s.	Phosphamidon	amount	_____
t.	Pyrethrum	amount	_____
u.	Rotenone	amount	_____
v.	Sevin	amount	_____
w.	Thiodan	amount	_____
x.	Vydate	amount	_____
y.	Other	amount	_____

New 3/93

Cooperative Extension work in Agriculture and Home Economics, State of Indiana, Purdue University and U. S. Department of Agriculture cooperating. H. A. Wadsworth, Director, West Lafayette, IN. Issued in furtherance of the acts of May 8 and June 30, 1914. The Cooperative Extension Service of Purdue University is an affirmative action/equal opportunity institution.