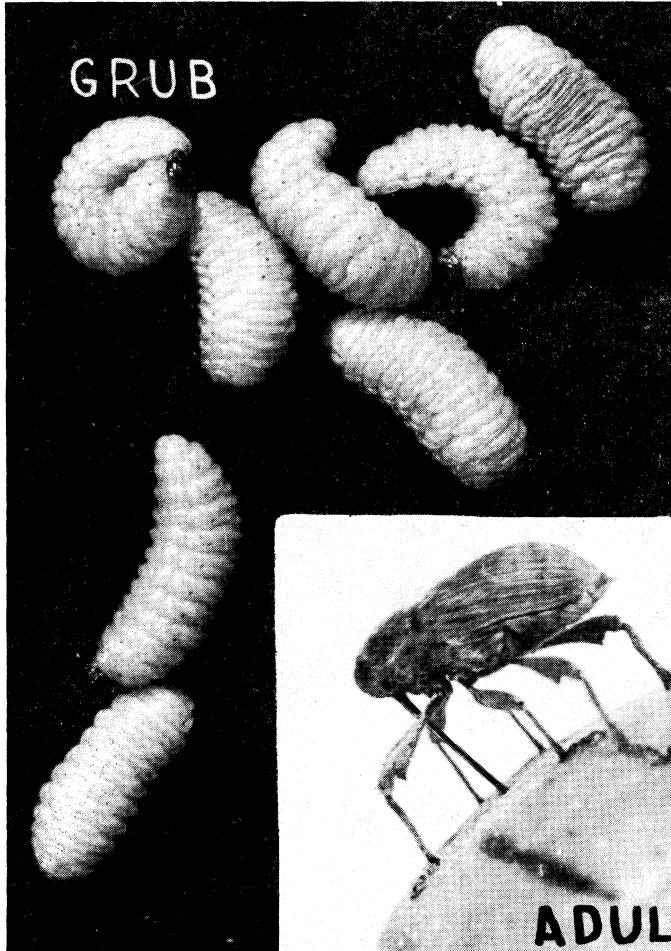


# Insecticide Tests for Pecan Weevil Control



By

Herman A. Hinrichs  
and Hugh J. Thomson

Agricultural Experiment Station  
DIVISION OF AGRICULTURE  
Oklahoma A & M College, Stillwater

## *This Bulletin in Brief . . . .*

Pecan weevils are spread across Oklahoma wherever pecan or hickory trees are growing. Losses from the insect are mounting each year.

Experimental tests aimed at finding ways to control the pecan weevil were conducted at the Oklahoma Agricultural Experiment Station. Tree spraying, soil applications and trunk treatment were investigated. This bulletin summarizes the results obtained from these tests and makes recommendations for control. Another type of treatment—soil fumigation—now under investigation will be reported later.

To plan an effective control program for the insect, we must understand the damage it causes. There are two types:

- The shedding of punctured nuts. This occurs when the adult insect attacks the pecan before the kernel has formed or developed. The loss can be extremely heavy.
- The destruction of nuts by the grubs. After the kernel has developed or hardened the adult insect lays eggs in the kernel. Such nuts are wormy and have no value for home use or sale.

Successful pecan weevil control depends upon timing the spray to prevent the adult from puncturing the pecan. Shaking the tree and collecting the adult insects on a canvas below is a good way to determine when to spray. Start the “tree-shaking” test by July 20. When five or more insects are collected per tree, it’s time to begin spraying.

The recommended spray in Oklahoma is four pounds of 50 per cent DDT wettable powder to 100 gallons of water. Usually the first spray is made about August 10 unless the “tree-shaking” tests show that it should be made sooner. Follow this with a second spray after the first heavy rain or, in case of no rain, by September 1.

The first spray stops the nuts from shedding while the second prevents wormy pecans.

