A Method for Monitoring Seasonal Activity of Pecan Phylloxera, *Phylloxera devastatrix* Pergande, with Observations on Emergence in Louisiana and Oklahoma

[1]Michael J. Hall,[2] Phillip G. Mulder, Jr.,[3] and John Austin[4]

LSU AgCenter, Pecan Research-Extension Station, Shreveport, Louisiana 71135-5519 USA

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Abstract A study was initiated to develop a method to monitor seasonal emergence of pecan phylloxera, *Phylloxera devastatrix* Pergande, in Louisiana and Oklahoma. The method used 2.54 cm wide strips of white cloth tape coated with a narrow bead of Tangle-Trap ® that was applied to smooth-barked limbs on the trees. The method proved effective in capturing emerging *P. devastatrix.* Observations made on emergence indicated an infestation period in both states of about 45-50 d. Emergence started and peaked about 12-14 d earlier in Louisiana than in Oklahoma. In Louisiana, significant differences occurred in the number of *P. devastatrix* captured by year and tree, and no significant differences were observed in the number captured on a specific cultivar. In Oklahoma, significant differences were observed in the number of *P. devastatrix* captured across cultivars and between years. No significant differences were observed in the number captured by specific trees. In both states fewer *P. devastatrix* were captured in 2001 than in 2000.

Key Words pecan phylloxera, *Phylloxera devastatrix*, pecan, *Carya illinoinensis*

Pecan phylloxera, *Phylloxera devastatrix* Pergande (Homoptera: Phylloxeridae), are small, cecidogenic insects that form galls on leaflet veins and petiolules, leaf rachises and petioles, current season shoot growth, catkins, and nuts of pecan, *Carya illinoinensis* (Wangenheim) K. Koch (Baker 1935). According to Baker (1935), formation of the galls on the rachis, petiole, and petiolules of the leaves can lead to premature abscission of leaflets and sometimes the entire compound leaf. Shoot growth also can be reduced, if high numbers of galls form on shoots. Nut quality and quantity also can be affected by high infestation levels of *P. devastatrix*. Deformed nuts and nut abortion result from the formation of galls on the nuts. The premature loss of foliage channels vital resources from nut development and redirects them toward production of new foliage. This, in turn, reduces nut quality and adversely affects future production. Galls of *P. devastatrix* also are known to harbor other insects, most notably hickory shuckworm, *Cydia caryana* Fitch (Boethel and Ezell 1977, Mitchell et al. 1984).

Baker (1935) stated that "the nymphs of *P. devastatrix* begin to appear in the

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[2]All requests (e-mail: mhall@agctr.lsu.edu).

[3]Department of Entomology, Oklahoma State University, Stillwater, Oklahoma 74078-3033.

[4]College of Business, Louisiana State University-Shreveport, Shreveport, Louisiana 71115.

spring, from the first to the middle of April." He noted that nymphs appear in large numbers over a period of 2-3 wks, and may continue to appear for an additional 1-3 wks. In Louisiana, Boethel and Ezell (1977) observed that phylloxera nymphs begin to hatch from eggs prior to bud break and start crawling toward the opening buds. They noted that nymphs can be found on new growth beginning about the last week of March and the first 2 wks in April.

When infestation levels are high, insecticides are often applied for control. Due to the lack of detailed information on the emergence patterns of *P. devastatrix*, the level of control and the number of insecticide applications made varies among growers.

The purpose of this study was to develop an accurate and practical technique that could be used to monitor the seasonal activity of *P. devastatrix* and to evaluate its use in determining emergence patterns of this insect on different pecan cultivars and at different locations. Of particular interest was determining the onset of emergence, the occurrence of peak emergence, the duration of emergence, and differences in emergence patterns due to location and cultivar.

Materials and Methods

Four sites were selected, two each in Louisiana and Oklahoma. In Louisiana, one site was located at the LSU Pecan Research-Extension Station pecan orchard in Robson (GPS coordinates 32°21′28″N latitude, 93°38′W longitude). The second site was located at a commercial pecan orchard near Benton (GPS coordinates 32°38′21″N latitude, 93°44′46″W longitude). At the Robson (Caddo Parish) site 5 trees of the cv. 'Stuart' were selected, whereas at the Benton (Bossier Parish) site 5 trees of the cv. 'Schley' were selected. In Oklahoma, both sites were located near Stillwater (Payne Co.). The first site was 1.6 km west of Western St. near OK Highway 51 (GPS coordinates 36°7 13″N latitude, 97°6 32″W longitude), whereas the second

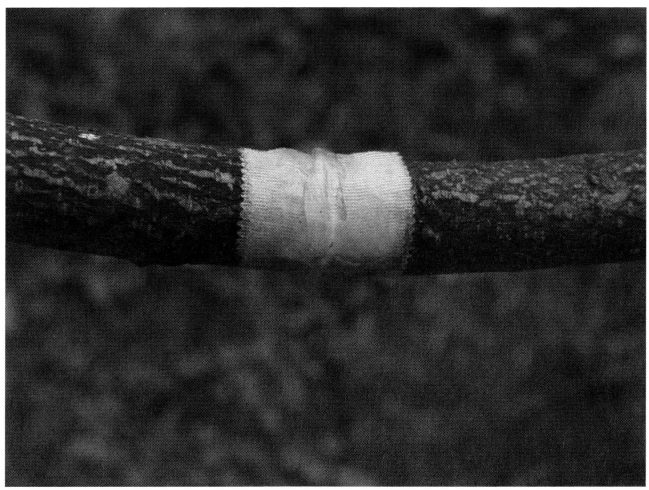

Fig. 1. White cloth tape with bead of Tangle-Trap ® used for capturing emerging *P. devastatrix*.

