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SHORT COMMUNICATION

Natural parasitism of *Metaparasitylenchus hypothenemi* (Tylenchida: Allantonematidae) on the coffee berry borer in Chiapas, Mexico

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We assessed the parasitism of *Metaparasitylenchus hypothenemi* on its host, the coffee berry borer, in 20 coffee plantations of Mexico. A total of 23,568 adult borers were dissected, with 179 of these infected with nematodes (0.76% infection rate). Although the level of parasitism is not encouraging, the nematode is another natural enemy, which limits the population growth of this pest in Mexico.

Keywords: coffee berry borer; *Hypothenemus*; *Metaparasitylenchus*; Mexico

The parasitic nematode *Metaparasitylenchus hypothenemi* (Tylenchida: Allantonematidae) was first reported infecting the coffee berry borer (*Hypothenemus hampei* (Ferrari); Coleoptera: Curculionidae: Scolytinae) in coffee plantations of Chiapas, Mexico (Castillo, Infante, Barrera, Carta, & Vega, 2002), and was later described as a new species (Poinar, Vega, Castillo, Chavez, & Infante, 2004). This discovery was noteworthy because it increased the limited number of natural enemies attacking the coffee berry borer, the main insect pest of coffee worldwide (Vega, Infante, Castillo, & Jaramillo, 2009; Vega, Infante, & Johnson, 2015), and revealed the presence of endemic populations of a biological control agent in an area where the insect had been introduced. Even though several papers have reported on commercially available entomopathogenic nematodes (*Steinernema* or *Heterorhabditis*) infecting the coffee berry borer in the laboratory (Allard & Moore, 1989; Castillo & Marbán-Mendoza, 1996; Lara, López-Núñez, & Bustillo, 2004; Benavides, Quintero, & López, 2010; Manton, Hollingsworth, & Cabos, 2012), only one other record of a nematode attacking the insect under natural conditions exists: *Panagrolaimus* sp. (Rhabditida: Panagrolamidae) parasitizing adult coffee berry borers in India (Varaprasad, Balasubramanian, Diwakar, & Rao, 1994).

M. hypothenemi infects larvae, pupae and adult stages of the coffee berry borer, causing partial or complete sterilisation of adult females (Poinar et al., 2004). In this study, we assessed the natural parasitism and distribution of *M. hypothenemi* in coffee plantation in the state of Chiapas, Mexico, in order to elucidate its role in the biological control of the coffee berry borer.

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Twenty commercial coffee plantations in the Soconusco region of Chiapas, Mexico, were selected. The plantations were located at elevations ranging from 223 to 1458 masl. Samplings were initiated in March 2012 and carried out for three consecutive months for a total of four sampling periods in one year: (1) March–May 2012, (2) June–August 2012, (3) September–November 2012 and (4) December–February 2013. Even though we had initially planned to collect 500 infested coffee berries per site (250 berries from the plant and 250 berries from the ground), the actual number of collected berries was dependent on their availability in the field. Consequently, the number of berries collected on each sampling date varied (Table 1). Infested berries were taken to the laboratory and dissected under a stereomicroscope to remove adult insects. These were then submerged in a saline solution and dissected with entomological pins to assess for the presence of nematodes. Nematodes were extracted from the body cavity and preserved in a solution of 95 parts of 70% alcohol and five parts of 100% glycerine. The identification of nematodes was based on the morphological characteristics of the parasitic juvenile and adult stages (Poinar et al., 2004).

M. hypothenemi was naturally distributed in plantations located at elevations ranging from 223 to 1165 masl and was recovered in 12 of the 20 (60%) coffee

Table 1. Natural parasitism by *M. hypothenemi* on adult coffee berry borers.

		Total borers dissected		Number of infected insects[a]			
Coffee plantation	Elevation (masl)	Plant	Ground	1	2	3	4
Rio Negro	223	690	6	0	0	0	2
Ampliación Retiro	353	286	22	0	0	0	0
Brasil	426	874	46	1	0	0	0
San Luis Nexapa	502	1469	335	0	(1)	0	0
La Unidad	548	1692	13	0	0	0	0
Salvador Urbina	612	1314	61	1	2	2	1
Piedra Redonda	626	683	0	0	0	1	0
El Zapote	694	1731	235	23 (1)	1	2	10
Dos de Mayo	699	1124	128	19	4 (1)	11	6
Perú-Paris	746	2175	67	0	0	0	0
Belisario Domínguez	763	451	109	0	0	0	0
Mexiquito	803	2034	589	1 (5)	1	1	2
La Chiripa	829	667	21	5	0	0	2
Faja de Oro	836	1722	136	9 (6)	2	13	4
Santo Domingo	862	503	81	8	4	6	14
Santa Catalina	870	315	0	0	0	0	0
Hamburgo	1137	1457	257	0	0	0	0
San José	1165	704	67	2	1	0	3
Buenos Aires	1215	854	281	0	0	0	0
Córdoba Matasanos	1458	359	10	0	0	0	0

