N O T E

Overwintering of *Anthonomus eugenii* (Coleoptera: Curculionidae) in Southern Georgia[1]

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The pepper weevil, *Anthonomus eugenii* Cano, is the key pest of peppers wherever the crop and pest coexist. Based on location of the original description (Cano 1894, Naturaleza 2: 377–379) and genetic analyses (Van De Vossenberg et al. 2019, PLos ONE 14(8): e0221182), the origin of the pepper weevil is considered to be Mexico. It is generally more prevalent in warmer climates and a consistent pest of peppers throughout Mexico, Central America, the Caribbean, and the southernmost states in the United States (Riley and King 1994, Trends in Agri. Sci. 2: 109–121). In the United States, the pepper weevil was first reported in Texas in 1904 (Walker 1905, USDA Bur. Entomol. Bull. 54: 43–48). This infestation was suspected to have resulted from importation and repackaging of infested peppers from Mexico (Elmore 1934, USDA Tech. Bull. 447). Elmore (1934) further indicated that movement of infested peppers, picking sacks, and young pepper plants likely moved weevils into new locations. Economically damaging infestations in both field and greenhouse grown peppers have been reported in more northern climates including New Jersey, Canada, the Netherlands, and Italy. These infestations have generally been attributed to importation of infested fruit as they occurred near repacking and processing facilities (Fernandez et al. 2020, J Integ. Pest Manag. 11(1): 1–11; Ingerson-Mahar et al. 2015, J. Integ. Pest Manag. 6(1): 77; Van de Vossenberg et al. 2019).

The pepper weevil has a limited host range with plants in the *Capsicum* and *Solanum* genera as the only reported reproductive hosts (Elmore 1934; Fernandez

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et al. 2017, IOBC/WPRS Bull. 124: 249–229). Peppers, *Capsicum annuum* L., are reported as the primary reproductive host and various nightshade species, *Solanum* sp., as reproductive weed hosts. Elmore (1934) indicated that eggplant, *Solanum melongena* L., may be damaged if near infested pepper fields; however, D. Riley (Univ. of Georgia, Tifton Campus, unpubl. data) has documented limited reproduction on eggplant. Elmore (1934) indicated that pepper weevil did not exhibit a true hibernation in southern California and that it could not survive the winter without host material, with maximum survival times of adults of 39 d on nonhost plant material and 5 mo with host material. Fernandez et al. (2020) reported weevil adults could survive at −10°C but not −15°C. This suggests that pepper weevil's northern range is limited primarily by temperatures that limit ready availability of host material throughout most of the year.

In Georgia, pepper weevil has historically been considered an occasional pest, with infestations generally attributed to human-aided movement. The first report of a pepper weevil infestation in Georgia occurred in 1946 in pimientos in Jones Co. (Dupree and Dempsey 1977, Georgia Exp. Sta. Res. Rep. 263). This infestation was attributed to bell peppers shipped from Florida for processing, with the processing residues dumped around the heavily infested field. They indicated a similar infestation in 1976 in Spalding Co. originated with transplants from Florida. Stacey (1984, Univ. Georgia Pepper Pest Management Handbook) indicated that pepper weevils do not overwinter in Georgia and were generally brought in on transplants from infested areas. This belief persisted with the most recent Georgia pepper production guide indicating growers should insure they are using weevil-free transplants (Sparks 2009, UGA Cooperative Ext. Bull. 1309: 29–38) and extensive educational emphasis on prevention of artificial introduction following severe infestations in southern Georgia in 2017.

Historically, pepper weevil has been an occasional pest in southern Georgia, occurring in isolated fields with little or no year-to-year carryover of populations. As with more northern climates, these infestations were typically attributed to movement of adults with transplants or pods. However, over the past 10 yr, occurrence of field infestations has increased in frequency and severity. In the fall of 2017, infestations in southern Georgia were widespread, with weevil infestations occurring in the vast majority of pepper fields throughout the production region. These infestations consisted of extreme population densities, with collection of infested pods consisting of simply walking down the rows and picking pods at random. Adults could be easily picked from foliage with multiple adults visible within a few feet of a row. For reference, suggested thresholds for pepper weevil are one adult for 400 terminal buds (Riley et al. 1992, J. Econ. Entomol. 85(5): 1919–1925), one or two adults per 100 terminals (Andrew et al. 2008, Tropical Pest Management), or 5% of bud clusters damaged (Cartwright et al. 1990, J. Econ. Entomol. 83(5): 2003–2007). While part of the severity of these infestations can be attributed to insecticide resistance (D. Riley, Univ. of Georgia, unpubl. data), the wide distribution suggested that random human-aided movement was not the most likely source of these populations.