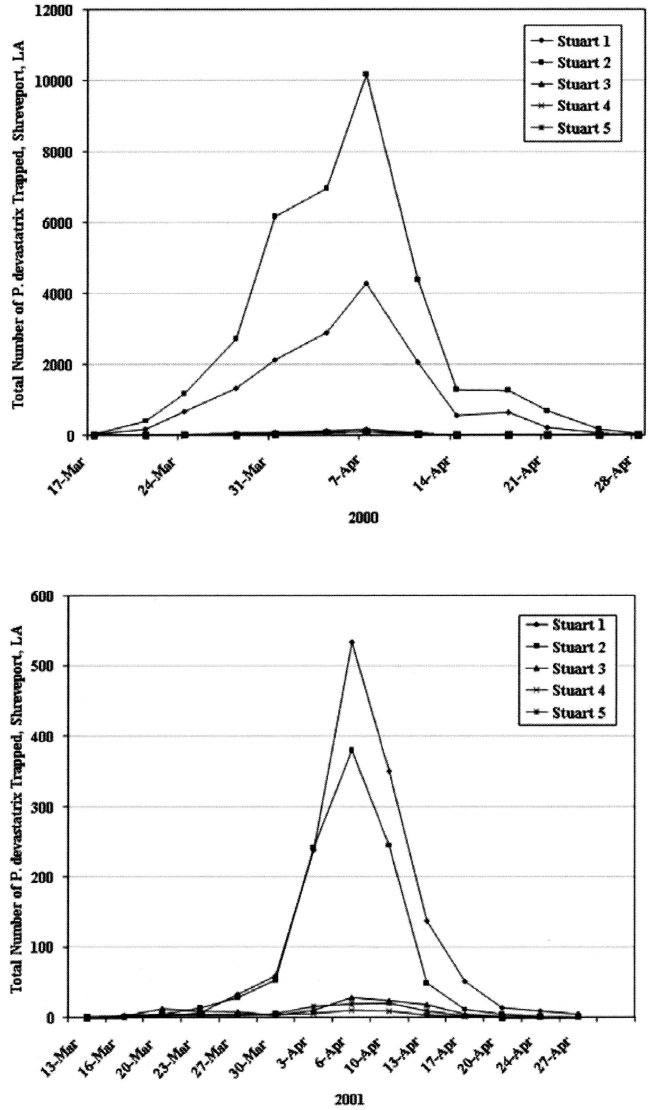

Fig. 2. Emergence pattern of *P. devastatrix* on 'Stuart' pecans at the Pecan Research-Extension Station pecan orchard, Shreveport, LA. Data points represent the total number of *P. devastatrix* captured.

site was 10 km east of Stillwater near OK Highway 51 (GPS coordinates 36°5′ 22″N latitude, 96°56′9′ W longitude). At the first site, 5 native trees were selected, whereas 5 trees of the cv. 'Maramec' were selected at the second site. All trees used in the study were heavily infested with *P. devastatrix* in 1999, the year previous to initiation