Note: Coffee berries infested with the insect were collected from the plant and from the ground every three months for one year (four samplings) in 20 commercial coffee plantations in Chiapas, Mexico. A total of 23,568 coffee berry borer adults were dissected from the infested berries. The adult coffee berry borers infected with nematodes at each of the four sampling times (1, March–May 2012; 2, June–August 2012; 3, September–November 2012; 4, December–February 2013) is presented in the last four columns.

[a]Infected insects inside berries attached to the plant, and in parenthesis, the infected insects from berries collected on the ground.

plantations (Figure 1; Table 1). A total of 23,568 coffee berry borer adults were recovered from 20,129 coffee berries. Juvenile stages of *M. hypothenemi* were found infecting 178 females and one male for an overall natural parasitism rate of 0.76%. Approximately 92% of the infected coffee berry borers were obtained from berries collected from coffee plants and 8% from berries that had fallen on the ground. The nematode was detected at all four sampling dates in five plantations (El Zapote, Faja de Oro, Salvador Urbina, Mexiquito and Santo Domingo).

Our results indicate that *M. hypothenemi* is widely distributed throughout the coffee-growing areas of the state of Chiapas. Although it is not known how insects become infected, Castillo et al. (2002) suggested that infection occurs in the ground, inside infested berries that have fallen on the leaf litter. Poinar et al. (2004) suggested that infected female beetles could enter a berry and deposit eggs at the same time as juvenile nematodes leave the females' bodies. When the beetle eggs hatch, the juvenile nematodes have matured to adults and mated. At this time, infective female nematodes enter the beetle larvae. The nematodes grow slowly and pass through the pupae and then into the adults. This life cycle could result in infection of the adult

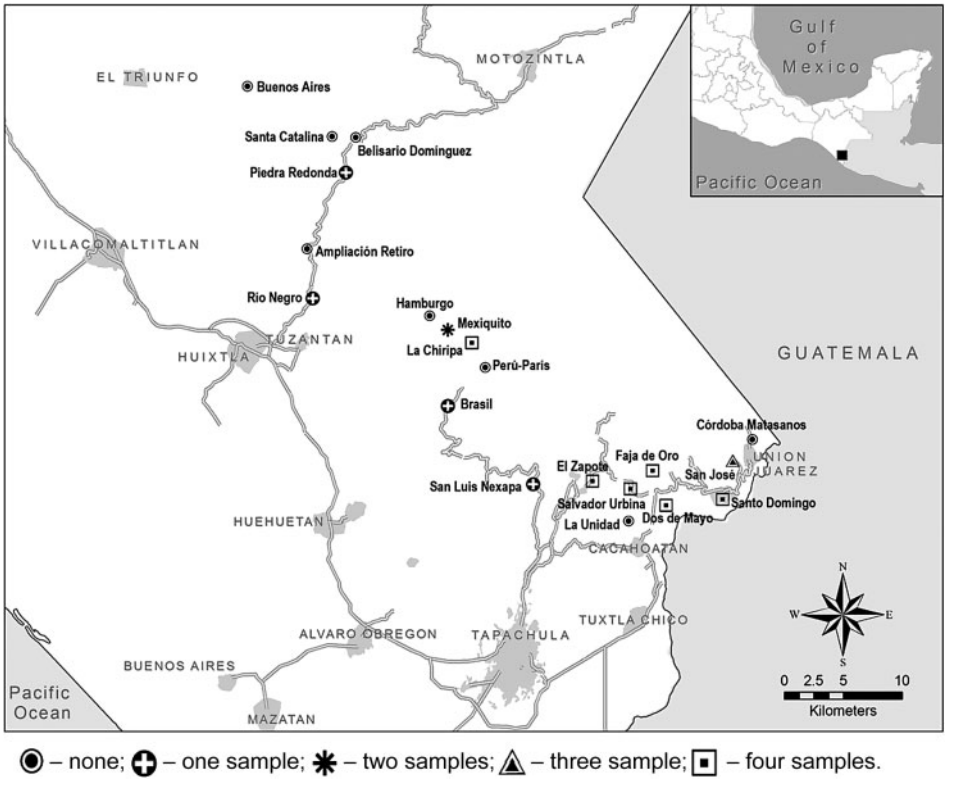

Figure 1. Geographic location of coffee plantations sampled for determining the presence of coffee berry borers infected with the nematode *M. hypothenemi*.
Note: The symbols after the name of the plantation denote the number of times the nematode was found in the plantation out of four samples collected three months apart in one year.

female progeny that emerges from the berry, without the berries having to be on the ground.

