Emergence of the Nut Curculio, *Conotrachelus hicoriae* (Schoof), at Two Pecan Orchards in Louisiana[1]

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Abstract A study was initiated in commercial pecan orchards located near Monroe and Natchitoches, LA, to determine the emergence pattern of the adult nut curculio, *Conotrachelus hicoriae* Schoof, from hibernation. The duration of emergence was found to be approximately 75 d, with initial emergence beginning as early as 18 May. No statistically significant differences were observed in the number of adults trapped between trees and sites; however, statistically significant differences in the number of adults trapped from year-to-year were observed. The wire cone traps proved to be effective in capturing the adults emerging from the soil.

Key Words Nut curculio, *Conotrachelus hicoriae,* pecan, emergence

The nut curculio, *Conotrachelus hicoriae* (Schoof), can be a major pest of pecans in Louisiana. In 1934, C. E. Smith of Baton Rouge, LA, reported that this insect was destructive to cultivated pecans (Schoof 1942). Smith observed that this nut curculio destroyed half of the pecans on 11-yr-old trees, and that the larvae fed on both the hull and the kernel. Osburn et al. (1963) also noted the destructiveness of this insect on pecan. Calcote (1970) reported that *C. hicoriae* attacks several cultivars of pecan but seems to prefer the 'Stuart' cultivar.

To date, little information has been published on the life cycle of *C. hicoriae.* Schoof's (1942) monograph was primarily a taxonomic description of curculios in the genus *Conotrachelus,* with some commentary on life cycles. In regard to *C. hicoriae,* information provided on the life cycle was based on the observations made by C. E. Smith of Baton Rouge, LA and J. D. Mitchell of Victoria, TX.

Calcote (1970) observed that *C. hicoriae* emerged from hibernation during the latter part of June and laid a single egg in the shuck of each nut during the latter part of June and early July. This seems to conflict with observations made at several orchards in north and central Louisiana (Hall, unpubl. data) where nut drop, due to feeding and oviposition by *C. hicoriae,* was observed to occur as early as mid-June. This would indicate that the emergence of hibernating adults may begin at a date earlier than what was reported by Calcote (1970). Although he discusses in general terms when *C. hicoriae* emerge from hibernation, and briefly discusses the duration of the developmental stages of this insect, he does not discuss the duration of emergence, or when peak emergence activity occurs.

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Control measures are directed at the adult stage of *C. hicoriae* to prevent nut loss from feeding and oviposition. Because insecticides targeted at the adults are the means used for control, it is important that growers understand the emergence pattern of *C. hicoriae.* To date, no detailed emergence pattern of *C. hicoriae* has been reported. The intent of this study was to carefully monitor the emergence of hibernating adult *C. hicoriae* in order to determine the onset of emergence, occurrence of periods of peak emergence activity, and the duration of emergence.

Materials and Methods

The study began in 1985 and continued through 1989, with the exception of 1987 during which no data were collected. Data were initially collected from a commercial pecan orchard located 5 km north of Monroe, LA, on LA Highway 165 in Ouachita Parish. A second orchard, located 0.8 km north of the intersection of LA Highways 1 and 6 in Natchitoches Parish, was added in 1988. Both orchards were selected because of their history of *C. hicoriae* activity.

Before data could be collected, a trap was needed that would capture the adults as they emerged from hibernation in the soil. The trap used for this study was derived from a wire cone trap design by West and Shepard (1974) for use in capturing adult pecan weevils, *Curulio caryae* (Horn), as they emerged from the soil. The design of that trap allowed for *C. caryae* to be captured as they emerged from under the trap and from the area around the trap.

The trap for capturing *C. hicoriae* consisted of a base or bottom cone and a top cone (Fig. 1a-b). Both base and top cones were constructed of 0.159-cm mesh window screen wire. A 5 cm^3, hinged, clear plastic box was attached to the top cone and served as the collection container. Spacers made of wooden dowels 0.63 cm in diam were attached to the inside of each top cone to allow *C. hicoriae* moving up the outside of the trap passage into the top cone and into the collecting container.

