

# LIFE HISTORY, HABITS, AND CONTROL OF THE CICADA KILLER WASP IN WEST VIRGINIA



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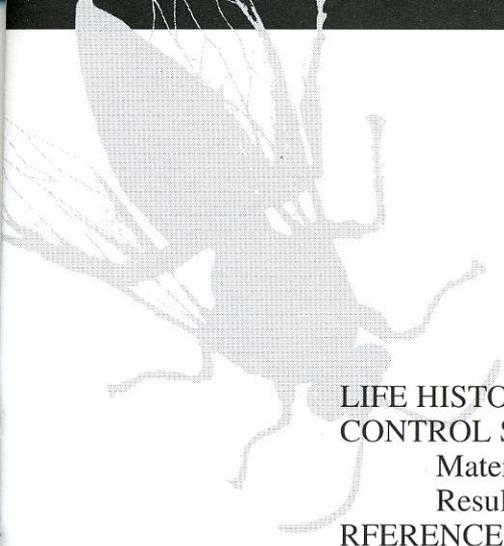


***Sphecus speciosus* Female**



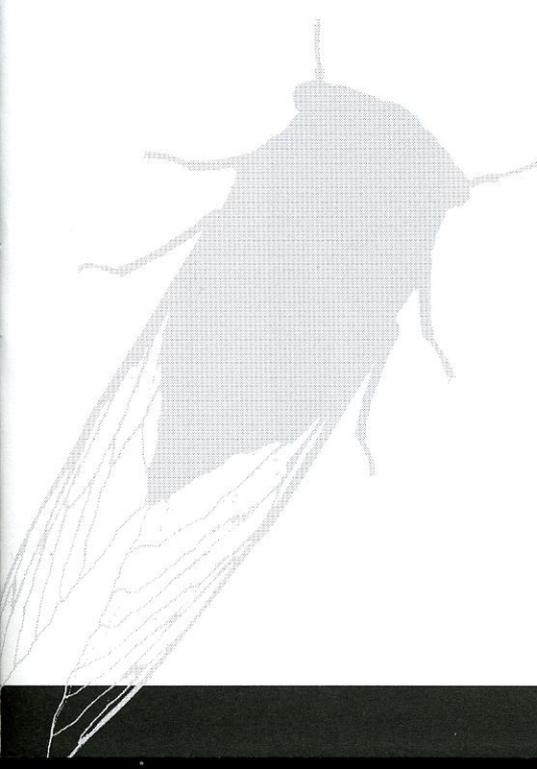
***Tibicen chloromerus* Female**

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# LIFE HISTORY, HABITS, AND CONTROL OF THE CICADA KILLER WASP IN WEST VIRGINIA

Joseph E. Weaver

The cicada killer wasp<sup>1</sup>, also called the sand hornet or golden digger wasp, occurs in all states east of the Rocky Mountains. In size and forbidding appearance the cicada killer appears to be the most formidable of the North American wasps. It is, however, unexpectedly docile. Females can sting but are not aggressive; they have no nest-guarding instinct and sting only when provoked. The prey of the wasp are species of annual cicadas (*Tibicen* spp.) which it captures and carries to the underground burrow as food for the developing brood (Fig. 1).