# Insecticide Tests for Pecan Weevil Control

By  
Herman A. Hinrichs  
and Hugh J. Thomson

Pecan weevil (*Curculio caryae*) (Horn) is a very destructive pecan pest in Oklahoma. It is widely distributed and found wherever pecan or hickory trees are growing. Heavy losses have occurred in many localities and observations made since 1945 show damage to be mounting. The weevil appears to be somewhat slow in becoming established in an orchard. Usually a few trees in different parts of the orchard have pecans infested. As the adults emerge from the soil, they tend to stay in the same tree if there are nuts available for feeding and egg laying. After a few years, the weevils become more evenly distributed in the orchard and the difference in degree of infestation tends to disappear.

## Damage

Two distinct types of damage occur from the pecan weevil. The first injury occurs during the early part of August and results in the shedding of nuts. The adult punctures the shuck and shell to feed upon the kernel. During the period while the kernel is still in a watery condition, the injured nut will drop from the tree. Often the damaged nut will show a stained place on the shuck where the juice exudes. A dark patch usually develops on the surface of the hull. The kernel becomes discolored and disorganized. Often the entire crop may be lost during this period when shedding occurs if the weevils are abundant and the crop is light.

The second type of damage is caused by grubs in the nuts. The kernel is completely destroyed leaving only dark powered refuse. Infested pecans are usually noticeable by the fact that the shucks fail to separate from the shell during the time when normal nuts are opening. These nuts usually remain on the trees. In case the adults deposit their eggs during the latter part of September or just before the shucks begin to separate, the pecan damage will go unnoticed until the hole is found in the nut or the grubs are found crawling from sacks of the gathered pecans.

## Life History

The life cycle of the pecan weevil ranges from one to three years. The majority of the weevils, however, complete their cycle in two years.

Trees that bear annually have a tendency to build up insect population where severe infestation will occur every year.

The adult weevil is a light brown or grayish colored insect having a long beak. The body is about three-eighths of an inch long. The beak varies from one-fourth to one-half inch in length—longest for the female and the shortest for the male. There are two sharp minute mandibles at the end of the beak used to make a small hole in the nut. The adult will work its beak back and forth and rotate around the hole in the process of puncturing the nut.

In Oklahoma, the adults emerge from the soil beginning in late July and continuing until October. The time and rate of emergence during this period will vary each year due to variation in soil conditions. Loose, moist soil allows adults to work their way to the surface with greater ease. Rains on dry soil during July, August, and September will speed up emergence. The average time for adults to begin emerging in Oklahoma is August 1.

Soon after the adults enter the trees, they puncture the nuts to feed upon the kernels. These damaged nuts usually fall from the tree within two to three days.

When the kernel has formed or hardened, the female weevil will begin to lay eggs. Two to four or more eggs are laid in the nut. Each egg is placed in separate pockets within the kernel through the one puncture.

Pecans differ greatly in susceptibility to attack because there is a wide variation in development of the kernel between varieties. Early maturing or filling types are most apt to be severely damaged. They are the first pecans in which the female weevil can lay eggs. In Oklahoma on varieties such as Stuart and Western, egg laying begins about August 20. Late filling varieties normally escape damage by grubs, because the adults may not be present during the time when the eggs can be laid in the nut.

Since the shell of the pecan usually has hardened by the time eggs are laid, the adult weevils have difficulty in making the holes. A distinctly marked circle is made on the shuck around the puncture. This characteristic symbol quite often indicates the presence of eggs or grubs in the nut.

Grubs or larvae hatch from the eggs in about one week and begin feeding upon the kernel. Five to six weeks are required for the grubs