At both sites, 12 traps were placed under each of five trees of the 'Stuart' cultivar. These same trees were used throughout the course of the study. The traps were placed in three rings (2.1, 4.2, and 6.4 m from the trunk) of four traps each (Fig. 1c-d). At the Monroe site the traps were placed in the field on 15 May 1985, 13 May 1986, 16 May 1988, and 15 May 1989. At the Natchitoches site the traps were placed in the field on 18 May 1988 and 10 May 1989. The traps were checked three times a week (Monday, Wednesday, and Friday).

Results and Discussion

Emergence curves for *C. hicoriae* from both orchards are presented in Fig. 2. The duration of emergence was approximately 75 d. Initial emergence of the hibernating adults occurred between 19 May and 29 May. Fifty percent of the total number of adult *C. hicoriae* trapped at both locations were captured between 20 June and 28 June, with the exception of 1985 at the Monroe orchard, where it was not until 3 July that 50% of the total number of adult *C. hicoriae* trapped were captured. The dates at which *C. hicoriae* were initially trapped and the dates when 50% of the total number of *C. hicoriae* trapped had occurred indicate that *C. hicoriae* is active much earlier than was initially reported by Calcote (1970).

Surprisingly, no statistically significant differences were observed in the number of adults trapped between trees and between sites (Tables 1-3). It is possible that the

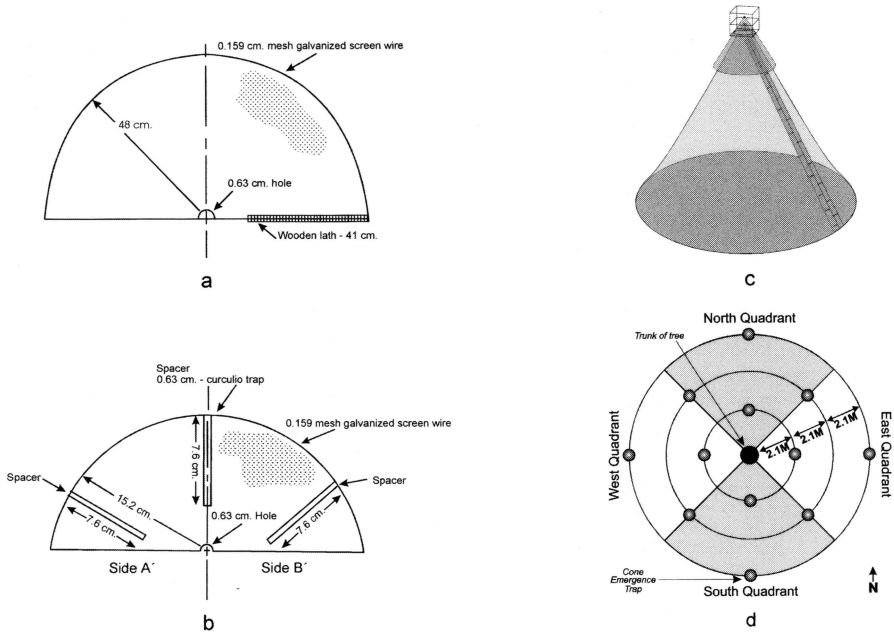

Fig. 1. Schematic diagrams of the bottom cone (a), top cone (b), completed trap assembly (c), and placement of the traps under the tree (d).

process used to select the orchards and the trees in each orchard may have biased the outcome of these results. High levels of *C. hicoriae* damage, based on the growers observations, were the reason that these two orchards and the trees in each orchard were selected. The selected trees were of the same cultivar, were adjacent to each other, and were located in an area of each orchard where damage levels were the highest. It may be necessary to place traps at additional orchards to monitor emergence of hibernating *C. hicoriae* to determine whether these results hold true at other orchards or are just an anomaly based on the experimental design used in this study. Additional monitoring will also be necessary to determine if the emergence pattern observed remains consistent across cultivars with respect to time.

Statistically significant differences were observed in the total number of *C. hicoriae* trapped from year-to-year (Tables 1, 2). The number of *C. hicoriae* trapped, both recorded at the Monroe orchard, ranged from a low of 113 in 1988 to a high of 764 in 1986. These differences appear to be correlated with the crop yield from the previous year. When crop yields were high, the number of adults trapped the following year were high and when crop yields were low, the number of adults trapped the following year were low. The female lays a single egg in each nut (Calcote 1970); however, it is not known how many eggs an adult female is capable of laying. During years when the crop yield is low, fewer nuts are available for oviposition; therefore, one would assume that fewer adult *C. hicoriae* would enter into hibernation. Higher crop yields mean more nuts would be available for oviposition, hence more adult *C. hicoriae* would enter into hibernation and emerge the following year.