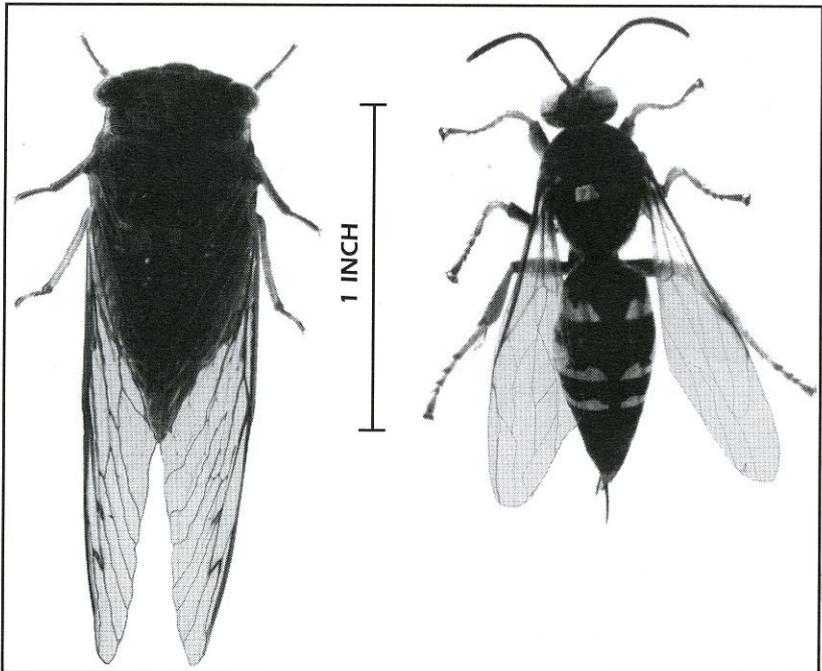


Figure 1. Adult female cicada Killer (right) and its prey, a dog-day cicada.

<sup>1</sup>*Sphecius speciosus* (Drury) (Hymenoptera: Sphecidae)

This insect has a slight economic importance as a pest of turfgrass because it makes unsightly mounds of earth as it digs its burrows (2). As much as five pounds of soil may be excavated during burrow construction by the female wasp. When the soil from the burrow is flattened during mowing, grass in that area may be killed. Large areas of turfgrass may be affected when populations are high. In addition, the wasp can be a nuisance pest on home lawns, golf courses, playgrounds and other recreational areas. Generally, cicada killers are considered to be solitary wasps but they have certain traits of social insects because of their habit of living in colonies consisting of individual burrows. Almost every golf course has an annual infestation of cicada killer wasps. Usually only a small number of wasps are found on a course and their nests occur in isolated colonies. However, populations of hundreds of adult wasps were observed on a golf course in West Virginia and such an occurrence prompted an investigation on how best to control this insect.

The study was conducted at the Preston Country Club near Kingwood, WV (Preston County). Part of this golf course was inundated by flood waters in 1985 and considerable amounts of sand and silt were deposited over a large area near the Cheat River. When the course was rebuilt, the soil composition (90.0% sand, 6.4% silt, 3.6% clay) over large areas was ideal for cicada killer wasps to establish nests. Over a period of time (1986 to about 1989), the wasp became well established on one large fairway and eventually spread to other areas of the course. In 1990, nearly 1,000 burrows were identified and treated; although the population was greatly reduced, 100 or more burrows were treated in 1991 and 1992. Because of the ideal nesting conditions on certain areas of the course, yearly treatment of new burrows is necessary to prevent the wasp from returning to the high levels of 1989-90.

The objective of this study was to evaluate various insecticides for control and to define a management strategy to effectively control the cicada killer wasp. Results of the study along with information on the life history and habits of the wasp are given herein.

## LIFE HISTORY AND HABITS

The most detailed and accurate account of the life history and habits of the cicada killer wasp, *Sphecius speciosus*, is given by Dambach and Good (1). Their observations, along with those made in this study, constitute the bulk of information presented here about this most interesting insect.

At Preston Country Club, the cicada killer is active from early July through most of September. Soil conditions on part of one fairway were especially suitable for colonies of the wasp to become established. On about half of this fairway, 22 large mounds 30 feet or more in diameter, and containing a high percentage of sand, were built on either side of the fairway during reconstruction. It was at this site that the activities of the wasp were observed.

