

TRACHEAL MITE *ACARAPIS WOODI* (RENNIE) (ACARI:  
TARSONEMIDAE) INFESTATIONS IN THE HONEY  
BEE, *APIS MELLIFERA* L. (HYMENOPTERA:  
APIDAE) IN TAMAULIPAS, MEXICO

L. G. Lozano, J. O. Moffett<sup>1</sup>, B. Campos P.

M. Guillen M., O. N. Perez E.,

D. L. Maki<sup>1</sup>, and W. T. Wilson<sup>1</sup>

Departamento de Parasitologia Agricola

Facultad Agronomia - Victoria

Universidad Autonoma de Tamaulipas

Cd. Victoria, Mexico

(Accepted for publication 27 May 1988)

ABSTRACT

In a 1986 survey taken in northeastern Mexico, 44% of the 6,200 honey bees, *Apis mellifera* L., examined were infested with tracheal mites, *Acarapis woodi* (Rennie). Mites were found in 80% of the 310 colony samples of 20 bees each. These samples were taken monthly from 10 colonies in each of three apiaries located from 130 to 230 km apart in the state of Tamaulipas.

Infestation levels varied greatly among apiaries, months, and between samples. Monthly infestations in individual bees ranged from a low of 2% in the Hidalgo apiary in August to a high of 97% in February in the Aldama apiary. The average infestation was 11% of the bees in the Hidalgo apiary, 35% in the Ciudad Mante apiary, and 71% in the Aldama apiary. Mite populations tended to decline in late spring and summer.

There was a significant correlation ( $r = 0.91$ ,  $p < 0.01$ ) between the percentage of bees infested in the apiary and the number of mites in each infested bee. The number of mites per infested bee ranged from an average of 14 for infested bees from the four monthly apiary samples with the lowest percentage of infested bees to 44 mites/infested bee in the four samples with the highest percent of infested bees. The average number of mites per infested bee was 34.2.

The proportion of mites in each life stage varied markedly. Overall, 19% of the 92,392 mites were in the egg stage, 37% were larvae, and 44% were adults. The ratio of males to females was 1:2.43 or 29% males to 71% females.

Both right and left tracheae were equally susceptible to becoming infested, as mites were found in 2,144 right and 2,138 left trachea. Both tracheae were infested in 58% of the bees parasitized with mites. There was also a highly significant correlation ( $r = 0.98$ ,  $P < 0.01$ ) between percentage of bees infested in each sample and percentage of infested bees with mites present in both tracheae.

Key Words: Acarine disease, Isle of Wight Disease, Tracheal tubes, *Apis mellifera*, *Acarapis woodi*

J. Entomol. Sci. 24(1): 40-46 (January 1989)

<sup>1</sup> USDA-ARS, Honey Bee Research Unit, 509 W. 4 St., Weslaco, TX. 78596

## INTRODUCTION

The tracheal mite *Acarapis woodi* (Rennie), has been a parasite of varying severity to honey bees in Europe for many years. However, tracheal mites were first reported in the Western Hemisphere in 1944 in Argentina by Skala (1944). In 1955 Müniz reported these mites in Uruguay. Nascimento (1970) wrote that the tracheal mites were in Brazil. In 1979 tracheal mites were found in bees from Colombia (Menapace and Wilson 1980).

These mites are a relatively new parasite of honey bees in North America. They were first found on this continent in 1980 in an apiary in southern Mexico by Wilson and Nunamaker on a collecting trip to Mexico (Wilson and Nunamaker 1982). They sampled 17 Mexican apiaries, and in only one of these apiaries were mites found. Since then, the mites have spread over most of Mexico (Zozaya et al. 1982) and a large portion of the United States (Delfinado-Baker, 1985; Wilson and Nunamaker 1985). This mite also has been imported into a few isolated localities in Canada (Anon. 1986; Anon. 1987; and Peer et al., 1987).

This study was undertaken since very little was known of the population fluctuations and severity of infestations of the mites in the Western Hemisphere. Data collection was confined to three widely separated commercial apiaries in the state of Tamaulipas, Mexico. The objectives of this study were to: 1. Determine the percentage of bees infested with the tracheal mite; 2. Count the population of the mites infesting each bee; 3. Follow the seasonal changes in the mite populations; and 4. Determine the ratios of both the various life states of the mites and of the sexes of the adults.