Despite the low levels of field parasitism reported in this study, the results are encouraging because they reveal the widespread presence of a natural enemy of the coffee berry borer in an area into which the insect has been introduced, thus suggesting that similar situations might occur in other coffee-producing countries. For example, *M. hypothenemi* has also been detected in Honduras (Poinar et al., 2004), and it is possible that sampling coffee berry borers from berries that have fallen on the ground in other coffee-producing countries might reveal infection with other species of parasitic nematodes. Based on the reduced fecundity caused by *M. hypothenemi* (Castillo et al., 2002; Poinar et al., 2004), it might be advisable to introduce infected coffee berry borers into other coffee-growing areas in Mexico to disseminate this biological control agent.

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Disclosure statement

No potential conflict of interest was reported by the authors.

References

Allard, G. B., & Moore, D. (1989). *Heterorhabditis* sp. nematodes as control agents for coffee berry borer, *Hypothenemus hampei* (Scolytidae). *Journal of Invertebrate Pathology*, *54*, 45–48. doi:10.1016/0022-2011(89)90138-9

Benavides, P., Quintero, J. C., & López, J. C. (2010). Evaluación en laboratorio de nematodos entomopatógenos nativos para el control de la broca del café [Laboratory evaluation of native entomopathogenic nematodes to control the coffee berry borer (in Spanish)]. *Cenicafé*, *61*, 119–131.

Castillo, A. & Marbán-Mendoza, N. (1996). Evaluación en laboratorio de nematodos entomopatógenos para el control biológico de la broca del café *Hypothenemus hampei* [Laboratory evaluation of entomopathogenic nematodes for the biological control of the coffee berry borer *Hypothenemus hampei* (in Spanish)]. *Nematropica*, *26*, 101–109.

Castillo, A., Infante, F., Barrera, J. F., Carta, L., & Vega, F. E. (2002). First field report of a nematode (Tylenchida: Sphaerularioidea) attacking the coffee berry borer, *Hypothenemus hampei* (Ferrari) (Coleoptera: Scolytidae) in the Americas. *Journal of Invertebrate Pathology*, *79*, 199–202. doi:10.1016/S0022-2011(02)00024-1

Lara, J. C., López-Núñez, J. C., & Bustillo, A. E. (2004). Efecto de entomonemátodos sobre poblaciones de la broca del café, *Hypothenemus hampei* (Coleoptera: Scolytidae), en frutos en el suelo [Effect of entomopathogenic nematodes on populations of the coffee berry borer, *Hypothenemus hampei* (Coleoptera: Scolytidae), in berries on the soil (in Spanish)]. *Revista Colombiana de Entomología*, *30*, 179–185.

Manton, J. L., Hollingsworth, R. G., & Cabos, R. Y. M. (2012). Potential of *Steinernema carpocapsae* (Rhabditida: Steinernematidae) against *Hypothenemus hampei* (Coleoptera: Curculionidae) in Hawai'i. *Florida Entomologist*, *95*, 1194–1197. doi:10.1653/024.095.0452

Poinar, G., Vega, F. E., Castillo, A., Chavez, I. E., & Infante, F. (2004). *Metaparasitylenchus hypothenemi* n. sp. (Nematoda: Allantonematidae), a parasite of the coffee berry borer, *Hypothenemus hampei* (Curculionidae: Scolytinae). *Journal of Parasitology*, *90*, 1106–1110. doi:10.1645/GE-3369

Varaprasad, K. S., Balasubramanian, S., Diwakar, B. J., & Rao, C. V. R. (1994). First report of an entomogenous nematode, *Panagrolaimus* sp. from coffee berry borer, *Hypothenemus hampei* (Ferrari) from Karnataka, India. *Plant Protection Bulletin*, *46*, 42.

Vega, F. E., Infante, F., Castillo, A., & Jaramillo, J. (2009). The coffee berry borer, *Hypothenemus hampei* (Ferrari) (Coleoptera: Curculionidae): A short review, with recent findings and future research directions. *Terrestrial Arthropod Reviews*, *2*, 129–147. doi:10.1163/187498209X12525675906031

Vega, F. E., Infante, F., & Johnson, A. J. (2015). The genus *Hypothenemus*, with emphasis on *H. hampei*, the coffee berry borer. In: F. E. Vega & R. W. Hofstetter (Eds.), *Bark beetles: Biology and ecology of native and invasive species* (pp. 427–494). San Diego, CA: Academic Press.