

ABUNDANCE OF PEACH INSECTS AND INSECTICIDE USAGE IN ILLINOIS, 1935-1957

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HISTORY OF SURVEYS AND INSECTS INVOLVED

Each year since 1935, the State Natural History Survey has conducted a survey at peach harvest time in the commercial peach-growing areas of southern Illinois to determine the extent of insect injury to the fruit. Started because of a need for information on a new and threatening pest, the oriental fruit moth, *Grapholitha molesta* (Busk), the early surveys included records on this insect only, but as the value of surveys became apparent, the objectives broadened.

First records of fruit "wormy" from the plum curculio, *Conotrachelus nenuphar* (Hbst.) were secured in 1937. When the importance of trying to correlate infestation with insecticides used was realized in 1938, work on this phase began. Certain stink bugs, notably of the genus *Euschistus*, and the tarnished plant bug, *Lygus lineolaris* (P. deB.), feed on the peach when it is very small and produce the distortion of the fruit called "catfacing". The inability to control these insects causing catfacing resulted in this injury being included, beginning in 1942. With the use of DDT as a part of our peach and apple insecticide program, leaf rollers were observed for the first time and became serious in some orchards in 1949. In the same year, we first included the records of fruit stung by the adults

of the plum curculio. This had always been a factor in poor quality fruit, but appeared to be especially bad where benzene hexachloride (BHC) was being used. Correlation between stung fruit and use of BHC in 1949 and 1950 seems apparent.

SURVEY METHODS

From 30 to 35 selected orchards in ten counties were included, largely commercial blocks in the major peach-growing areas. Where possible, the same orchards were checked each year. Just before or at the time of first picking, 500 peaches were examined at random on the trees in a representative block. The surveys were limited to Elberta peaches, which even now constitute 70 to 75% of the peaches of the state. The fruit was scored for the various injuries noted in Table 1. The grower was interviewed to find out which insecticides were used and the number of applications made, in liquid and dust form, in the early and late brood periods. Data on chemicals are condensed into Tables 2 and 3. The tables outline much of a quarter of a century of peach growing and insect control in Illinois.

DISCUSSION OF INSECT INFESTATIONS

Oriental fruit moth: The oriental fruit moth was first found in Pularski County in 1927, and it soon

TABLE 1.—Average Percentages of Peaches Damaged by Plum Curculio, Oriental Fruit Moth, and Leaf Roller, in 30 Representative Orchards in Southern Illinois.

Year	Percent fruit infested, plum curculio larvae	Percent fruit stung, adult curculios	Percent fruit infested, oriental fruit moth	Percent oriental fruit moth larvae parasitized	Percent fruit, catfaced	Percent fruit injured, leaf rollers
1934...				20.0		
1935.....				17.7		
1936.....			22.1			
1937.....	2.0		3.3	17.3		
1938.....	4.3		12.2	28.0		
1939.....	3.8		3.7	56.8		
1940.....	no crop		1.2			
1941.....	0.7					
1942.....	7.2		0.3			
1943.....	7.8		1.6		11.7	
1944.....	1.7		5.8		19.9	
1945.....	3.6		0.9		3.8	
1946.....	6.0		1.6	51.0	5.8	
1947.....	3.4		5.2	48.3	12.2	
1948.....	4.6		2.2		4.8	
1949.....	4.5	9.9	5.2	53.9	10.7	low
1950.....	1.7	5.8	2.0		9.6	3.3
1951.....	4.9	2.39	3.2		8.6	0.2
1952.....	1.4	2.34	4.4		4.1	0.1
1953.....	1.3	0.72	0.3		6.5	0.1
1954.....	0.1	0.41	0.2		3.3	0.7
1955.....	no crop		0.7		2.6	0.1
1956.....	0.33	0.38	0.47		4.49	0.18
1957.....	0.18	0.90	3.20		7.20	1.74

became widespread. Parasites, chiefly *Macrocentrus ancylivorous*, reared in the Bureau of Entomology Laboratory in New Jersey, were flown to Illinois and liberated in infested peach orchards. First recovery collections were made in 1934. As will be seen in Table 1, there was little increase in parasitism until 1938, when it reached 56.8%, which later proved to be about the normal average. With the exception of the excessively hot, dry season of 1936, the infestations of the oriental fruit moth remained high until parasitism reached its maximum in 1938 and then decreased. The general in-

clusion of DDT in spray and dust schedules helped to control the infestation. Later, parathion was responsible for much of the reduction. The moth is still potentially a bad pest, however, with the five possible broods a year which caused the seven-fold increase observed in the very wet season of 1957.