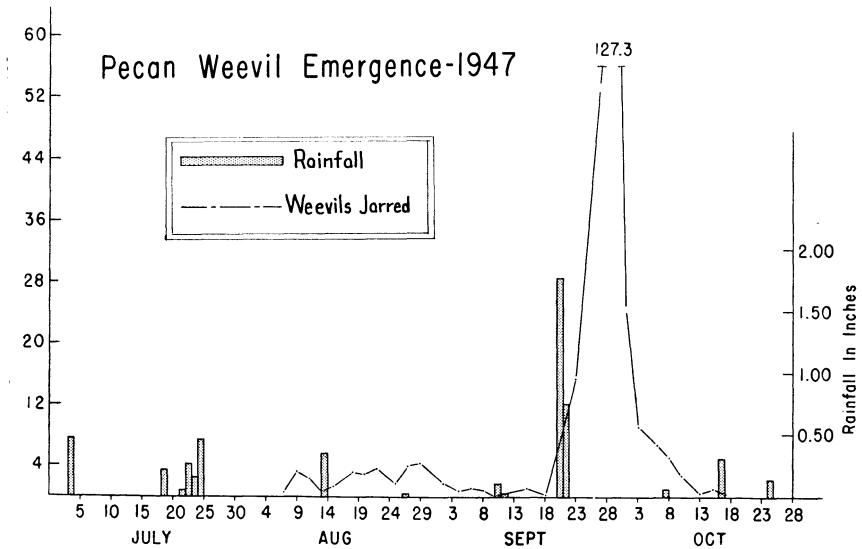
to reach maturity. Then from the inside they cut a one-eighth inch circular hole through the shell and shuck to leave the nut and enter the soil. Only one hole is made in the nut through which all grubs will emerge. Emergence usually begins during late September and continues into November. In some instances the grubs that mature late in the season may not emerge from the nut until December or later because they become inactive during low or freezing temperature.

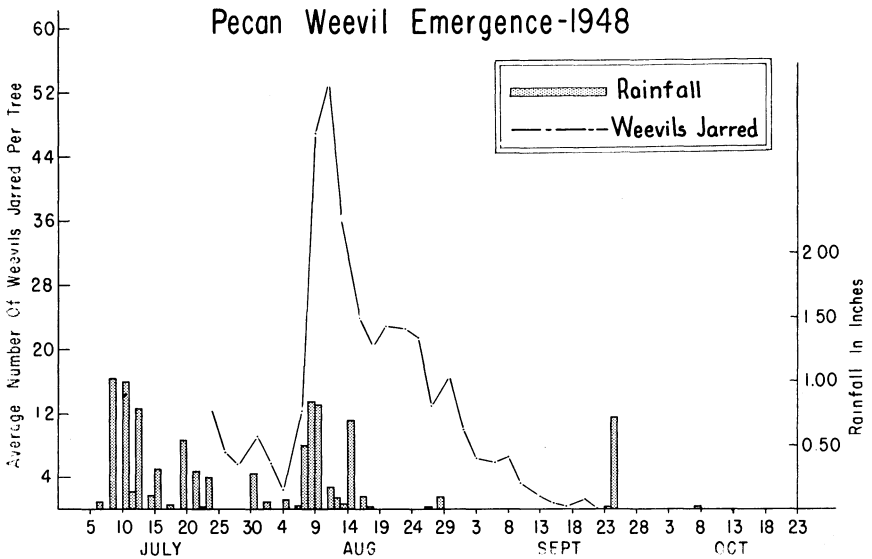
Grubs enter the soil and form cells at various depths below the surface. The depth of penetration is variable with the compactness of the soil. Sandy loose soils allow deeper penetration than heavy compact clay soil. Also, grubs go deeper in cultivated than uncultivated soils. Table 1 shows depth of penetration in tilled and undisturbed clay loam soils.

The range of penetration was from two to 15 inches. It was also observed in examining for grubs in a very loose sandy soil that they penetrated below 18 inches of the surface. Pupation takes place in the earthen cell during the second fall after leaving the nut. A few grubs, however, pupate during the first fall and some carry over to the third fall. This tends to build up broods during alternate years. The summer following pupation the adults emerge from the soil to enter the trees. They travel either by flying or crawling up the tree trunk.