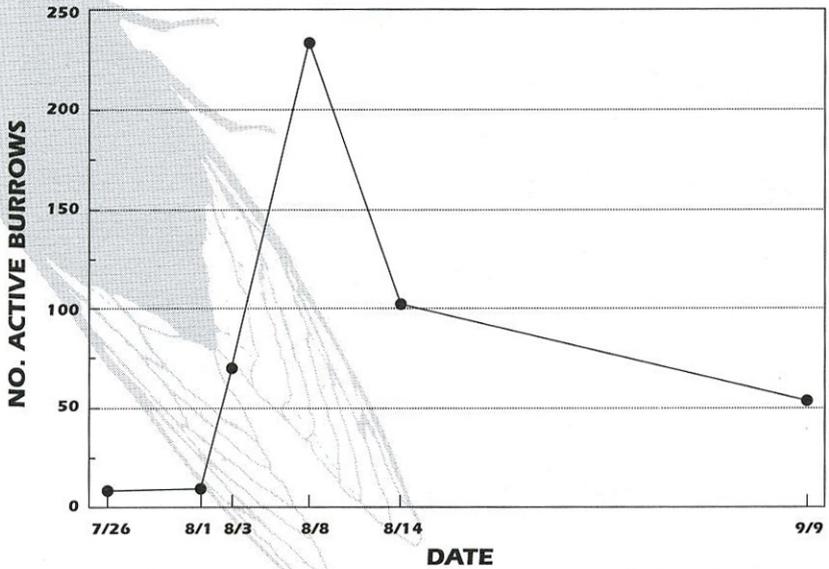
Adult emergence from old nests began in early July, closely approximating the emergence of its prey, the annual cicada. By mid- to late-July, hundreds of male wasps were actively flying over and around the mounds; they were still plentiful through about mid-August. Sweep net captures (20-30 sweeps) of adults at about weekly intervals from July 26 to August 15 (4 weeks) contained 50, 56, 30, and 22 male wasps, respectively; only 2 females were captured in the samples and those were caught on the first sample date. There is a distinct size difference between the adult male and female; average length of males and females, respectively, were 29 and 39 mm (1.14 - 1.54 inches) (Fig. 2). Males are territorial in habit and were aggressively protecting areas around the mounds. When a female wasp entered the area of the mound where numerous males were active, she was captured by one and carried to the ground. Immediately, several other males were attracted to the pair and formed a circular group nearly the size of a tennis ball; the entire mass of wasps wriggled and moved around over the ground surface. Three mating groups were captured with one group comprising 13 males and 1 female.



**Figure 2. Adult cicada killers. Female on left, male on right.**

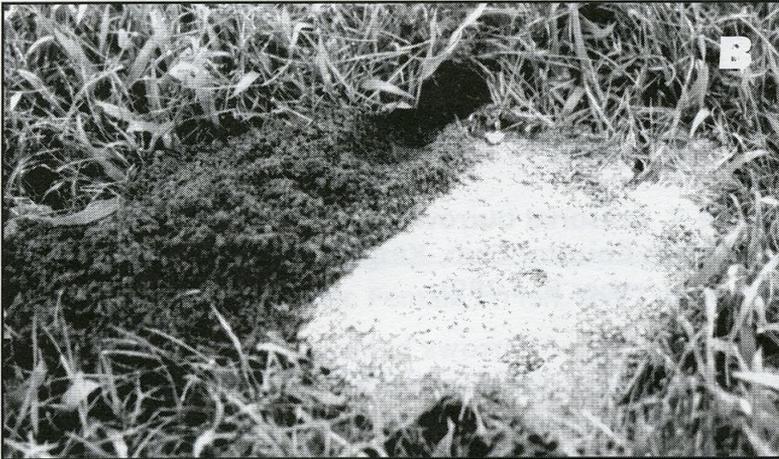
This activity was most noticeable in early August. Flight activity around the mounds, primarily by the males, began about 7:30 a.m. and increased in numbers with hundreds swarming about during late morning and early afternoon; thereafter flight activity greatly decreased. A few male wasps were present in the area until late August but their numbers declined sharply after mid-August and only four were captured by sweep net on August 22.

Very little burrowing activity was noticed before July 26. At that time, counts of active burrows on 22 large sandy mounds along the fairway were begun and numbers recorded periodically during a period of 45 days until September 9 (the last observation date). The number of active burrows increased steadily from late July and peaked at 234 on August 8 (Fig. 3). During this period, soil excavation ceased at many burrows presumably because the nests were fully provisioned with cicada prey; several nests were dug into and disturbed near the surface, probably by skunks.

