

Periodical Cicadas in 1963, Brood 23¹

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In 1961, Hamilton (1) summarized investigations made on periodical cicadas (*Magicicada* spp.) and discussed the injury that they cause in apple and peach orchards. Emphasis was placed on "tree decline" of apples caused by feeding of cicada nymphs on the roots of the trees.

The purpose of this discussion is to summarize information obtained since 1961, especially in reference to the 13-year Brood 23, which emerged in southwestern Indiana in 1963. Reference will also be made to distribution of 17-year Brood 3, since adults from it also emerged in western Illinois, and to reports of the appearance of cicadas in other States in 1963. Data reported were obtained on emergence, oviposition, and hatch of eggs in or in the vicinity of orchards in Knox and Sullivan Counties, Indiana and Lawrence County, Illinois.

Adults began to emerge along the Wabash River north of Vincennes on May 19, first in areas where the sun shone directly on the soil, oftentimes along the edges of timbered areas or where the trees had been removed since 1950. By May 20 heavy emergence started in open areas, where orchards or trees had been removed. There was little or no emergence under trees or in shaded areas until May 24 when adults began coming out in large numbers. Time of day that emergence occurred was not observed, but it was estimated that to be early in the morning at predawn. Minimum daily air temperatures were 60° C. or above when mass emergence began. Lower temperatures, just prior to May 24, seemed to be holding back emergence. Peak emergence occurred between May 24 and 31. As nearly as could be determined, emergence was completed June 2. By July 2, practically all adults had died; only an occasional adult could be seen in the woodlands, and none were found in apple orchards.

The ability of cicada nymphs to develop and emerge as adults under adverse conditions was demonstrated in an area along the Illinois bank of the Wabash River, 5 miles north of Vincennes, where heavy emergence of adults occurred in 1963. This area was subjected to flood waters 34 different times between December 7, 1950 and June, 1963, as shown by the following tabulation:

Egg laying began in the Vincennes area on June 3. Movement of adults from tree to tree and from wooded areas into adjacent orchards increased at this time. Peak oviposition occurred June 6 to 10. The tempo of adult movement during this period was exceptionally high and movement into orchards near wooded areas was very high. For example, a 3-year-old peach orchard planted in an open field just west of Lawrenceville, Illinois, that was at least ½ mile away from the nearest emergence area, was severely injured. Oviposition was completed by June 20.

1. Ms. Ent. 3117.

Occurrence of floods in area along Wabash River where
cicada emerged in 1963²

Year	No. Times Under Water	Year	No. Times Under Water
1950	1	1958	4
1951	4	1959	3
1952	6	1960	3
1953	1	1961	2
1956	2	1962	2
1957	5	1963	1

Hatching of eggs started near Vincennes on July 26, reached its maximum August 1, and was last observed August 12. Apple limbs on trees in heavily infested orchards in which cicadas were active were found with six oviposition cuts per linear inch of wood, each with an average of 13 eggs, or about 76 eggs in each inch of injured wood.

At the time of hatching, the embryo within the egg begins to wiggle, or move. This causes the egg to move forward in the oviposition cut until it reaches the open air at the outside of the cut. At this point the shell breaks, the nymph wiggles out and forward, so that the egg shell remains attached to the twig on the outer portion of the oviposition scar. The nymph pauses on the twig at the mouth of the oviposition scar momentarily, then drops to the ground, and immediately disappears in the soil. Eggs within a single oviposition puncture hatch singly with the one nearest the mouth (outer opening) of the oviposition scar hatching first. They hatch at intervals of 5 seconds. A live embryo is capable of bypassing a single dead egg within the oviposition puncture, but a composite of several dead eggs blocks the passage enough to prevent further hatch from that particular puncture.

According to Alexander and Moore (2) there are six species of periodical cicadas, three of which require 13 years to complete their life cycle. These are *Magicicada tredecim* (Wabash and Riley), Riley's 13-year cicada, *Magicicada tredecassini*, Cassin's 13-year cicada, and *Magicicada tredecula*, the little 13-year cicada. They predicted that a brood emerging within a given year would be comprised of individuals from the three species. Collections of recently emerged cicadas, taken at random, contained all three species as shown in the following tabulation: *M. tredecassini* and *M. tredecim* were far more prevalent than *M. tredecula*. Identification of 701 specimens, collected on several occasions during the adult flight period, showed 70 percent *M. tredecassini*, 29 percent *M. tredecim*, and 1 percent *M. tredecula*. These collections also indicated that males emerged earlier in the season than females.

2. Data from Wm. Frisz, U. S. Weather Bureau, Vincennes, Ind. This area was under water a total of 454 days during this period, and at one time was covered with water for 34 days. During the highest flood period more than 12 feet of water covered the area.