### Emergence of Adults

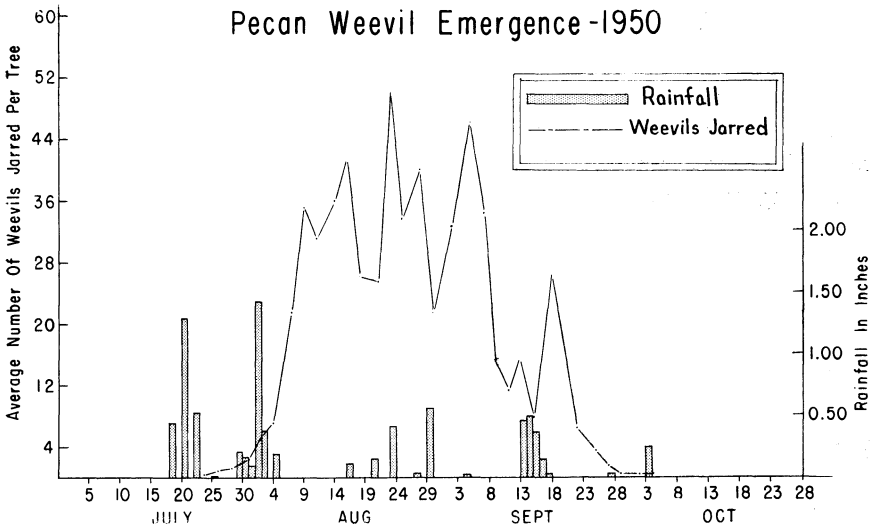
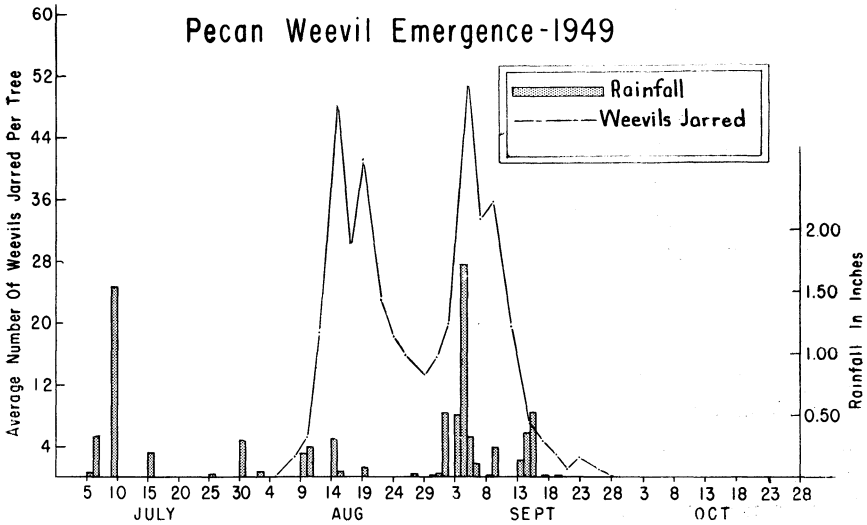
To control the pecan weevil successfully, spray applications must be properly timed according to the emergence of the adults.





During the seasons of 1947 to 1950 when spray tests were conducted, heavily infested trees were jarred three times weekly to ascertain the time and rate of emergence and to determine when to apply sprays. A canvas was placed beneath the spread of branches to collect dislodged adults. The results obtained from jarring for the years 1947, 1948, 1949, 1950 are shown in the accompanying graphs. The earliest date of emergence recorded was July 24 in 1948 and 1950; however, in 1948, 12.75 weevils were jarred and collected per tree. This was the first day of jarring and the emergence had probably begun before this date. The heavy rains in July probably caused the adults to start emerging before August. In 1947 and 1949 the weevils began to appear in the trees on August 7 and August 9, respectively. The latest date when adults were found in the trees was October 17, 1947. In 1948, 1949, and 1950 the emergence did not extend beyond October 1.

The rate of emergence varies according to the ease with which adults can work their way to the surface. Loose, moist soil allow adults to emerge with less difficulty. As the soil becomes dry and hard, emergence will decline. Then a rain will immediately result in increased emergence. In 1947 the emergence was extremely low through August and early September because the soil was dry. A heavy rain on September 20-21 caused the weevils to come out in large numbers from September 23 to October 1. In 1948, the soil was moist during July and August resulting in early emergence. During this year the majority of



the adults emerged by September 1 with the peak of emergence on August 11. In 1949, there were two peaks of emergence. The first one was on August 12 and the second on September 5. The decline in emergence between the two dates was due to soil becoming dry and hard. In 1950, the emergence of adults was high from August 4 to September 23.