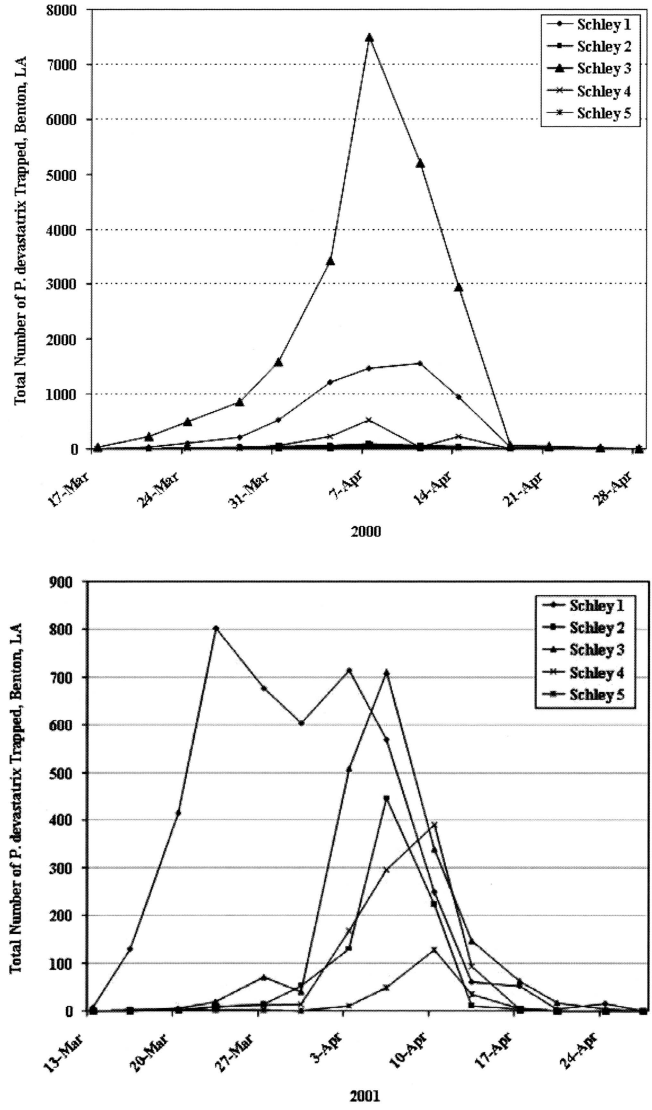

Fig. 3. Emergence pattern of *P. devastatrix* on 'Schley' pecans at the Atkins-Sonnier pecan orchard, Benton, LA. Data points represent the total number of *P. devastatrix* captured.

of this study. Differences in cultivars grown in the two states prevented use of the same cultivars in both states. The trees used in the study were not sprayed with pesticide.

To capture the emerging nymphs, a single, 2.54 cm wide strip of cloth adhesive tape was affixed to each of 5 smooth-barked limbs per tree (Fig. 1). A narrow bead of

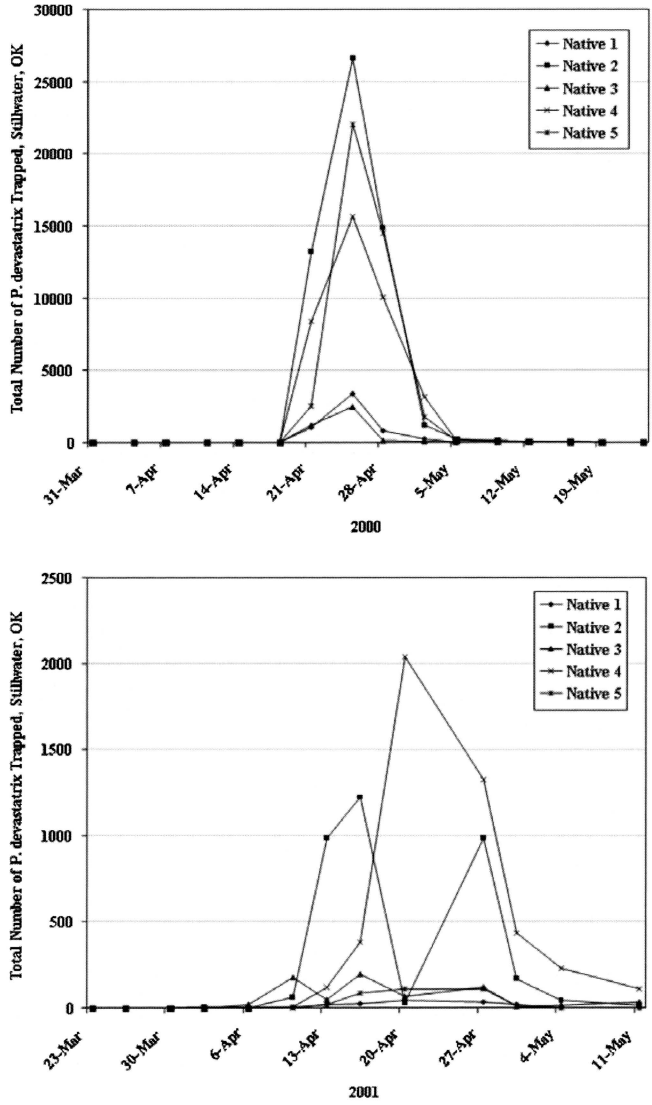

Fig. 4. Emergence pattern of *P. devastatrix* on native pecans near Stillwater, OK. Data points represent the total number of *P. devastatrix* captured

Tangle-Trap® was applied around the middle of each strip of tape which served to capture the emerging nymphs as they moved from the overwintering sites onto the opening buds. Tape strips were removed twice weekly and replaced with fresh strips. Once removed, the tape strips were transported to the laboratory where nymphs were counted using a dissecting microscope. Statistical comparisons were performed using the SAS General Linear Models procedure (SAS 2001).