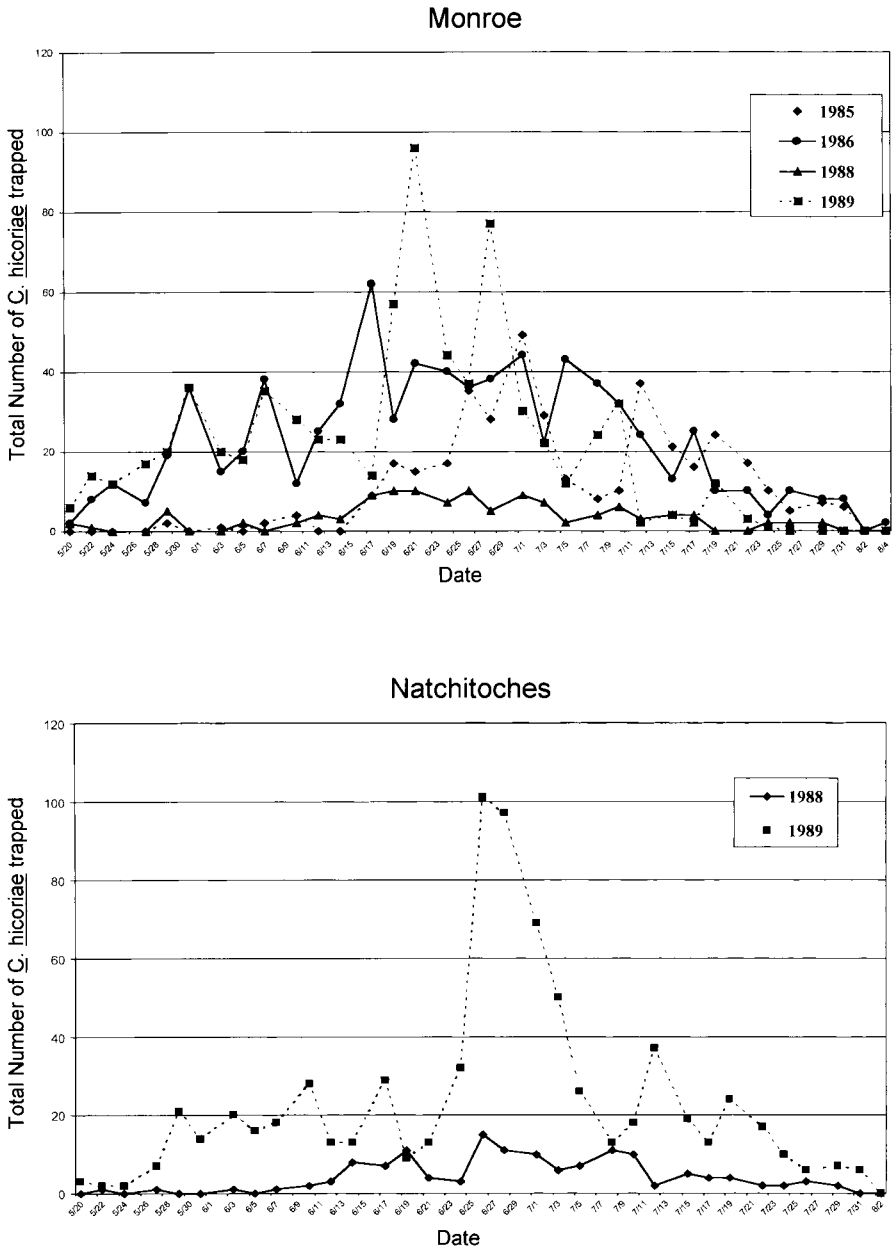

Fig. 2. Emergence pattern of *C. hicoriae* at the Crescent Pecan Orchard, Monroe, LA and the Hillin Pecan Orchard, Natchitoches, LA. Data points represent the total number (5 trees, 12 traps/tree) of *C. hicoriae* captured.