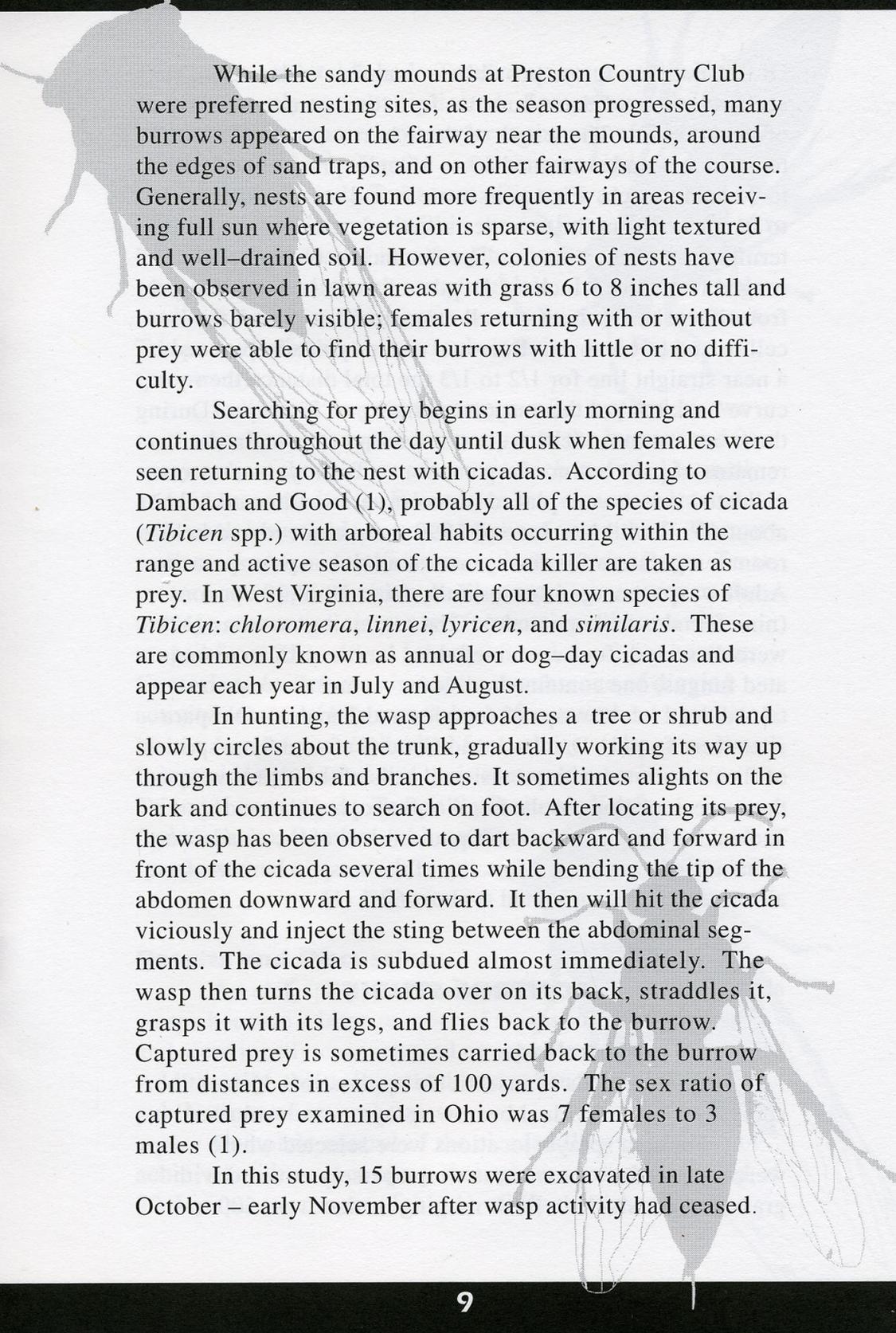


**Figure 3. Seasonal burrowing activity of the cicada killer at Preston Country Club, Kingwood, West Virginia (July 26 - September 9, 1989).**