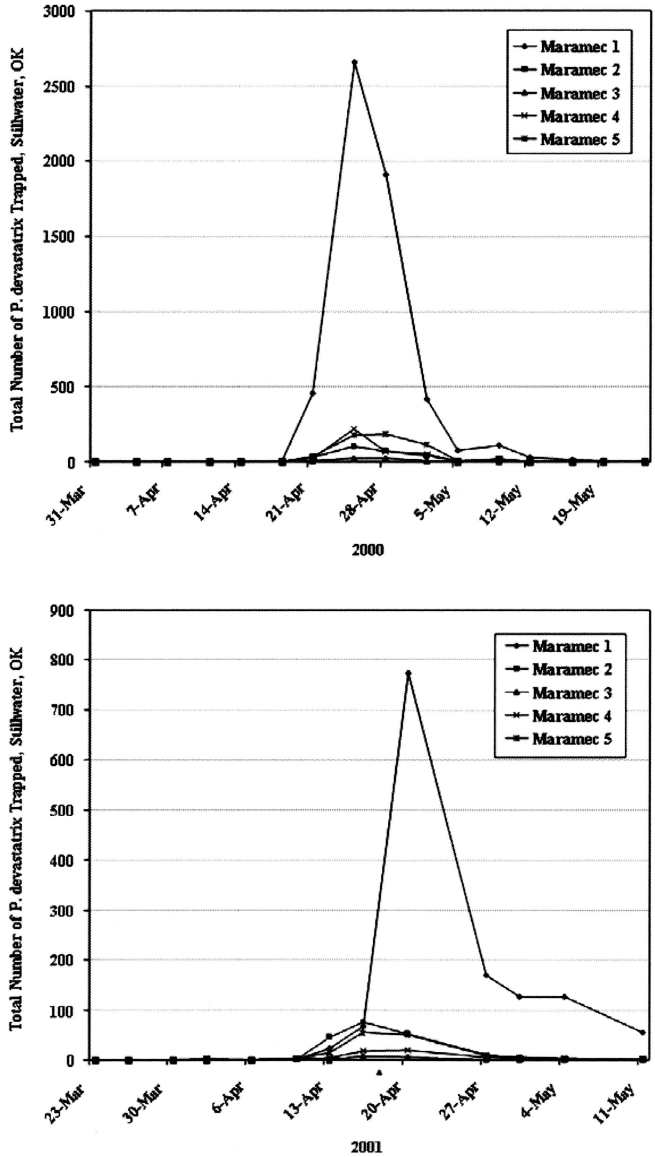

Fig. 5. Emergence pattern of *P. devastatrix* on 'Maramec' pecans at the Dick Huffman pecan orchard, Stillwater, OK. Data points represent the total number of *P. devastatrix* captured.

Results and Discussion

Tape strips were effective in trapping the emerging *P. devastatrix* nymphs. Use of the tape strips facilitated detection of onset of emergence, the occurrence of

Table 1. Analysis of variance for comparison of the number of *P. devastatrix* trapped in Louisiana by year, cultivar, and tree.

Source	df	ss	ms	F-statistic	P-value
Year	1	20404350.4	20404350.4	17.47	<.0001
Cultivar	1	837560.9	837560.9	0.72	0.3978
Tree	4	19156634.9	4789158.7	4.10	0.0031

Table 2. Analysis of variance for comparison of the number of *P. devastatrix* trapped in Oklahoma by year, cultivar, and tree.

Source	df	ss	ms	F-statistic	P-value
Year	1	50680133.9	50680133.9	6.99	0.0087
Cultivar	1	73665990.3	73665990.3	10.16	0.0016
Tree	4	37165669.0	9291417.2	1.28	0.2273

peak emergence, and the duration of emergence. From data collected, emergence curves for *P. devastatrix* for each cultivar and at each location were generated (Figs. 2-5).

In Louisiana, emerging nymphs were first observed on both the 'Schley' and 'Stuart' trees on 17 March 2000 (Figs. 2, 3). In 2001, they were first observed on the 'Schley' trees on 13 March and on the 'Stuart' trees on 16 March (Figs. 2, 3). In Oklahoma, emerging nymphs were first observed on the 'Maramec' and native trees on 14 April 2000 (Figs. 4, 5). In 2001, they were first observed on the native trees on 30 March and on the 'Maramec' trees on 3 April (Figs. 4, 5). In both states, the duration of emergence in 2000 and 2001 was approximately 45-50 d.

Emergence patterns of *P. devastatrix* at each location were well defined, with the onset of emergence and the occurrence of peak emergence occurring on, or close to, the same date at that location; however, a couple of variations were observed in 2001. On one 'Schley' tree at the orchard in Benton, LA, emergence began and peaked earlier than on any of the other trees (Fig. 3). It is not clear why this occurred, as a similar pattern was not observed on that tree the previous year. Also, a decrease in the number of *P. devastatrix* captured on one of the native trees in Oklahoma was observed whereas increasing numbers of *P. devastatrix* were being captured on the other trees (Fig. 4). This was not due to any pecularities in emergence, but rather the coming off of several tape strips from the branches during a period of inclement weather between sampling dates.

Differences were observed in the onset of emergence and the occurrence of peak emergence between the states, with these events occurring approximately 2 wks earlier in Louisiana than in Oklahoma in 2000 and 2001. It also should be noted that the onset of emergence and the occurrence of peak emergence were earlier in 2001 than in 2000, despite lower January-March temperatures in 2001.

Table 3. Means and standard deviations for the number of *P. devastatrix* trapped on cv. Maramec and Native pecan trees in Oklahoma by date and by tree across all dates.