Table 1. Analysis of variance for comparison of the number of *C. hicoriae* captured between trees and between years. Crescent Pecan Orchard, Monroe, LA

Source	df	ss	ms	F-statistic	*P*-value
Between trees	4	37.25	9.31	0.76	0.551
Between years	3	1736.45	578.82	47.29	<0.00001
Error	654	8004.96	12.24		
Total	661	9778.66			

Table 2. Analysis of variance for comparison of the number of *C. hicoriae* captured between trees and between years. Hillin Pecan Orchard, Natchitoches, LA

Source	df	ss	ms	F-statistic	*P*-value
Between trees	4	10.86	2.71	0.19	0.54
Between years	1	1153.60	1153.6	79.67	<0.00001
Error	324	4691.30	14.48		
Total	661	9778.66			

Table 3. Analysis of variance for comparison of the number of *C. hicoriae* captured between the Crescent Pecan Orchard and the Hillin Pecan Orchard

Source	df	ss	ms	F-statistic	*P*-value
Between sites	1	17.73	17.73	1.13	0.29
Error	993	15634.75	15.74		
Total	994	15652.48			

At the Monroe site, the mean number of *C. hicoriae* captured per tree was highest in 1986 and 1989 (Table 4). At the Natchitoches site, the mean number of *C. hicoriae* captured was higher in 1989 than 1988 (Table 5). The variances for the number of *C. hicoriae* captured per tree were compared by site and year in a pair-wise manner using the F-test. No statistically significant differences ($P = 0.05$) were observed among the trees.

This study was just the initial step in trying to develop an understanding of the emergence pattern of *C. hicoriae.* The wire cone emergence traps proved to be an effective tool for monitoring the emergence of adult *C. hicoriae* from hibernation. The traps were relatively inexpensive, simple to construct, and easy to use. To utilize

Table 4. Mean number of *C. hicoriae* captured over all sampling dates by tree and year. Crescent Pecan Orchard, Monroe, LA

	1985 (n = 33)		1986 (n = 33)		1988 (n = 34)		1989 (n = 33)		Total (n = 133)	
	Mean	Var.	Mean	Var.	Mean	Var.	Mean	Var.	Mean	Var.
Tree 1	2.48	13.95	4.27	14.51	1.06	1.64	4.33	19.98	3.02	14.04
Tree 2	1.79	6.05	3.70	7.97	0.71	1.12	3.91	19.46	2.51	10.21
Tree 3	2.88	10.86	4.73	13.89	0.56	0.62	4.30	33.34	3.10	16.94
Tree 4	2.15	5.45	4.97	13.97	0.59	0.67	4.97	25.91	3.15	14.75
Tree 5	2.27	8.95	5.42	20.13	0.47	0.68	4.33	28.73	3.11	17.87
Per tree	2.31	8.96	4.62	14.10	0.68	0.97	4.37	24.98	2.98	14.73
Orchard	11.57	162.87	23.09	231.02	3.38	11.15	21.84	487.51	14.88	282.24

Table 5. Mean number of *C. hicoriae* captured over all sampling dates by tree and year. Hillin Pecan Orchard, Natchitoches, LA

	1988 (n = 33)		1989 (n = 33)		Total (n = 66)	
	Mean	Var.	Mean	Var.	Mean	Var.
Tree 1	0.88	0.92	4.33	22.04	2.61	14.33
Tree 2	0.85	1.76	4.45	21.88	2.65	14.94
Tree 3	0.94	1.31	5.06	39.62	3.00	24.46
Tree 4	0.67	0.85	4.24	31.81	2.45	19.33
Tree 5	0.79	1.73	4.73	24.52	2.76	16.86
Per tree	0.82	1.29	4.56	27.38	2.69	17.80
Orchard	4.12	17.17	22.82	586.34	13.46	385.85

these traps as a tool for estimating population density and for timing insecticide applications for control of this insect, additional data will be needed to determine if variations occur in the number of *C. hicoriae* captured between traps, in the emergence patterns between other pecan cultivars, and how trap catch relates to the number of *C. hicoriae* found in the trees.

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