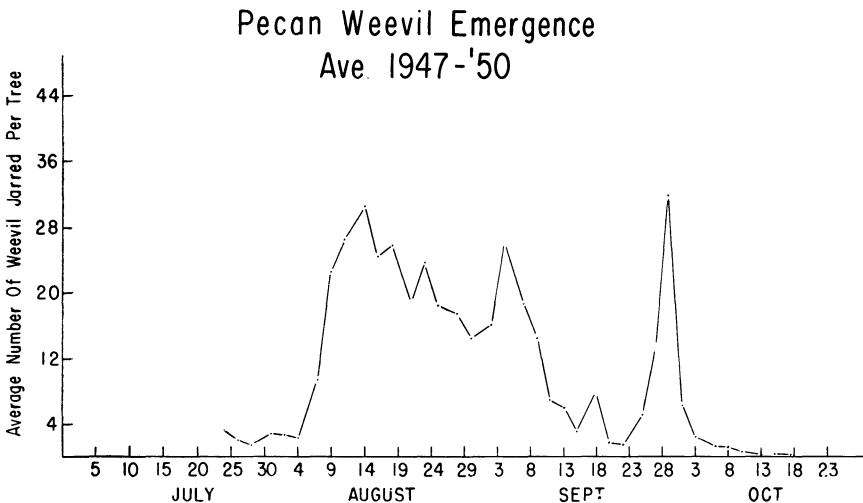
The total average numbers of weevils jarred per tree for each year were as follows: 1947—277.67; 1948—370.67; 1949—413.0; and 1950—580.5.

The average emergence calculated for 1947, 1948, 1949, 1950 shown in a graph on page 8 reveals that the emergence begins to rise on August 4 and remains high until nearly mid-September. A second sharp rise is noted on the last of September. This indicates that the weevil can be a constant threat from August 4 to October 3.

## Summary of Control Tests

Spray tests were conducted on the W. A. Adams Nut Farm, Stillwater, Oklahoma, during 1947, 1948, 1949, and 1950. Three materials, DDT, Arsenate of Lead, and Chlordane, were applied in single and multiple sprays. Applications were timed to coincide with the emergence of adults as secured from the jarring test.

A power sprayer operating at 600 pounds pressure with two spray master delux guns was used to apply the material. The spraying was accomplished by two men riding the machine, one spraying the upper half and the other the lower part of the tree as they traveled in and out around the trees in such a manner that all sides were covered. Thirty to 35 gallons of spray material were required to thoroughly cover each tree. These trees were 21 years old in 1947. Results were determined by examining nuts in each treatment for weevil puncture and grubs.





The results obtained indicate that DDT was very effective in controlling pecan weevils when applications were properly timed. Ninety percent or better control was obtained with four pounds of 50 per cent DDT wettable powder to 100 gallons of water. Six pounds of 50 per cent DDT did not improve the control over the four pounds.

One to three applications were necessary for control depending upon the time and rate of emergence. Table II compares the results obtained with various number of DDT applications, to unsprayed tree for 1947-1950. In 1947 when the emergence was late, a single application consisting of six pounds of 50 per cent DDT wettable powder applied on September 25 resulted in 9.47 per cent wormy pecans at harvest as compared to 92.89 per cent for unsprayed trees. Two extra sprays applied at earlier dates reduced the infestation to 4.83 per cent. By omitting the September 25 application and making two applications in August, 66.91 per cent of pecans were wormy.

In 1948, the infestation after one application of six pounds of 50 per cent DDT applied on August 13 was 9.54 per cent as compared to 96.65 per cent for unsprayed trees. An additional spray on either July 24 or August 4 improved the control slightly. It was not necessary to apply a spray after August 13 with the emergence coming to an end.

The spray tests conducted in 1949 were failures. Three applications were made, but the third application was eight to 10 days late. Heavy rains prevented getting into the orchard to spray when high emergence was occurring. The female weevils had laid eggs in all the nuts before application could be made.

