NOTE

Natural Enemies of the Apple Bud Weevil (Coleoptera: Curculionidae), an Apple Pest in Coahuila, Mexico[1]

Sergio R. Sánchez-Peña,[2] Flaviano Quechulpa-Montalvo and Maricela García-Martínez

Departamento de Parasitología Agrícola, Universidad Autónoma Agraria Antonio Narro (UAAAN), Saltillo, Coahuila, 25315 Mexico

J. Entomol. Sci. 36(2): 211-213 (April 2001)

Key Words Apple bud weevil, biological control, Curculionidae, entomopathogenic fungi, parasitoid, Pteromalidae, Tachinidae

More than 8,570 ha of apple orchards are in Arteaga, Coahuila, in Northeastern Mexico. This is 14% of the total apple acreage in Mexico (Anonymous 1998, El Sector Alimentario en Mexico, INEGI, Mexico City). A curculionid has recently emerged as the primary apple insect pest in Arteaga. This weevil is similar in appearance to *Otiorhynchus* spp. and has been identified as *Crocidema* sp. (Leptopiinae, Promecopini, near *Amphidees*), possibly an undescribed species (Charles O'Brien, pers. comm.). In previous reports this weevil was misidentified as *Anametis* sp., a related genus. *Crocidema* and *Otiorhynchus* are similar in some life history traits including nocturnal feeding on leaves and buds by adults; parthenogenesis; flightless, with fused elytra; and subterranean, root-feeding larvae (E. Guerrero-Rodriguez, pers. comm.; Davidson and Lyon 1987, Insect pests of farm, garden and orchard, Wiley, NY; Hill 1987, Agricultural pests of temperate regions and their control. Cambridge Univ. Press, UK). *Crocidema* spp. have a known distribution in Arizona, California, Texas, and Utah; they have not been previously reported from Mexico (O'Brien and Wibmer 1982, Memoirs Amer. Entomol. Inst. 34).

Crocidema adults feed nocturnally on dormant buds during the frequent warm periods of winter and spring, when leaves are not available. This damage can be very severe. Girdled buds may die, reducing the numbers of flowers and fruits. Feeding on vegetative buds affects the formation of fruit-bearing branches and can also distort the growth pattern of young trees. Although larval feeding on apple tree roots is currently considered non-significant, further research must define the economic impact of larvae. Up to 70% of flower buds on a tree can be destroyed by adults during the winter dormancy period (Sánchez-Valdez 1992, Proc. XXVII Congreso Nacional de Entomologia, Mexico, p. 266). Severely infested trees suffer dramatic reductions in fruit load. Local growers intensively apply synthetic insecticides to control *Crocidema.* Knowledge of natural enemies of this insect is needed, in order to develop an IPM program for the pest. Here, we report the results of surveys of the apple-growing

[1]Received 15 April 2000; accepted for publication 17 September 2000.

[2]Current address: School of Biological Sciences, Experimental Science Bldg., University of Texas at Austin, Austin, TX 78712 USA.

area of the state of Coahuila, Mexico, to detect fungal pathogens and parasitoids associated with this pest.

Weevils were collected from apple orchards scattered across an area comprised of five valleys or canyons on the Sierra Madre Oriental of Mexico, next to the town of San Antonio de las Alazanas (municipality of Arteaga, Coahuila, 26° 15′ Lat. N., 100° 35′ Long W., 2200 m above sea level at San Antonio). In the Koppen classification, the predominant weather type is BS_1kx': semidry temperate, extremely variable; annual average precipitation at San Antonio is 498 mm; annual average temperature is 13.3°C (Anonymous 1981, weather charts, INEGI, Mexico City).

The five valleys were La Carbonera, Jamé, Los Lirios, San Antonio de las Alazanas, and El Tunal. These valleys have the same general weather patterns, but their topography is complex, leading to great variation in climatic determinants (altitude, exposure, rain, fog, occasional snow, hail, wind, etc.) and soil over short distances. Collections were from the San Antonio de las Alazanas and La Carbonera valleys from September 1995 through March 1997, every 4 to 5 wks (except during the last 2 wks of December and all of January). Five orchards were sampled in each valley with 20 to 50 trees randomly selected as permanent sampling units in each orchard. All five canyons were sampled from April 1997 through October 1998. For this period 30 trees were randomly selected as permanent sampling units in five orchards/canyon (total of 750 trees). Collections were made in each orchard every 20 d, except for January 1998.

The sampling method consisted of placing corrugated cardboard bands (20 cm wide) around the trunk of trees, tied with nylon cord 20 to 30 cm above the ground. Weevils sought refuge under these bands, where they remained during the day, and at night they climbed up the tree to feed. Directed diurnal searches were made under these cardboard traps. Only trees with a trunk diam >5 cm at 30 cm above ground were selected for sampling. For each sample, live and dead weevils were collected. Dead weevils showing external fungal growth were separated, while dead weevils not showing external fungal growth were placed in moist chambers at room temperature in order to induce fungal sporulation. Live weevils were maintained in the laboratory in groups of 10 to 13 in Petri dishes (100 × 15 mm), at 24 to 27°C, with a continuous supply of fresh apple foliage, to detect emergence of natural enemies. Those weevils dying after collection were placed in moist chambers to induce fungal sporulation. In the case of fungi, only those weevils dying within 7 d after field collection were examined further in an attempt to eliminate those infected through horizontal transmission during manipulations in the field and laboratory.