Maramec						Native					
Date	Mean	Std. Dev.	Tree #	Mean	Std. Dev.	Date	Mean	Std. Dev.	Tree #	Mean	Std. Dev.
3/31/2000	0	0	1	354.69	779.27	3/31/2000	0	0	1	338./37	859.43
4/4/2000	0	0	2	16.06	30.73	4/4/2000	0	0	2	3516.06	7767.13
4/7/2000	0	0	3	3.44	7.39	4/7/2000	0	0	3	243.5	656.14
4/11/2000	0	0	4	23.5	55.81	4/11/2000	0	0	4	2346.12	4739.32
4/14/2000	0.2	0.45	5	33.12	63.41	4/14/2000	4.4	6.65	5	2562.12	6319.51
4/18/2000	0	0				4/18/2000	0	0			
4/21/2000	108.6	194.54				4/21/2000	5252.2	5344.14			
4/25/2000	636	1132.76				4/25/2000	14005.4	10872.2			
4/28/2000	449.8	819.57				4/28/2000	8058.8	7194.09			
5/2/2000	126	167.51				5/2/2000	1273.8	1261.68			
5/5/2000	16.8	32.02				5/5/2000	111.6	97.99			
5/9/2000	29.4	45.67				5/9/2000	62.4	59.28			
5/12/2000	6.2	11.1				5/12/2000	20.6	18.68			
5/16/2000	2.8	5.72				5/16/2000	21.8	13.18			
5/19/2000	2.2	2.95				5/19/2000	8.2	5.89			
5/23/2000	0.6	0.89				5/23/2000	0.6	0.89			
Date	Mean	Std. Dev.	Tree #	Mean	Std. Dev.	Date	Mean	Std. Dev.	Tree #	Mean	Std. Dev.
3/23/2001	0	0	1	103	209.84	3/23/2001	0	0	1	12	14.2
3/26/2001	0	0	2	14	25.36	3/26/2001	0	0	2	270.54	458.76
3/30/2001	0	0	3	1	2.27	3/30/2001	0.4	0.89	3	51.85	68.21
4/2/2001	0.2	0.45	4	3.85	6.46	4/2/2001	2.2	3.19	4	357.38	622.53

Table 3. Continued.

Maramec						Native					
Date	Mean	Std. Dev.	Tree #	Mean	Std. Dev.	Date	Mean	Std. Dev.	Tree #	Mean	Std. Dev.
4/6/2001	0	0	5	10.46	18.69	4/6/2001	5.6	7.7	5	25.69	43.68
4/10/2001	0.8	0.84				4/10/2001	49.6	74.16			
4/13/2001	16.6	17.66				4/13/2001	237.8	420.25			
4/16/2001	43.8	30.18				4/16/2001	381.8	491.02			
4/20/2001	179.4	332.41				4/20/2001	456.4	882.42			
4/27/2001	38.6	73.55				4/27/2001	514.8	598.08			
4/30/2001	27.2	55.82				4/30/2001	127.2	183.87			
5/4/2001	26	55.91				5/4/2001	57.6	98.56			
5/11/2001	11.4	24.38				5/11/2001	32	46.05			

Table 4. Means and standard deviations for the number of *P. devastatrix* trapped on cv. Schley and Stuart pecan trees in Louisiana by date and by tree across all dates

Schley						Stuart					
Date	Mean	Std. Dev.	Tree #	Mean	Std. Dev.	Date	Mean	Std. Dev.	Tree #	Mean	Std. Dev.
3/17/2000	7	12.92	1	468.85	605.43	3/17/2000	10.4	13.97	1	1145.31	1327.11
3/21/2000	53.4	96	2	28	31.12	3/21/2000	110.2	164.51	2	2714.85	3232.27
3/24/2000	125.8	207.95	3	1722.23	2393.9	3/24/2000	369.8	520.87	3	39.15	51.8
3/28/2000	226.2	361.62	4	84.08	153.67	3/28/2000	818.2	1195.92	4	20.69	27.04
3/31/2000	448.8	670.5	5	18.77	22.27	3/31/2000	1685.6	2658.11	5	19.54	28.28
4/4/2000	990.8	1442.42				4/4/2000	2016	3021.69			
4/7/2000	1928.8	3163.21				4/7/2000	2956	4410.1			
4/11/2000	1381.2	2238.7				4/11/2000	1303.6	1920.74			
4/14/2000	836.8	1240.43				4/14/2000	364.4	558.47			
4/18/2000	19.8	25.17				4/18/2000	383.4	553.71			
4/21/2000	13.4	15.24				4/21/2000	178.6	290.87			
4/25/2000	5	7.68				4/25/2000	42.8	63.23			
4/28/2000	0	0				4/28/2000	3.8	7.43			
Date	Mean	Std. Dev.	Tree #	Mean	Std. Dev.	Date	Mean	Std. Dev.	Tree #	Mean	Std. Dev.
3/16/200	1.4	3.13	1	306.5	308.15	3/13/2001	0	0	1	102.28	162.24
3/20/2001	26.6	57.81	2	63.5	127.46	3/16/2001	1.4	1.14	2	73.14	121.92
3/13/2001	84.6	184.15	3	137.43	222.83	3/20/2001	4.2	3.96	3	7.78	9.12
3/23/2001	167.6	354.14	4	70.43	126.31	2/23/2001	6.4	4.39	4	2.71	3.05
3/27/2001	154.4	292.31	5	16.57	35.44	3/27/2001	14.4	14.01	5	5.21	6.97

Table 4. Continued.