In 1950, heavy emergence prevailed through August and most of September. A single application of four pounds of 50 per cent DDT wettable powder to 100 gallons of water applied on August 8 gave nearly perfect control, 0.27 per cent infestation as compared to 97.45 per cent for unsprayed trees. Two extra sprays were applied on August 21 and September 20 but proved to be not necessary. The cool weather prevailing through August and September probably allowed the DDT to remain effective to control adults in September. It was noted from the tests that when the maximum temperature during the week following application average above 93° F. effective control was secured only when the spray was repeated within two weeks.

Spraying the soil with six pounds of 50 per cent DDT wettable powder to 100 gallons of water on August 4 and August 18 in 1950 did not

control the adults as they emerged from the soil. A total crop loss resulted.

Lead arsenate, used at the rate of six pounds to 100 gallons of water, gave between 50 to 63 per cent control. This was not adequate for control.

Chlordane was ineffective for the control of pecan weevil.

Jarring trees three times weekly to collect and destroy adults was not an effective method of control. From 75 to 91 per cent of nuts at harvest were wormy.

**TABLE 1—Distribution of Pecan Weevil Larvae in Clay Loam Soil**

Depth (inches)	Number of Pecan Weevil Grubs		
	soil Uncultivated	Cultivated & Plowed 5 inches deep	Soil worked 15 inches deep
2.0	2		
2.5	6		
3.0	14		1
3.5	14		2
4.0	24	3	2
4.5	31	5	2
5.0	21	17	4
5.5	28	4	9
6.0	38	13	5
6.5	16	14	4
7.0	7	7	6
7.5	1	4	7
8.0		0	7
8.5		3	9
9.0			16
9.5			12
10.0			9
10.5			16
11.0			17
11.5			13
12.0			9
12.5			5
13.0			5
13.5			2
14.0			2
14.5			2
15.0			1
<b>Total</b>	<b>202</b>	<b>70</b>	<b>167</b>

Tangle Foot compound applied in a six-inch band around the tree trunk did not trap or prevent adults from getting into the trees. They would fly from the ground.

## Recommendations

The recommended control for pecan weevil in Oklahoma is to spray with four pounds of 50 per cent DDT wettable powder to 100 gallons of water. One to two applications will be necessary depending on time and rate of emergence. Two applications are necessary under severe infestation.

Thorough shaking of the trees to collect adults on a canvas is the best way to determine when to spray. Begin checking the trees which were known to be infested during previous years by July 20, and when five or more adults are found per tree, it is time to make the first appli-

**TABLE 2—Results of DDT Applications to Control Pecan Weevil  
1947 - 1950**

Number of Applications	Date of Application	Pct. Nuts Infested at Harvest
<b>1947</b>		
One application	Aug. 30	86.53
One application	Sept. 25	9.47
Two applications	Aug. 21 Aug. 30	66.91
Three applications	Aug. 21 Aug. 30 Sept. 25	4.83
Unsprayed		92.89
<b>1948</b>		
One application	July 24	91.27
One application	Aug. 4	73.46
One application	Aug. 13	9.54
Two applications	July 24 Aug. 4	55.62
Two applications	July 24 Aug. 13	5.93
Two applications	Aug. 4 Aug. 13	7.76
Three applications	July 24 Aug. 4 Aug. 13	4.85
Unsprayed		96.65
<b>1949</b>		
Three applications	Aug. 12 Aug. 25 Sept. 13	100.00
Unsprayed		100.00
<b>1950</b>		
One application	Aug. 8	0.27
Three applications	Aug. 8 Aug. 21 Sept. 20	0.14
Unsprayed		97.45

cation. Trees should be rechecked after rains or two weeks after first application to determine time for making the second application. DDT remains effective for two weeks or longer, depending on climatic conditions.

Timing spray applications is very important for control. The usual time to apply sprays in Oklahoma is: first application August 10, and second application after a heavy rain following the first application, or by September 1. Rain during August and September will regulate the rate of emergence. The first spray will prevent the shedding of nuts while the second application will prevent wormy pecans.