Digging of burrows begins before mating activity ceases and continues throughout the summer until late August/early September. Excavation is accomplished by using the mouthparts to dislodge soil which is then kicked out of the burrow in much the same manner as a dog digging a hole; as digging progresses, the soil is often moved up near the burrow entrance and pushed out by the head. Apparently some digging occurs at night since some wasps were observed moving soil out of burrows before daylight. The accumulated soil outside the burrow is kept away from the opening and a neat, slightly depressed (U-shaped) pathway, often several inches long, is maintained to the burrow entrance (Figs. 4A, 4B). A considerable amount of soil may be excavated in digging the burrow; the volume of loosely packed soil collected around 10 active burrows in late August averaged about 100 cubic inches per burrow. When a large amount of soil accumulates, it can be flattened by mowing and not only become unsightly on a fairway but may cause some dieback of grass (Fig. 4C).



**Figure 4. Cicada Killer burrows: (A and B) Typical undisturbed burrows. (C) Soil from burrow flattened by mower on fairway.**



While the sandy mounds at Preston Country Club were preferred nesting sites, as the season progressed, many burrows appeared on the fairway near the mounds, around the edges of sand traps, and on other fairways of the course. Generally, nests are found more frequently in areas receiving full sun where vegetation is sparse, with light textured and well-drained soil. However, colonies of nests have been observed in lawn areas with grass 6 to 8 inches tall and burrows barely visible; females returning with or without prey were able to find their burrows with little or no difficulty.

Searching for prey begins in early morning and continues throughout the day until dusk when females were seen returning to the nest with cicadas. According to Dambach and Good (1), probably all of the species of cicada (*Tibicen* spp.) with arboreal habits occurring within the range and active season of the cicada killer are taken as prey. In West Virginia, there are four known species of *Tibicen*: *chloromera*, *linnei*, *lyricen*, and *similaris*. These are commonly known as annual or dog-day cicadas and appear each year in July and August.

In hunting, the wasp approaches a tree or shrub and slowly circles about the trunk, gradually working its way up through the limbs and branches. It sometimes alights on the bark and continues to search on foot. After locating its prey, the wasp has been observed to dart backward and forward in front of the cicada several times while bending the tip of the abdomen downward and forward. It then will hit the cicada viciously and inject the sting between the abdominal segments. The cicada is subdued almost immediately. The wasp then turns the cicada over on its back, straddles it, grasps it with its legs, and flies back to the burrow. Captured prey is sometimes carried back to the burrow from distances in excess of 100 yards. The sex ratio of captured prey examined in Ohio was 7 females to 3 males (1).

In this study, 15 burrows were excavated in late October – early November after wasp activity had ceased.