Schley						Stuart					
Date	Mean	Std. Dev.	Tree #	Mean	Std. Dev.	Date	Mean	Std. Dev.	Tree #	Mean	Std. Dev.
3/30/2001	141.6	258.72				3/30/2001	24.4	28.94			
4/3/2001	306	293.51				4/3/2001	101.4	125.67			
4/6/2001	413.4	254.79				4/6/2001	193.6	246.11			
4/10/2001	265.8	102.68				4/10/2001	128.8	158.15			
4/13/2001	69.4	53.02				4/13/2001	42.2	55.35			
4/17/2001	25.4	28.67				4/17/2001	13	21.6			
4/20/2001	4.4	7.8				4/20/2001	3.2	5.63			
4/24/2001	3.8	6.5				4/24/2001	1.6	3.6			

Table 5. Means and standard deviations for the number of *P. devastatrix* trapped across tape strips (five strips/tree) on cv. Maramec pecan trees in Oklahoma

	Tree 1		Tree 2		Tree 3		Tree 4		Tree 5	
Date	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
3/31/2000	0	0	0	0	0	0	0	0	0	0
4/4/2000	0	0	0	0	0	0	0	0	0	0
4/7/2000	0	0	0	0	0	0	0	0	0	0
4/11/2000	0	0	0	0	0	0	0	0	0	0
4/14/2000	0.2	0.45	0	0	0	0	0	0	0	0
4/18/2000	0	0	0	0	0	0	0	0	0	0
4/21/2000	91.2	118.56	5.6	5.32	0.8	1.1	4	4.06	7	6.28
4/25/2000	531.6	415.7	21	18.61	4.6	4.67	43.8	32.98	35	43.28
4/28/2000	440.2	443.76	13.8	7.73	4	3.81	13.2	7.6	36.4	41.14
5/2/2000	83.6	63.59	8.2	9.04	1.6	1.67	10.2	9.42	22.4	30.05
5/5/2000	14.8	15.21	0.8	1.3	0	0	0.4	0.89	0.8	1.79
5/9/2000	22	18.71	0.8	1.3	0	0	3	3.08	3.6	2.88
5/12/2000	5.2	5.97	0.2	0.45	0	0	0.4	0.89	0.4	0.89
5/16/2000	2.6	2.7	0	0	0	0	0	0	0.2	0.45
5/19/2000	1.4	1.52	0.6	0.89	0	0	0.2	0.45	0	0
5/23/2000	0	0	0.4	0.55	0	0	0	0	0.2	0.45
Date	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
2/23/2001	0	0	0	0	0	0	0	0	0	0
3/27/2001	0	0	0	0	0	0	0	0	0	0
3/30/2001	0	0	0	0	0	0	0	0	0	0
4/3/2001	0	0	0	0	0	0	0	0	0.2	0.45
4/6/2001	0	0	0	0	0	0	0	0	0	0

Table 5. Continued.

Date	Tree 1		Tree 2		Tree 3		Tree 4		Tree 5	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
4/10/2001	0	0	0	0	0.2	0.45	0.4	0.55	0.2	0.45
4/13/2001	4.4	7.7	8.8	12.85	0	0	0.6	0.89	2.8	3.27
4/17/2001	43.2	62.99	15	21.14	1.4	1.52	3.4	6.07	10.8	13.61
4/20/2001	154.6	257.24	10.2	7.95	1	1.22	3.8	4.49	9.8	18.05
4/27/2001	56.4	60.62	2	4.47	0	0	1	1	1.6	2.61
4/30/2001	25.4	47.78	0.4	0.89	0	0	0.4	0.89	1	1.41
5/4/2001	25.2	50.94	0	0	0	0	0.2	0.45	0.6	1.34
5/11/2001	11	24.6	0	0	0	0	0.2	0.45	0.2	0.45

Table 6. Means and standard deviations for the number of *P. devastatrix* trapped across tape strips (five strips/tree) on Native pecans in Oklahoma

	Tree 1		Tree 2		Tree 3		Tree 4		Tree 5	
Date	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
3/31/2000	0	0	0	0	0	0	0	0	0	0
4/4/2000	0	0	0	0	0	0	0	0	0	0
4/7/2000	0	0	0	0	0	0	0	0	0	0
4/11/2000	0	0	0	0	0	0	0	0	0	0
4/14/2000	0	0	1.4	3.13	3	5.66	0	0	0	0
4/18/2000	0	0	0	0	0	0	0	0	0	0
4/21/2000	207.8	73.82	2635	2580.23	240.6	161.74	1672	1363	496.8	273.17
4/25/2000	668	290.64	5320	2758.99	487.4	519.08	3130	1212.23	4400	3731.62
4/28/2000	158.8	105.04	2966.8	2757.52	26.6	21.45	1943.6	2621.57	2903	2418.01
5/2/2000	42.6	22.63	242	233.19	6.2	6.14	625	1148.12	358	231.84
5/5/2000	2.8	3.11	49.2	57.02	4.6	3.36	33.2	44.38	21.8	22.76
5/9/2000	1.2	1.3	23.6	26.58	2.8	2.39	26.6	27.83	8.2	5.63
5/12/2000	0.2	0.45	4.4	3.65	0.8	1.3	9.2	12.36	6	10.1
5/16/2000	0.8	0.84	7.6	3.71	3.4	3.85	6.2	7.33	3.8	5.81
5/19/2000	0.6	0.55	1	1.22	3.6	2.97	1.8	1.3	1.2	2.17
5/23/2000	0	0	0.4	0.55	0.2	0.45	0	0	0	0
Date	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
3/23/2001	0	0	0	0	0	0	0	0	0	0
3/27/2001	0	0	0	0	0	0	0	0	0	0
3/30/2001	0.4	0.89	0	0	0	0	0	0	0	0
4/3/2001	1.4	3.13	0.8	1.1	0	0	0	0	0	0

Table 6. Continued.