## MATERIALS AND METHODS

Adult bees were collected in 80% ethanol and examined for mites by three senior university students working under the direction of Professor Lidia G. Lozano de Haces of the Univ. Autonoma of Tamaulipas, Ciudad Victoria, Mexico. The three apiaries studied belonged to commercial beekeepers who continued to manage the bees.

Colony samples were collected monthly from 10 colonies in each of the apiaries. Later, in the laboratory, both prothoracic tracheae from 20 bees from each colony were dissected laterally under a stereoscope. This method of dissection increases the number of mites detected when compared to examinations without cutting the tracheal tubes. The mites were identified to sex and life stage and counted under 100X magnification with a compound scope.

The locations of the apiaries were: 1. *Aldama Apiary*. The colonies were at Villa Aldama ca. 140 km southeast of Ciudad Victoria; 2. *Ciudad Mante Apiary*. This apiary was ca. 18 km south of Ciudad Mante on the road to Ciudad Valles and about 150 km south of Ciudad Victoria; and 3. *Hidalgo Apiary*. This apiary was close to Hidalgo and ca. 50 km northwest of Ciudad Victoria.

## RESULTS AND DISCUSSION

The tracheal mite infestation in honey bees in Tamaulipas, Mexico was very high compared to infestation levels reported in England (Bailey 1963). Almost

44% of the 6,200 bees examined were infested with tracheal mites (Table 1). These mites were found in 80% of the monthly colony samples of 20 bees. In the infested colonies, mites were found in 55% of the bees examined. In comparison Bailey (1961) found less than 5% of the bees infested in the autumn in England over a six year period from 1955 - 1960. He found the winter loss increased steadily as the amount of infestation increased. Nine percent of his colonies died during the winter when no mite infestation was observed. Bailey's winter loss increased steadily as the level of mite infestation increased and was 76% when one-half or more of the bees were infested with mites. Moreover, Bailey (1958, 1963) reported that when 30% or more of the bees in a colony became infested with tracheal mites, the infested colonies were more likely to die than uninfested colonies. Recent studies by Eischen (1987) have shown that moderate and heavy infestations of tracheal mites adversely affected colony wintering and honey production in Mexico. Peer et al., (1987) reported that when package bees heavily infested with mites were installed in Canada, these packages did not develop satisfactorily. They would not have produced an adequate crop of honey. Otis (1986) suggests from limited data that colonies with heavy infestations of tracheal mites were more likely to die in the winter than colonies with lower infestations in New York State. For example, 75% of his colonies with 50% or more of the bees infested with mites died during the winter compared to a 30% loss when 26 to 40% of the bees were infested.

Table 1. Infestations of tracheal mites in honey bees in three apiaries in Tamaulipas, Mexico. 1986.

Item	Apiary Location			Total or Average
	Aldama	Ciudad Mante	Hidalgo	
Bees examined, #	2,400	2,400	1,400	6,200
Bees infested, #	1,698	848	156	2,702
Bees infested, %				
Average	70.8 $\pm$ 1.8	35.3 $\pm$ 1.6	11.1 $\pm$ 1.6	43.6 $\pm$ 1.2
Lowest Month	34.0 $\pm$ 6.6	6.5 $\pm$ 3.4	2.0 $\pm$ 1.9	
Highest Month	97.0 $\pm$ 1.2	69.0 $\pm$ 6.4	36.5 $\pm$ 6.7	
Colonies:				
Examined	120	120	70	310
Infested	117	97	33	247
% Infested	97.5 $\pm$ 1.3	80.1 $\pm$ 7.0	47.1 $\pm$ 11.7	79.7 $\pm$ 4.5

95% Confidence limits.

The infestation rate varied manyfold among apiaries, months, and colonies. Overall, 11% of the bees were infested with mites at the Hidalgo apiary, 35% at the Cd. Mante location, and 71% at Aldama. Seasonal infestation rates were highest during the six months from October through March and lowest during the warmer months (Fig. 1).