A total of 998 weevils were collected from the two valleys in 1995-1997. Of these, 8.2% weevils were killed by the entomopathogenic fungi: *Beauveria bassiana* (Balsamo) Vuillemin (56, 5.6%), a sporodochial *Fusarium* (very similar to *F. coccophilum* (Desm.) Wollenweber and Reinking) (16, 1.6%), *Metarhizium anisopliae* var. *anisopliae* (Metschnikoff) Sorokin, (7, 0.7%); *M. anisopliae* was mostly present as mixed infections with *B. bassiana* on the same insect; and *Paecilomyces farinosus* (Holm ex Gray) Brown and Smith (3, 0.3%). With the exception of the *Fusarium*, these fungi have been reported as pathogens of curculionids (Steinhaus and Marsh 1962, Hilgardia 33: 349-490; Humber 1992, USDA-ARS Publ. 110, 177 pp.).

An additional 244 (24.4%) weevils were parasitized by hymenopteran and dipteran parasitoids. An undescribed species of the gregarious endoparasitoid *Tomicobia* Ashmead (Hymenoptera: Pteromalidae: Pteromalinae) emerged from 135 (13.8%) of the weevils. These wasps pupated inside the dead weevil. Dead *Crocidema* parasitized

by *Tomicobia* sp. always showed outstretched fore and rear legs. Adult parasites emerged from inside the killed weevil, chewing an emergence hole through the posterodorsal surface of one elytron. Seven to 13 wasps emerged per weevil.

Ninety-four weevils (9.6%) were parasitized by an undescribed species of the solitary endoparasitoid *Oestrophasia* (near *O. signifera* Wulp) (Diptera: Tachinidae: Dexiinae). Mature larvae of this fly emerged from the weevil, possibly through the anus (no visible emergence hole) and pupated outside the host. Adult flies were lightly colored (orange) indicating possible nocturnal habits (Wood 1987, Manual of Nearctic Diptera, J. F. McAlpine [ed.], Pp. 1193-1269, Agric. Canada, Ottawa).

Gregarious braconids had emerged from 15 (1.5%) weevils contained in Petri dishes. These parasitoids emerged as mature larvae and pupated in cocoons outside the insects, loosely connected to them by silk threads. There is no information on the life stage attacked by these parasitoids.

During the survey of the five valleys in 1997 and 1998, 25,342 weevils were collected (an average of 33.8 weevils/tree). Some trees harbored up to 380 weevils. *Beauveria bassiana* (1.06%) and *M. anisopliae* (0.15%) were the only entomopathogenic fungi observed. *Oestrophasia* sp. and *Tomicobia* sp. also emerged from collected weevils; no braconids were detected.

Perales-Gutiérrez (1992, M. S. thesis, Univ. Aut. Agraria Antonio Narro, México) reported the same pteromalid from *Crocidema* adults in the same area. He found the lowest parasitism levels (below 10%) in March through June, increasing to 15% in July, with a peak in October (39.9%). He did not report other parasitoids emerging from *Crocidema* adults. The two known species of *Tomicobia* in North America parasitize adult bark beetles (Coleoptera: Scolytidae) (Burks 1979, catalog of Hymenoptera in America north of Mexico, K. Krombein et al. [eds.], Pp. 768-835, Smithsonian, Washington, DC).

Oestrophasia spp. are widely distributed in the Nearctic zone (Sabrosky and Arnaud, 1965, Catalog of the Diptera of America north of Mexico, A. Stone et al. [eds.], Pp. 961-1108. USDA Publ. 976). In Europe, the tachinid *Rondania* Robineau-Desvoidy (Dexiinae: Dufoursiini) is a parasite of *Otiorhynchus* spp., emerging also from adult weevils. (Pschorn-Walcher et al., 1999, http://www.forst.uni-muenchen.de/LST/ZOO/HEITLAND/PONLINE/_SYSTEMATIK/). Regarding the prevalence of *Oestrophasia* in this work, the foliage fed to weevils in the laboratory was cut from orchards infested with parasitized weevils. This foliage could have harbored eggs or larvae of this previously unknown fly (Askew 1973, Elsevier, NY, 316 pp.), thus resulting in involuntarily increased parasitism.

Thanks to C. O'Brien (Department of Entomology, Florida A&M University) for identifying *Crocidema,* to S. Heydon (Bohard Museum of Entomology, University of California) for identifying *Tomicobia,* to N. Woodley (Systematic Entomology Laboratory, USDA-ARS) for identifying *Oestrophasia,* to J. Pena (TREC, University of Florida) for getting the insects to the right people, to E. Guerrero-Rodriguez (UAAAN, Saltillo, Mexico) for specific information on the weevil, and to W. A. Gardner (Department of Entomology, University of Georgia) for editorial support. This report was supported by projects 02.04.0902.2234 and 2567, "Parasitoids and entomopathogens of five primary agricultural pests of Coahuila", Dirección de Investigación, Universidad Autónoma Agraria Antonio Narro.