Collections of periodical cicadas by dates, 1963

Date Collected	No. Specimens Collected	Percent of Collections That Were					
		<i>M. tredecassini</i>		<i>M. tredecim</i>		<i>M. tredecula</i>	
		Total	Males	Total	Males	Total	Males
May 23	32	34	91	56	89	9	100
May 28	34	15	80	70	33	15	80
June 7	34	44	0	56	11	0	—
At random thru season	701	70	29	29	53	1	57

Records obtained on the appearance of Brood 23 involved 14 orchards in Sullivan, Knox, Gibson, and Vanderburg Counties, Indiana, and 30 orchards in Crawford, Lawrence, Randolph, Jackson, Union, and Calhoun Counties, Illinois. Cicadas reported in 3 orchards in Pulaski, McDonough, and Fulton Counties, Illinois, are believed to represent 13-year Brood 3. Brood 23 was also reported from Kentucky, Tennessee, and Missouri and Brood 3 from Lee County, Iowa.

In Indiana emergence of Brood 23 in 1963 involved 400 acres of apples and 225 acres of peaches. In the tri-state area of Indiana, Illinois, and Kentucky, it involved approximately 1,652 acres of apples and 900 acres of peaches.

Control Investigations

Most of the growers timed applications of carbaryl sprays to reduce populations of cicada adults within their orchards during the preoviposition period. Such sprays generally killed most of the adults they came in contact with. However, because of the extended emergence period, at least four applications were necessary at about 5- to 7-day intervals to assure reductions in oviposition. At the peak of egg-laying (June 7-10) adults moved from tree to tree throughout the day in dense droves. Many orchards within the infested area, adjacent to untreated woodland, were quickly reinfested with females that laid eggs rapidly; control measures failed in many places during this attack. It was evident that future recommendations for control of cicada outbreaks in orchards should include aerial sprays of surrounding woodlands.

Tests in which corrugated paper bands were dipped in spray solutions of carbaryl, Bayer 37344 (4-(methylthio)-3,5-xylyl methylcarbamate), an experimental carbamate from Union Carbide, Zectran® (4-dimethylamino-3,5-xylyl methylcarbamate), and an experimental carbamate from the Mobil Corporation at 8 ounces and 1 pound for 100 gallons, allowed to dry 24 hours, and then exposed to 30 adult cicadas, showed that the experimental carbamate from Union Carbide effectively knocked down all adults rapidly (within 3 hours) at both dosage levels. At the 1-pound dosage level, following 24- and 48-hour exposures, Zectran was significantly more effective than carbaryl and carbaryl was a little more so than Bayer 37344. The experimental carbamate from

the Mobil Corporation was also effective. These conclusions were confirmed by field-laboratory studies in which adult cicadas were caged with sprayed leaves from field plots and by observations made in orchard plots at two separate locations. In the field tests the materials included in the laboratory dipping experiments were applied at 1 pound per 100 gallons of water four times at 7-day intervals during the period of adult activity.

Field plots were also treated for cicada control July 30, or about the time eggs began to hatch, with sprays containing 1 pound carbaryl, an experimental carbamate from Union Carbide, or Zectran per 100 gallons or 6 ounces demeton, phorate, or dimethoate applied to the trees or to the ground under the trees (set up as two separate experiments). The ground treatments were also repeated in the greenhouse, where apple seedlings with newly hatched nymphs placed in each pot were used. Results have not yet been determined.

Hamilton (1) reported the application of a series of soil treatments to individual trees in the Bessire Orchards, Nashville, Indiana, where nymphs from the 1953 emergence of the 17-year Brood 10 were causing severe tree decline. At the time of the report in 1961, available evidence did not indicate that these treatments, applied in the fall of 1960 and spring of 1961, had been effective.

However, examinations of these plots during the growing seasons of 1962 and 1963 very definitely showed that tree decline was corrected where wettable powder formulations of carbaryl or phorate were injected into the soil beneath the trees. In 1963, vigor of fruit set on treated trees appeared to be normal. The improvement in vigor was first noticeable in 1962, 1 year after treatment had been made. However, when carbaryl was applied to the soil surface and worked into the soil with a tree hoe, it did not correct tree decline. The following data show the effect of these treatments on the yield of apples in 1963:

Soil Injection Treatments	Number Apples Per Tree
May 18, 1961—Variety Grimes	
Phorate 10 oz./tree	1651
Carbaryl 10 lb./tree	1096
Untreated	2
October 4, 1960	
Carbaryl 2½ lb./tree	
Grimes	587
Red Delicious	601
Untreated	
Grimes	2
Red Delicious (2 trees)	100; 234

Literature Cited

- HAMILTON, D. W. 1962. Periodical Cicadas, *Magicalada* spp., as Pests in Apple Orchards. Proc. Ind. Acad. Sci. 1961. 71:116-121.
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