The reasons for the drop in mite populations in the spring and early summer are unknown. However, some of the possibilities are: 1) At this time of year, large amounts of brood are produced. Thus, young bees may be produced faster than the mites can spread and reproduce; 2) The life of adult bees is much shorter in the spring and summer than during the fall and winter. Therefore, the mites would not have as much time to build up populations in the tracheae and infest other

Fig. 1.

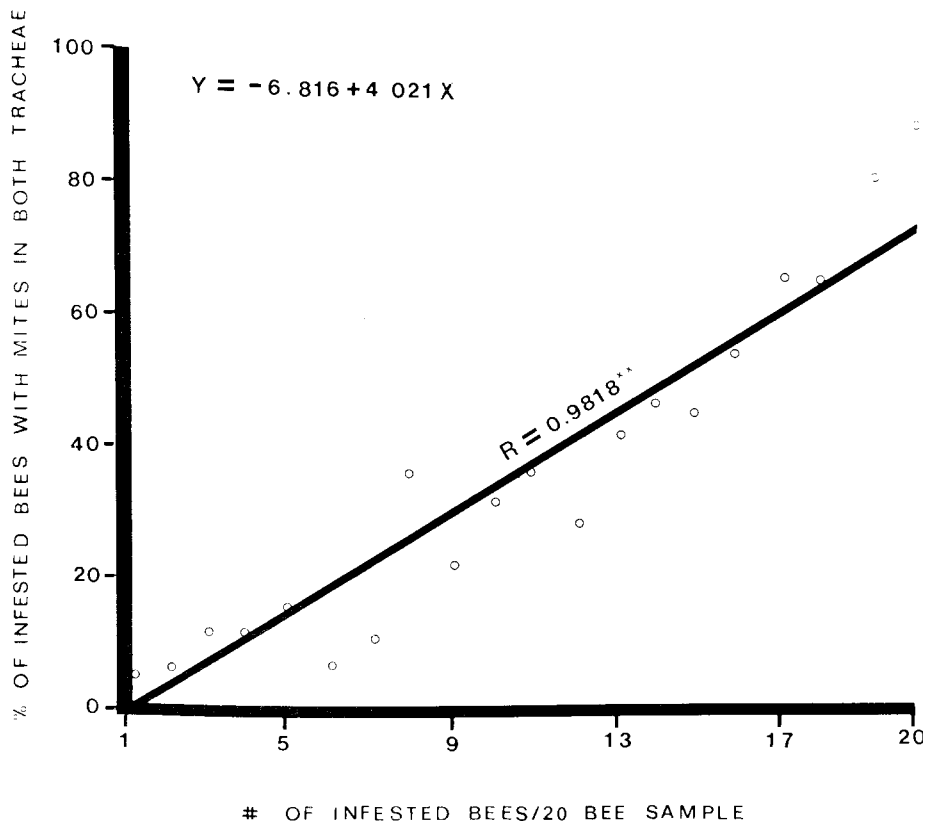


Fig. 1. The relationship between the percentage of infested bees with both prothoracic tracheae infested and the percentage of infested bees in the 20-bee samples. Tamaulipas, Mexico. 1986.

bees when the bees' lives are shortened; and 3) When the bees fly during hot weather, the mites are probably subjected to high temperatures. These higher temperatures may adversely affect the survival, reproduction, and/or transmission of the mites.

Although the infestations showed seasonal fluctuations, over 50% of the bees examined from the Aldama apiary had mites in 10 of the 12 months. The lowest mite infestation at Aldama was in July when 34% of the bees were infested, and the highest was in February when 97% of the bees were infested (Table 1). At the other two locations, mite populations were highest during the early part of the year and declined sharply in the summer to 2% in the Hidalgo apiary and to 6.5% in the Cd. Mante location. Overall, mites were found in 80% of the 20-bee monthly samples.

The population of mites in the monthly samples varied tremendously among apiaries and to a lesser degree within the apiaries (Table 2). For example, the number of mites in the samples was 8 times as large in February as in July (10,451

Table 2. Monthly changes in populations of tracheal mites, of mite-infested bees, and of mites in infested bees in three apiaries in Tamaulipas, Mexico,. 1986.

