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Digonogastra kimballi Kirkland[1] as a Parasitoid of *Diatraea lineolata* (Walker)[2]: New Record at Tabasco, México

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Abstract. The Neotropical cornstalk borer, *Diatraea lineolata* (Walker) 1856 (Lepidoptera: Crambidae), is a pest of economic importance for cultivation of maize, *Zea mays* L., in Mexico. *Digonogastra kimballi* Kirkland 1989 (Hymenoptera: Braconidae) was identified as a gregarious ectoparasitoid of fifth-instar larvae of *D. lineolata*. Parasitism was low, 0.39 to 0.98% on cornstalk borers during three maize planting seasons. This is the first record of *D. kimballi* parasitizing *D. lineolata* larvae in maize at Macuspana, Tabasco, which broadens the distribution of the species in Mexico.

The Neotropical cornstalk borer, *D. lineolata* (Walker), is a major pest of maize, *Zea mays* L. (Dyar and Heinrich 1927, Peairs and Saunders 1980, Rodríguez-del-Bosque et al. 1988b, Osorio-Osorio et al. 2015). It also has been found in sugarcane, *Saccharum officinarum* L. (Bleszynski 1969), sorghum, *Sorghum bicolor* L. (Agnew et al. 1988), Johnsongrass, *Sorghum halepense* L., and other species of Poaceae (Rodríguez-del-Bosque et al. 1988a). Its distribution in the Neotropical region of the world ranges from Venezuela to Colombia, Ecuador, Central America, Caribbean Islands, Mexico, and southern Texas, USA (Dyar and Heindrich 1927, Bleszynski 1969). In Mexico, *D. lineolata* causes significant damage to maize crops at Jalisco (Pérez-Domínguez and Ireta-Moreno 2017), Tabasco (Osorio-Osorio et al. 2015), Tamaulipas (Rodríguez-del-Bosque et al. 1988b), and Veracruz (Aguirre 2007). In the State of Tabasco, 62.4% of stalks of a crop of 'Mejen' maize were bored, thereby warranting control (Osorio-Osorio et al. 2015). Chemical control of stalk borers of the genus *Diatraea* is problematic because of the cryptic feeding habits of the insect, use of alternate host plants throughout the year (De Freitas et al. 2007), and overlapping of generations of mature and immature insects during outbreaks of the pest.

Parasitoid wasps of the family Braconidae are the second-most abundant family of the order Hymenoptera (Quicke 2015). In Mexico, 704 species of Hymenoptera have been recorded, of which 19 species are found at Tabasco

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(Coronado-Blanco and Zaldívar-Riverón 2014). Species of *Digonogastra* Viereck, 1912 are solitary or gregarious idiobiont ectoparasitoids of concealed larvae of Coleoptera (Cerambycidae) and Lepidoptera (Crambidae, Psychidae, and Pyralidae) (Achterberg and Polaszek 1996). Most species of *Digonogastra* formerly were included in *Iphiaulax* Foerster or *Ipobracon* Dalla Torre (Wharton et al. 1997). Quicke (1988) restricted the definition of *Iphiaulax* to Old World species, resulting in transfer of New World species to *Digonogastra*, a name previously treated as a synonym of *Iphiaulax*. *D. kimballi* is a gregarious ectoparasitoid of *D. considerata* Heinrich, *D. grandiosella* Dyar, *D. lineolata*, *D. magnifactella* Dyar, and *D. saccharalis* (Fabricius) (Achterberg and Polaszek 1996)

During development of a study to evaluate damage by stalk borers in maize during the summer-autumn cropping season of 2014 (Osorio-Osorio et al. 2015), a species of ectoparasitoid attacking *D. lineolata* larvae was detected. Interest followed in identifying the parasitoid and evaluating natural parasitism of the pest in a Mejen maize crop at the Chinalito ejido municipality of Macuspana, Tabasco, Mexico (17º 45´12´´ N, 92º15´47´´ W, 11 m above sea level). Under rainfed agricultural conditions in the study area, Mejen maize was planted in a 1-ha area in autumn-winter 2016, spring-summer 2017, and summer-autumn 2018. In each planting season, parasitism by *D. kimballi* was studied by sampling on *D. lineolata* during peak abundance (Osorio-Osorio et al. 2015), which coincided with physiological maturity of the maize plants. Three sample periods were 85 to 93 days after maize was planted (21 January 2016, 26 August 2017, and 1 November 2018). On each sampling date, 500 maize plants were randomly selected and cut at the base. The stalks were opened longitudinally to extract larvae and pupae of *D. lineolata*, which were later placed individually into plastic containers. The larvae were maintained with diet proposed by Badilla-Fernández et al. (1994) to continue development until emergence of borer adults or parasitoids. The containers were kept at 28 ± 5ºC, 70 ± 5% relative humidity, and photoperiod of 12:12 light:dark hours in a breeding chamber. The identity of larvae of the Neotropical cornstalk borer was confirmed by studying the genitalia of adult males (Dyar and Heinrich 1927, Bleszynski 1969). The parasitoid was identified by keys by Wharton et al. (1997) and Wharton and Smith (1989).