The plum curculio: Over the years more insecticides have been directed against the plum curculio and the disease brown rot, which it indirectly stimulates, than any other peach pest. The high averages of wormy fruit during the first three-fourths of the survey period are seen in

Table 1, and to this must be added stung and roughened fruit and even some fruit catfaced by the adult curculios. The effect of a total crop failure in 1930 has been noted, but no detailed records were made of the infestation in 1931. In 1940, the failure of the crop resulted in a decrease from 3.8% in 1939 to 0.7% in 1941 (Table 1). The use of chlor-dane, parathion, and dieldrin after 1951 (Tables 2 and 3) was largely responsible for the low subsequent infestations, although these were assisted by a dry cycle starting in 1952.

Leaf roller: Leaf roller injury was practically unknown before the advent of DDT. By 1949, it became quite serious in some orchards, with 10 to 15% of the fruit being injured. Enough of the 38 orchards examined were so slightly affected that the average was only 3.3% (Table 1). It was at first assumed that this leaf roller on peach trees was the same as the one that had appeared on apple trees following DDT. It was later determined to be one closely resembling it, *Platynota flavedana* (Clem.). The very marked increase in average infestation of 1957 over 1956, about nine times, may be associated in some way with the very wet season of 1957.

Catfacing: The importance of catfacing is very great. Although peaches damaged in this way possibly are not as objectionable as those tunneled by the larva of the plum curculio or the oriental fruit moth, they are still culls, and the number of catfaced peaches commonly equals or exceeds all other injuries combined. Referring to Table 1, we obtain the following comparisons:

	Fruit injuries				
	1952	1953	1954	1956	1957
Catfaced	6.5	3.3	2.6	4.49	7.20
Other	4.14	2.92	1.31	1.36	6.02

DISCUSSION OF INSECTICIDES USED

Lead arsenate and cryolite: Lead arsenate was almost the only insecticide used on peaches before 1947. During these early years, tests were conducted to find any possible substitutes or softeners to alleviate the burning effect of lead arsenate on fruit and foliage. For a while it was thought that the less caustic basic lead arsenate could be used, but insect control was inferior to that of the none-too-good acid lead arsenate in use. Cryolite eliminated all foliage injury in a spectacular way (Tables 2 and 3), and it was being rapidly accepted. However, it produced a softening of the suture of the fruit and was less effective than lead arsenate in controlling bad curculio infestations. Thus, it was never used again. With the advent of DDT and other organic insecticides, the picture changed rapidly.

DDT: DDT was found to be of little or no value for the control of the plum curculio, although it reduced catface injury about 50%. It also controlled the oriental fruit moth fairly well. For this reason, one or two DDT applications in bloom or petal fall and also late in the season became standard. Records of the numbers of applications containing DDT appear in Table 2, beginning in 1947.

The other chemicals listed in Tables 2 and 3 were designed primarily for the control of the plum curculio.

TABLE 2.—Numbers and Kinds of Spray and Dust Applications Used in Southern Illinois Peach Orchards.

Year	No. orchards	DDT, cañface insects	DDT, oriental fruit moth	Lead arsenate	BHC	Chlor-dane	Cryo-lite	Para-thion	Diel-drin	Mala-thion	Total no. eureulio applications			Percent applied as dusts	Av. no. eureulio applica-tions per orchard	
											Sprays	Dusts	Totals			
1938...	30			103			9					50	62	112	55	3.7
1939...	35			141			34					78	97	175	55	5.0
1940... No crop																
1941...	27			78								39	39	78	50	2.9
1942...	26			114								26	88	114	77	4.4
1943...	14			91								21	70	91	77	6.5
1944...	27			146								33	113	146	77	5.4
1945...	36			214								42	172	214	80	5.9
1946...	36			358								40	318	358	89	9.9
1947...	30	18	8	274								50	224	274	82	9.1
1948...	27	21	34	171	70	11						46	206	252	82	9.3
1949...	38	40	56	120	209	39		2				54	316	370	85	9.7
1950...	36	53	34	64	133	47		50				114	180	294	61	8.1
1951...	15	18	14	11	17	15		52	5			40	60	100	60	6.6
1952...	30	25	30	41	16	14		220	19			159	151	310	49	10.3
1953...	32	23	24	13	6	13		218	7			150	147	297	49	9.3
1954...	32	27	12	8	6	6		214	74	2		176	134	310	43	9.7
1955... No crop																
1956...	32	31	7	7	2	7		210	64	9		187	107	294	36	9.3
1957...	32	33	5	11	1	2		234	66	9		187	134	324	42	10.7