Number of Mites, Bees Infested and Mites per Infested Bee									
Aldama			Ciudad Mante			Hidalgo			
Month	Mites	Infested Bees	Mites/ Infested Bee	Mites	Infested Bees	Mites/ Infested Bee	Mites	Infested Bees	Mites/ Infested Bee
Jan.	5,179	184	28.1	2,965	126	23.5	X	X	X
Feb.	10,451	194	53.9	4,025	126	31.9	1,433	43	33.3
Mar.	4,951	168	29.5	2,857	133	21.5	2,848	73	39.0
Apr.	2,971	107	27.8	4,041	138	29.3	93	5	18.6
May	3,792	108	35.1	1,301	66	19.7	635	19	33.4
June	3,268	87	37.6	1,286	48	26.8	124	6	20.7
July	1,354	68	19.9	673	46	14.6	54	6	9.0
Aug.	7,411	185	40.1	1,549	72	21.5	35	4	8.8
Sept.	6,550	125	52.4	228	17	13.4	X	X	X
Oct.	5,704	168	34.0	514	38	13.5	X	X	X
Nov.	6,136	130	47.2	405	25	16.2	X	X	X
Dec.	9,498	174	54.6	61	13	4.7	X	X	X
Total or Average:									
	67,265	1,698	39.6	19,905	848	23.5	5,222	156	33.5

X: No samples taken.

versus 1,354) in the Aldama apiary. In the Hidalgo apiary the range was even more striking, as 35 mites were found in the August samples compared to 2,848 in the March samples, or a difference of 81 fold. The extreme differences in mite populations among monthly samples without regard to apiary was even greater, as the largest monthly population in the Aldama apiary was 299 times larger than the lowest monthly population in the Hidalgo apiary.

Infested bees from apiaries with a high percentage of parasitism had more mites per infested bee than infested bees from apiaries with less parasitism (Table 3). There was a significant correlation between the percentages of infested bees in an apiary and the number of mites in the tracheae of the infested bees ( $r = 0.911$ ). This was particularly evident at the extremes. The four monthly apiary samples with the lowest percentage of infested bees averaged only 14 mites per bee compared to 44 mites per infested bee from the samples with the highest percentage of infested bees. The average number of mites of all life stages per infested bee was 34.

Overall, 19% of the 92,392 mites were observed in the egg stage and 37% in the nymphal stage. Adults made up 44% of the mites counted (Table 4). Almost twice as many larvae were seen as eggs (34,283 versus 17,886). The most probable explanation for this is that the mite spends less time in the egg stage than in the larval stage (Bruce, 1987, personal communication).

Females comprised 71% of the 40,223 adults counted. The ratio of males to females was 1:2.43 (Table 4). It was not determined if this ratio was due to more females than males developing or if it was caused by the adult females living much longer than the males.

The mites showed no consistent preference between infesting either the right or left tracheae. Mites were found in both tracheae in 1,580 of the 2,702 infested

Table 3. Relationship of percent of bees infested with mites in a colony with the number of mites per infested bees in three apiaries in Tamaulipas, Mexico, 1986.

Month Sample Taken	Apiary Location	Number of Infested Bees	Mites Found	Number of Mites Per Infested Bee
August	Hidalgo	4	35	8.8
April	Hidalgo	5	93	18.6
June	Hidalgo	6	124	20.7
July	Hidalgo	6	54	9.0
December	C. Mante	13	61	4.7
September	C. Mante	17	228	13.4
May	Hidalgo	19	635	33.4
November	C. Mante	25	405	16.2
October	C. Mante	38	514	13.5
February	Hidalgo	43	1,433	33.3
July	C. Mante	46	673	14.6
June	C. Mante	48	1,286	26.8
May	C. Mante	66	1,301	19.7
July	Aldama	68	1,354	19.9
August	C. Mante	72	1,549	21.5
March	Hidalgo	73	2,848	39.0
June	Aldama	87	3,268	37.6
April	Aldama	107	2,971	27.8
May	Aldama	108	3,792	35.1
September	Aldama	125	6,550	52.4
January	C. Mante	126	2,965	23.5
February	C. Mante	126	4,025	31.9
November	Aldama	130	6,136	47.2
March	C. Mante	133	2,857	21.5
April	C. Mante	138	4,041	29.3
March	Aldama	168	4,951	29.5
October	Aldama	168	5,704	34.0
December	Aldama	174	9,498	53.4
January	Aldama	184	5,179	28.2
August	Aldama	185	7,411	40.1
February	Aldama	194	10,451	54.3
Total or Average:		2,702	92,392	34.2

bees or 58% of the time. Mites were found only in the right tracheae in 564 bees and only in the left tracheae in 558 bees.