Date	Tree 1		Tree 2		Tree 3		Tree 4		Tree 5	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
4/6/2001	1	2.24	0.4	0.55	3.8	4.66	0.4	0.55	0	0
4/10/2001	2.1	1.64	12	15.6	35	53.72	3	4.24	0.2	0.45
4/13/2001	3.4	7.06	197.2	315.38	37	47.66	23.6	24.05	3.8	2.86
4/17/2001	4.4	7.7	245	203.38	45	62.53	76.8	108.26	16.8	12.79
4/20/2001	8.6	15.95	36.6	54.81	23.4	26.25	406.8	369.91	21.8	20.09
4/27/2001	6.8	8.07	197	248.59	23.8	30.75	287.4	246.73	22	26.65
4/30/2001	4	3.08	33	31.21	1.6	2.61	86.8	156.3	1.8	1.79
5/4/2001	0	0	12.2	14.24	4.2	5.36	46.2	90.83	0.2	0.45
5/11/2001	0	0	3.2	6.61	8	8.75	22.2	33.33	0.2	0.45

Table 7. Means and standard deviations for the number of *P. devastatrix* trapped across tape strips (five strips/tree) on cv. Schley pecan trees in Louisiana

	Tree 1		Tree 2		Tree 3		Tree 4		Tree 5	
Date	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
3/17/2000	0.6	0.89	0	0	6	8.86	0.4	0.55	0	0
3/21/2000	7.4	8.96	0.2	0.45	44.6	60.86	0.8	1.3	0.4	0.55
3/24/2000	20.6	7.37	2.2	2.95	98.2	101.57	2.4	2.07	2.4	1.34
3/28/2000	40.4	14.88	7.4	2.07	171.6	202.64	3.8	3.11	3	1.58
3/31/2000	106	55.99	10	2.24	317.4	217.74	10.8	3.96	4.6	1.52
4/4/2000	243.4	76.79	12.8	5.31	684	650.79	43.8	56.1	6.8	2.28
4/7/2000	292.2	95.81	18.8	14.96	1499.4	2111.55	104.2	148.49	14.2	8.73
4/11/2000	311.4	140.29	10.8	18.59	1042.2	964.17	74	102.25	10.8	5.67
4/14/2000	187.8	162.53	9	12.51	590.6	862.28	45.4	66.16	4.2	2.86
4/18/2000	4.8	3.03	1	2.24	12.4	16.04	0.2	0.45	1.4	1.14
4/21/2000	3.2	2.59	0.8	1.3	7.8	8.64	0.6	0.55	1	0.71
4/25/2000	1.2	0.84	0	0	3.6	5.86	0.2	0.45	0	0
4/28/2000	0	0	0	0	0	0	0	0	0	0
Date	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
3/13/2001	1.4	0.89	0	0	0	0	0	0	0	0
3/16/2001	26	19.65	0.4	0.55	0	0	0.2	0.45	0	0
3/20/2001	82.8	83.52	0.2	0.45	1.2	1.1	0.2	0.45	0.2	0.45
3/23/2001	160.2	156.82	1.8	1.79	3.8	2.39	1.6	1.34	0.2	0.45
3/27/2001	135	138.38	2.6	2.79	14.2	8.73	2.4	1.82	0.2	0.45
3/30/2001	120.6	143.18	10.2	11.78	8	8.28	2.8	3.03	0	0

Table 7. Continued.

	Tree 1		Tree 2		Tree 3		Tree 4		Tree 5	
Date	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
4/3/2001	142.8	148.28	26	28.91	101.6	112.5	33.4	27.13	2.2	1.92
4/6/2001	113.6	132.46	89	108.71	142	151.12	59	49.75	9.8	10.23
4/10/2001	49.6	70.66	44.6	74.63	67.8	96.08	78.2	51.95	25.6	29.16
4/13/2001	12.2	5.89	2.2	1.92	29.4	41.07	18.6	12.78	7	5.1
4/17/2001	10.2	11.1	0.8	1.3	13.2	21.81	0.8	1.3	1.2	2.17
4/20/2001	0.8	1.3	0	0	3.6	5.86	0	0	0	0
4/24/2001	3	3.39	0	0	0	0	0	0	0	0
4/27/2001	0	0	0	0	0	0	0	0	0	0

Table 8. Means and standard deviations for the number of *P. devastatrix* trapped across five tape strips (five strips/tree) on cv. Stuart pecans in Louisiana