The average number of poison applications thought necessary by representative growers to control the pest is of interest. As will be seen in the last column of Table 2, from 1938 through 1942, three to five sprays or dusts were applied, but the number of applications has since been increased to nearly 10, despite the fact that more effective insecticides are now used. The manner of application also changed (Table 2). Dusting was used primarily from 1942 to 1948, but with improvement in spray machinery and the use of one man, non-stop spray rigs, the percentage of orchards dusted is now the lowest it has been since the surveys started.

Benzene hexachloride (BHC): BHC was the major insecticide used in 1949 and 1950. It was rapidly discontinued after that time due to the off flavor it imparted to fruit and to the increase in stings on the

fruit. The large percentage of fruit stung in 1949 was probably the result of the general use of this material which killed the beetles very well but was slow-acting.

Chlordane and dieldrin: Chlordane was found to be superior to BHC in controlling the plum curculio with much less danger of imparting an off flavor to the fruit. It might have held its favored place except that dieldrin proved to have a greater residual quality and also killed the stink bugs which produce catfacing. Dieldrin is still favored (Table 3), though it is quite specific and cannot replace a more general insecticide like parathion.

Parathion and substitutes: Parathion, a general purpose insecticide, is not as efficient as dieldrin for the control of the plum curculio. Nevertheless, it has become the dominant insecticide (Table 2). The decrease in DDT used for the control of the

TABLE 3.—Percentage of Applications (Spray and Dust) in Which Each of Several Insecticides Were Used for Control of Plum Curculio, as Calculated from Table 2.

Year	Lead arsenate	Cryolite	BHC	Chlordane	Parathion	Dieldrin	Malathion	Methoxychlor
1938.....	93.4	7.6	0.0	0.0	0.0	0.0	0.0	.....
1939.....	80.6	19.4	0.0	0.0	0.0	0.0	0.0	.....
1940.....	No crop							.....
1941 through								
1947.....	100.0	0.0	0.0	0.0	0.0	0.0	0.0	.....
1948.....	67.9	0.0	27.7	4.4	0.0	0.0	0.0	.....
1949.....	32.4	0.0	56.5	10.6	0.5	0.0	0.0	.....
1950.....	21.8	0.0	45.2	16.0	17.0	0.0	0.0	.....
1951.....	11.0	0.0	17.0	15.0	52.0	5.0	0.0	.....
1952.....	13.2	0.0	5.2	4.5	71.0	6.1	0.0	.....
1953.....	4.5	0.0	2.1	4.4	73.0	16.0	0.0	.....
1954.....	2.5	0.0	1.9	1.9	69.5	23.6	0.6	.....
1955.....	No crop							.....
1956.....	2.4	0.0	0.6	3.1	71.4	19.4	3.1	0.0
1957.....	3.4	0.0	0.3	0.6	72.2	20.7	2.8	0.3

oriental fruit moth since 1954 is due to the good control of this insect by parathion.

Because of parathion's great hazards to handlers, substitutes such as malathion and other less dangerous materials are being tested by growers and experimenters.

The future of specific insecticides to be used in the peach orchards is uncertain. Despite current general acceptance, parathion is short-lived and dangerous to handle. Some insects and mites appear to be building up resistance to it. New and efficient insecticides and miticides are being developed for possible future use.

SUMMARY

Annual peach harvest surveys conducted from 1935 to 1957 gave information on the principal insect pests and insecticides used for their control. The oriental fruit moth caused serious damage in the early years, but this was reduced by intro-

ducing parasites and efficient insecticides. The injury from catfacing, caused by the tarnished plant bug and several stink bugs, is usually as great as or greater than all other types of insect injury combined. The plum curculio is potentially the worst insect pest of peach trees, and more poison applications are made to control it than all other insects combined. For years lead arsenate was almost the only insecticide used. It has been practically replaced by benzene hexachloride, chlordane, and dieldrin. Of these three, dieldrin takes first place for the control of the plum curculio and for catfacing insects. However, parathion, being a much more general insecticide, ranks first and is used in about 70% of the applications. At present, 40% of the poisons are applied in dust form as compared with more than 80% in former years. The total number of poison applications made per orchard has increased from three or four to nearly ten per season at the present time.