There was a highly significant correlation ( $r = 0.98$ ,  $p < 0.01$ ) between percent of bees infested in each apiary sample and percent of infested bees with both tracheae infested (Fig. 1). The formula for this relationship was  $Y = -6.816 + 4.021X$  when  $Y$  was the percent of infested bees in the individual apiary samples. In apiary samples with over 80% of the bees infested, both tracheae were infested 76% of the time in bees that were infested. In contrast, when less than 20% of the bees were infested, both tracheae were infested in only 14% of the infested bees. A few more mites were found in the right tracheae, 47,203, than in the left tracheae, 45,189, or a ratio of 51.1% to 48.9%.

Table 4. Numbers, life stages, and adult sex ratios of tracheal mites found in honey bees in three apiaries in Tamaulipas, Mexico. 1986.

Category	Apiary Location			Total or
	Aldama	Ciudad Mante	Hidalgo	Average
Mites Found	67,265	19,905	5,222	92,392
Life Stages				
Eggs	11,800	4,327	1,759	17,886
Larvae	25,408	7,291	1,584	34,283
Adults	30,057	8,287	1,879	40,223
Male female ratio:	1:2.37	1:2.68	1:2.35	1:2.43

## LITERATURE CITED

- Anonymous. 1986. The Editor's Notebook: Honeybee tracheal mites. *Can. Beekeeping* 13(1): 2.
- Anonymous. 1987. Honey bee tracheal mites: Are they harmful? *Beelines*, #81 (March): 1-6. Saskatchewan Agriculture, Prince Albert, Canada.
- Bailey, L. 1958. The epidemiology of the infestation of the honey-bee, *Apis mellifera* L., by the mite *Acarapis woodi* (Rennie), and the mortality of the Infested Bees. *Parasitology*. 48: 493-506.
- Bailey, L. 1961. The natural incidence of *Acarapis woodi* (Rennie) and the winter mortality of honeybee colonies. *Bee World*. 42: 96-100.
- Bailey, L. 1963. Infectious diseases of the Honey-Bee. Land Books, London. 176 pp.
- Delfinado-Baker, M. 1985. An acarologist's view: The spread of the tracheal mite of honey bees in the United States. *Am. Bee J.* 125: 689-90.
- Eischen, F. A. 1987. Overwintering performance of honey bee colonies heavily infested with *Acarapis woodi* (Rennie). *Apidologie* 18: 293-304.
- Menapace, D. M., and W. T. Wilson. 1980. *Acarapis woodi* mites found in honey bees from Columbia, South America. *Am. Bee J.* 120: 761, 62, 65.
- Muniz Suarez, M. 1955. Acarine Disease in Uruguay. *Apicultor Americano* 1: 4-7.
- Nascimento, C. B. 1970. Investigation on internal and external parasites of honey bees (in Brazil). In: *1<sup>o</sup> Congresso Brasileiro de Apicultura*. 199-207. *Apic. Abstr.* 25(3): 149. (1974).
- Otis, G. W. 1986. Tracheal mite project in New York. *Can. Beekeeping*. 12: 231-32.
- Peer, D., J. Gruszka and A. Tremblay. 1987. Preliminary observations on the impact of *Acarapis woodi* on the development of package bee colonies. *Beelines*, #81 (March): 6-14. Saskatchewan Agriculture, Prince Albert, Canada.
- Skala, O. 1944. La acariosis en la Argentina. *Revista de Apicultura*. 21: 5-7.
- Wilson, W. T. and R. A. Nunamaker. 1982. The infestation of honey bees in Mexico with *Acarapis woodi*. *Am. Bee J.* 122: 503-05, 08.
- Wilson, W. T. and R. A. Nunamaker. 1985. Further Distribution of *Acarapis woodi* in Mexico. *Am. Bee J.* 125: 107-11.
- Zozaya-R. A. J., E. Tanus-S. and E. Guzman-N. 1982. Mexicans report on acarine mite survey. *The Speedy Bee*. 10: 16.