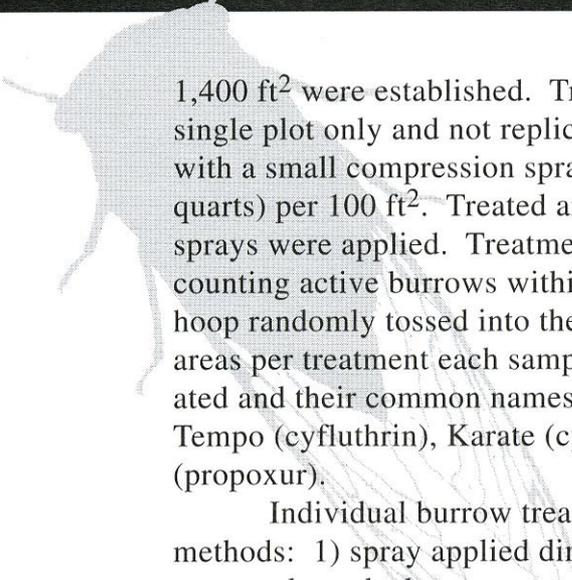
Of this number, it was possible to examine with reasonable accuracy three of these burrows from the entrance to the end of the burrows. The length of these burrows ranged from 31 to 74 inches and contained 13 to 15 cells provisioned with 1 to 3 cicadas each. First cells were found at a distance of 14 to 21 inches from the entrance and the last cell at or near the termination of the burrow. The distance between cells ranged from 2 to 6 inches. Depths of these burrows ranged from 12 inches at the first cell down to 15 inches at the last cell or end of burrows. Burrows would typically proceed in a near straight line for 1/2 to 1/3 the total distance then curve back toward the entrance forming a "J" shape. During these excavations, cells were often found to contain the remains of prey but no wasp cocoons. Twenty-two cocoons collected intact were placed in moist vermiculite and held at about 40° F until late June of 1990 then removed and held at room temperature for emergence of adult wasps or parasites. Adult wasps emerged successfully from 10 of 20 cocoons (nine females and one male). The remaining cocoons (12) were dissected; four contained dead larvae with an associated fungus, one contained a live larva, and the rest contained dead adult wasps (5 females and 2 males). No parasites were found. Dambach and Good (1) found three species of flies associated with provisioned cells of the cicada wasps; these species belong to the families Sarcophagidae and Tachinidae but their relationship to survival of the cicada wasp remains undetermined. Mortality of the wasp in burrows from all causes has been reported at about 62% (1).

## **CONTROL STUDIES**

### **Materials and Methods**

Two methods of insecticide application, 1) area sprays, and 2) individual burrow sprays, were evaluated.

For area sprays, locations were selected where wasps were most active; these areas were sparsely covered with grass and not shaded. Plots ranging in size from 500 to



1,400 ft<sup>2</sup> were established. Treatments were applied to a single plot only and not replicated. Sprays were applied with a small compression sprayer at the rate of 2 liters (1.9 quarts) per 100 ft<sup>2</sup>. Treated areas were not irrigated after sprays were applied. Treatment efficacy was evaluated by counting active burrows within the confines of a 3.6 ft<sup>2</sup> wire hoop randomly tossed into the plot; counts were made in 3 areas per treatment each sampling date. Insecticides evaluated and their common names were: Triumph (isazophos), Tempo (cyfluthrin), Karate (cyhalothrin), and Baygon (propoxur).

Individual burrow treatments were applied by two methods: 1) spray applied directly into the burrow and 2) spray only at the burrow entrance which included a small area of excavated soil. Five active burrows were treated with each insecticide for each application method. Burrows were marked for identification with stake wire flags. Treatments were applied with a small compression sprayer; the average amount of spray used for treating all burrows ranged from 25 to 48 ml (about 0.8 to 1.6 oz) per burrow. Control evaluation was based on the absence of digging activity at treated burrows 3 days after treatment; untreated, nearby burrows were checked for activity at the same time. Insecticides evaluated and their common names were: Triumph (isazophos), Tempo (cyfluthrin), Karate (cyhalothrin), Dursban (chlorpyrifos), and Baygon (propoxur).

## **Results and Discussion**

An area spray was evaluated for control of the cicada wasps because a large number of wasps infested the course and were mostly concentrated on a portion of one fairway. Additionally, this is a method recommended in extension publications of several states.

Complete control of the cicada killer wasp was not achieved with an area spray through an evaluation period of 20 days posttreatment (Table 1). Only two insecticides

**Table 1. Cicada Killer wasp control with area sprays.**

Treatment	Rate lb (AI)/acre	Area treated (ft <sup>2</sup> )	No. active burrows/100 ft <sup>2</sup> at days posttreatment				
			0	6	8	13	20
Triumph 4E	1.0	1000	0.1	0.1	0.9	2.4	2.1
Triumph 4E	2.0	1400	<0.1	0	0.2	1.5	1.2
Tempo 2E	0.2	500	0	0	0.2	0.8	0.2
Karate 1E	0.2	500	0.2	0.4	0.6	1.6	0.2
Baygon 1.5E	5.6	500	0.4	0.4	1.2	3.8	1.2
Untreated	—	—	0	0	0.5	1.8	1.4

(Tempo and Karate), which are pyrethroids, held cicada populations substantially below untreated levels (0.2 vs. 1.4 burrows/100 ft.<sup>2</sup>). Complete elimination of the cicada killer wasp is highly desirable from areas of play on golf courses and recreational areas because of the distraction and annoyance caused to people by wasp activity. None of the area spray treatments were successful in this respect.