	Tree 1		Tree 2		Tree 3		Tree 4		Tree 5	
Date	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
3/17/2000	3	3.54	6.6	3.65	0.4	0.55	0	0	0.4	0.55
3/21/2000	31.8	21.81	75.8	21.21	1	0.71	1	1.73	0.6	0.89
3/24/2000	130.4	65.89	231.8	154.92	4	4.3	2.6	3.65	1	0.71
3/28/2000	261.6	129.8	542.4	639.53	9	11.38	3.2	5.22	2	1.58
3/31/2000	421.4	140.24	1233.2	824.34	15.6	14.79	5.2	3.77	10.2	9.07
4/4/2000	577.6	156.71	1392.6	808.1	23	16.61	11.4	8.17	11.4	10.5
4/7/2000	855	294.05	2031.4	1014.9	33.8	30.47	17.8	13.08	18	19.9
4/11/2000	411	237.54	872.4	320.59	7.6	4.56	8.8	4.66	3.8	3.35
4/14/2000	107.4	82.54	254.8	119.9	1.2	1.79	0.8	0.45	0.2	0.45
4/18/2000	129	101.04	248.6	140.57	2.4	1.82	1.6	0.55	1.8	2.39
4/21/2000	40.4	30.92	135.2	71.57	2.2	1.48	0.4	0.55	0.4	0.55
4/25/2000	8.8	6.1	30.4	17.04	1.6	1.52	1	1.41	1	1.41
4/28/2000	0.4	0.55	3.4	3.21	0	0	0	0	0	0
Date	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
3/13/2001	0	0	0	0	0	0	0	0		
3/16/2001	0.6	0.55	0.4	0.55	0.2	0.45	0	0	0.2	0.45
3/20/2001	0.2	0.45	0.6	0.55	2.2	0.84	0.8	0.84	0.4	0.55
3/23/2001	1.2	1.64	2.6	1.34	1.6	1.34	0.6	0.89	0.4	0.55
3/27/2001	6.4	3.78	5.4	3.29	1.4	1.14	0.8	0.45	0.4	0.55
3/30/2001	11.8	14.87	10.6	7.02	0.4	0.55	0.6	0.55	1	1

Table 8. Continued.

Date	Tree 1		Tree 2		Tree 3		Tree 4		Tree 5	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
4/3/2001	47.4	38.4	48.2	25.74	1.8	1.64	1	1	3	2.35
4/6/2001	106.6	70.71	76	45.35	5.6	4.67	1.8	1.64	3.6	3.21
4/10/2001	70	50.37	48.8	32.39	4.6	2.7	1.6	2.07	3.8	2.39
4/13/2001	27.2	8.96	9.6	5.41	3.4	1.95	0.4	0.89	1.6	0.89
4/17/2001	10.2	3.56	2	1	0.6	0.55	0	0	0.2	0.45
4/20/2001	2.6	2.19	0.6	0.55	0	0	0	0	0	0
4/24/2001	1.6	1.67	0	0	0	0	0	0	0	0
4/27/2001	0.6	0.89	0	0	0	0	0	0	0	0

The difference in latitude between the Louisiana and Oklahoma sites is 3°46′. According to Hopkins' Bioclimatic Law (Hopkins 1918), "other things being equal, the variation in the time of occurrence of a given periodic event in temperate North America is at the general average rate of four days to each degree of latitude northward, five degrees of longitude eastward, and 400 ft of altitude upward in early spring and summer." In late summer and fall this pattern is reversed (Hopkins 1918). Assuming this law is valid in regard to *P. devastatrix*, the onset of emergence and the occurrence of peak emergence should occur about 16 d later at the Oklahoma sites than at the Louisiana sites. In this study, these events occurred about 12-14 d earlier in Louisiana than in Oklahoma, which is very close to the predicted difference in the time when these events should occur according to Hopkins' Bioclimatic Law (Hopkins 1918). To determine whether this law is applicable to *P. devastatrix*, additional emergence data from different locations will need to be collected.

In Louisiana (Table 1), significant differences occurred in the number of *P. devastatrix* captured between years and by specific trees. No significant differences were observed in the numbers captured on a specific culitvar. In Oklahoma (Table 2), significant differences were observed in the number of *P. devastatrix* captured across the 2 cultivars and between the 2 years. No significant differences were observed in the number captured by specific trees. In both states fewer *P. devastatrix* were captured in 2001 than in 2000, with the difference being significant in both states. After 2001, no *P. devastatrix* were captured at either of the two Louisiana sites (Tables 3-8).

The method developed and used in this study to monitor the seasonal activity of *P. devastatrix* was successful and allowed for the creation of baseline information on the seasonal activity of this insect on pecan in two states. No conclusions were reached on the effects of temperature on emergence, except that it appears that the farther north a site is located, the later emergence occurs. To better understand how temperature affects emergence, additional emergence data need to be collected from sites located in areas between those used in this study, and from sites located in areas south of the sites used in Louisiana. No conclusions could be reached in regard to cultivar effects on emergence. It has been postulated that *P. devastatrix* appears earlier on cultivars where bud break begins earlier and later on those where bud break begins later; however, this could not be ascertained from the cultivars selected in this study. Emergence data need to be collected from additional cultivars, particularly those that exhibit differences in the occurrence of bud break, to determine if this hypothesis is true.

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