D. kimballi was identified as a gregarious ectoparasitoid of fifth-instar larvae of *D. lineolata* (Fig. 1). According to Wharton and Smith (1989), adults of the species are distinguished from other species of *Digonogastra* by a combination of relatively smooth metasomal sculpture, length of the ovipositor (2.4-5.0 mm), black head, red mesonotum, dark propodeum with pale median streak, and completely red female metasoma. The sculpture of the face varies from almost smooth to punctated. The clypeal depression is bordered dorsally by a distinctive carina, and the dorsal margin of the clypeus clearly rises above the level of the face.

During any sampling period, parasitism of *D. lineolata* by *D. kimballi* was low. Of a total of 719 specimens of *D. lineolata*, only four parasitized larvae (all fifth ínstars) were found. One larva was collected on 21 January 2016 (autumn-winter 2016), another on 26 August 2017 (spring-summer 2017), and two more on 1 November 2018 (summer-autumn 2018). The percentages of parasitism by sampling date were 0.98, 0.39, and 0.54%, respectively. On average, 6.5 wasps emerged per larva, and the sex ratio (female:male) of *D. kimballi* was 1:1.2.

In Mexico, the parasitoid was recorded at Morelos (Jojutla, Miacatlán, Palo Bolero, San Miguel, Tetela, and Xochitepec), Guanajuato (Pénjamo), and Veracruz (Kirkland 1982, Wharton et al. 1989). At Veracruz, it was associated with *D.*

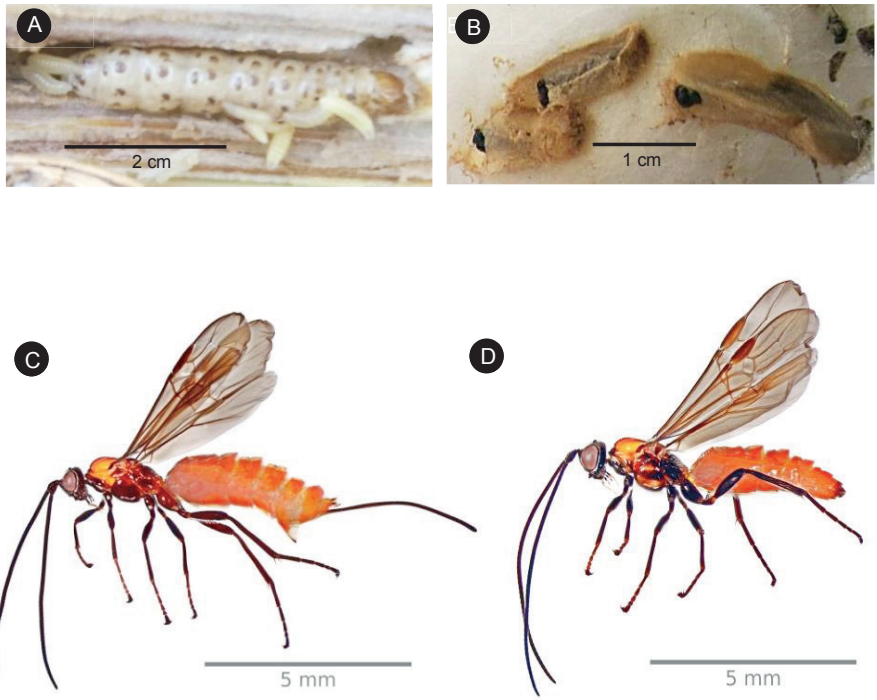

Fig. 1. *Digonogastra kimballi* larvae feeding on a *D. lineolata* larva (A), cocoons from emerged wasps (B), and female (C) and male (D) parasitoids.

(Poza Rica) associated with *D. grandiosella*, *D. lineolata*, and *D. sacharalis magnifactella*, at Jalisco (Autlán) and Nayarit (Tepic) with *Diatraea* sp., and at Sinaloa (Culiacán) with *D. considerata*).

This is the first record of *D. kimballi* parasitizing *D. lineolata* larvae in a maize crop at Macuspana, Tabasco, which broadens the distribution of the species in Mexico. Kirkland (1982) indicated that *D. kimballi* rarely exceeded 5% parasitism of stalk borer populations at sites he visited in Mexico (Jojutla, Miacatlan, Palo Bolero, San Miguel, Tetela, and Xochitepec [Morelos], Poza Rica [Veracruz], and Penjamo [Guanajuato]), which coincides with the current study. In a maize crop at Tamaulipas, *Digonogastra* sp. parasitized 0.9 and 0.6% of the *D. lineolata* and *D. saccharalis* stalk borers, respectively (Rodríguez-del Bosque et al. 1990). In contrast, Overholt and Smith (1990) mentioned that parasitism by *D. kimballi* on *D. grandiosella* was 11.3%. Under laboratory conditions, *D. kimballi* parasitized 60% of diapausing *D. lineolata* larvae (Rodríguez-del Bosque and Smith 1989).

In conclusion, few detailed studies recorded *D. kimballi* associated with stalk borers in Mexico. Natural presence of the parasitoid in seven states of Mexico, together with large percentages of parasitism recorded in the laboratory indicated the species of parasitoid is a promising agent for biological control of the Neotropical cornstalk borer.

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