Treatment of individual burrows provided 100% control of the cicada wasps whether applied directly into the burrow or at the burrow entrance only (Table 2).

**Table 2. Cicada Killer wasp control with Burrow sprays.**

Treatment	Rate (% AI)	Mean amount (ml) of spray per burrow <sup>1</sup>	% Control when spray applied	
			Directly into burrow	At burrow entrance only
Triumph 4E	0.10	35	100	100
Tempo 2E	0.03	31	100	100
Tempo 20W	0.03	30	100	100
Karate 1E	0.03	35	100	100
Dursban 50 W	0.10	30	100	100
Dursban ME	0.10	25	100	100
Baygon 1.5 E	0.50	48	100	100

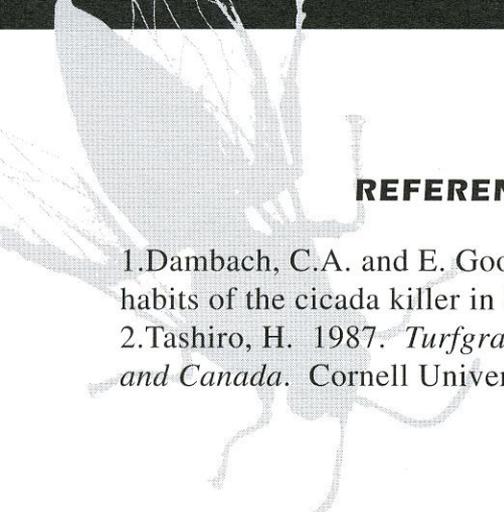
<sup>1</sup>To convert to fluid ounces, divide by 29.6.

Although complete control was achieved by both methods when applied by the author, less than 100% control was achieved by maintenance personnel when spray was applied only to the soil near the burrow entrance. Nearly half of the 804 burrows treated with the insecticides listed in Table 3 were split applications of the two treatment methods. Apparently the spray in some cases was not placed near enough to the burrow entrance to be effective in contacting the adult wasp as it enters the burrow. Therefore, applying the insecticide directly into the burrow entrance is the method of choice to achieve 100% control. In addition, maintenance personnel tended to use more spray per burrow than is necessary for control using an average of 45 ml vs 33 ml/burrow by the author (compare Table 3 vs Table 2).

**Table 3. Number of cicada killer burrows treated by maintenance personnel at Preston C. C. during August 1989.**

Treatment	No. burrows treated	Mean amount (ml) of spray per burrow <sup>1</sup>
Triumph 4E	357	45
Tempo 2E	258	47
Karate 1E	107	38
Baygon 1.5 E	82	49
	(TOTAL 804)	(MEAN 45)

<sup>1</sup>To convert to fluid ounces, divide by 29.6.



## REFERENCES CITED

1. Dambach, C.A. and E. Good. 1943. "Life history and habits of the cicada killer in Ohio." *Ohio J. Sci.* 43:32-41.
2. Tashiro, H. 1987. *Turfgrass Insects of the United States and Canada*. Cornell University Press, Ithaca, NY, 391 pp.

## ACKNOWLEDGMENTS

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Color Photographs of specimens collected by Vicki Kondo were taken with a Fuji Finepix S7000, Jul. 2006.



***The author, Joe Weaver, passed away in May, 1996. He is sorely missed by his many colleagues and associates. This is one of his more popular publications, and is posted on this web site in memory of his service to West Virginia University and the State of West Virginia.***

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