The following spring (2018), jalapeno pepper pods were collected from commercial fields which had been mowed in early winter in Echols and Brooks counties. These pods were found to harbor low infestations of adult pepper weevils. Additionally, pepper weevil pheromone traps established in a single field in Colquitt Co. caught low levels of adult weevils throughout April, indicating the potential

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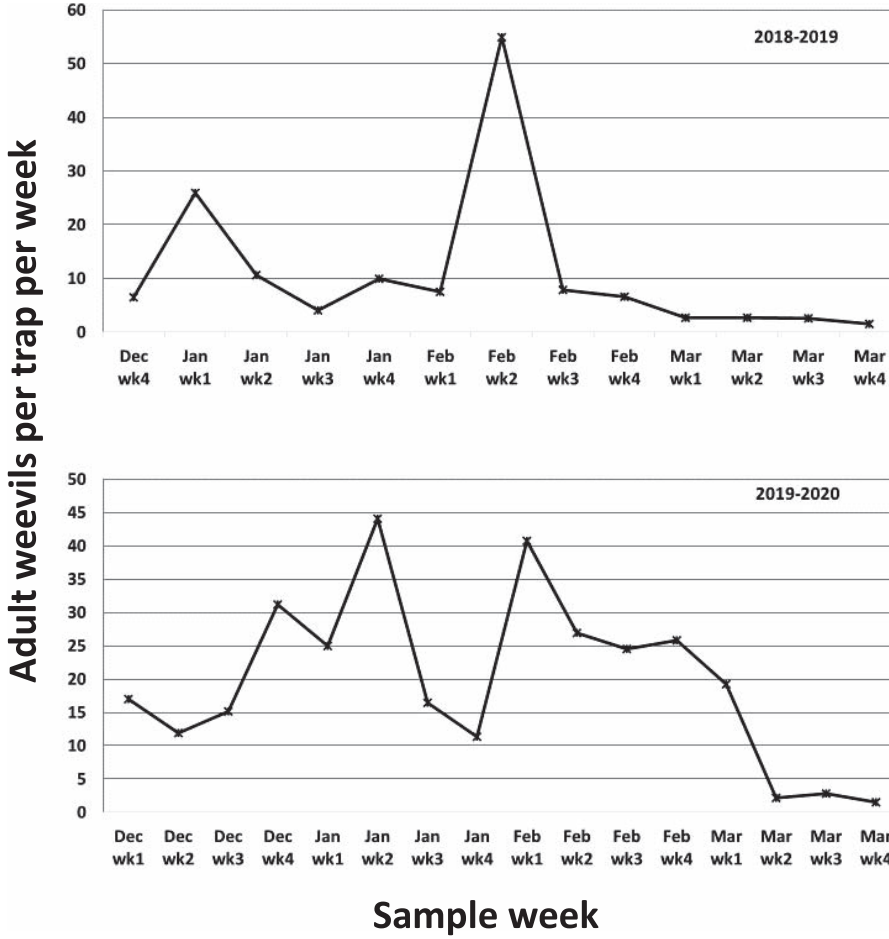

Fig. 1. Pepper weevil adult captures on pheromone-baited sticky traps in southern Georgia during the winters of 2018–2020. Counts are averaged across all fields (16 in 2018–2019; 15 in 2019–2020) monitored in each year.

presence of overwintering weevils at the beginning of the spring planting of peppers, which typically begins in mid-March to early April throughout southern Georgia. Pheromone traps established in commercial fields in Brooks (four fields), Colquitt (three fields), and Grady (three fields) counties from mid-April to May in 2018 resulted in a single adult being caught. This might suggest that weevils did not successfully overwinter; however, these traps were placed in commercial fields with pepper plants present, which generally reduces the efficacy of the traps.

The experiences with pepper weevil from the fall crop of 2017 to the spring crop of 2018 suggested that pepper weevil may be overwintering in southern Georgia. To investigate the likelihood and distribution of pepper weevil overwintering in

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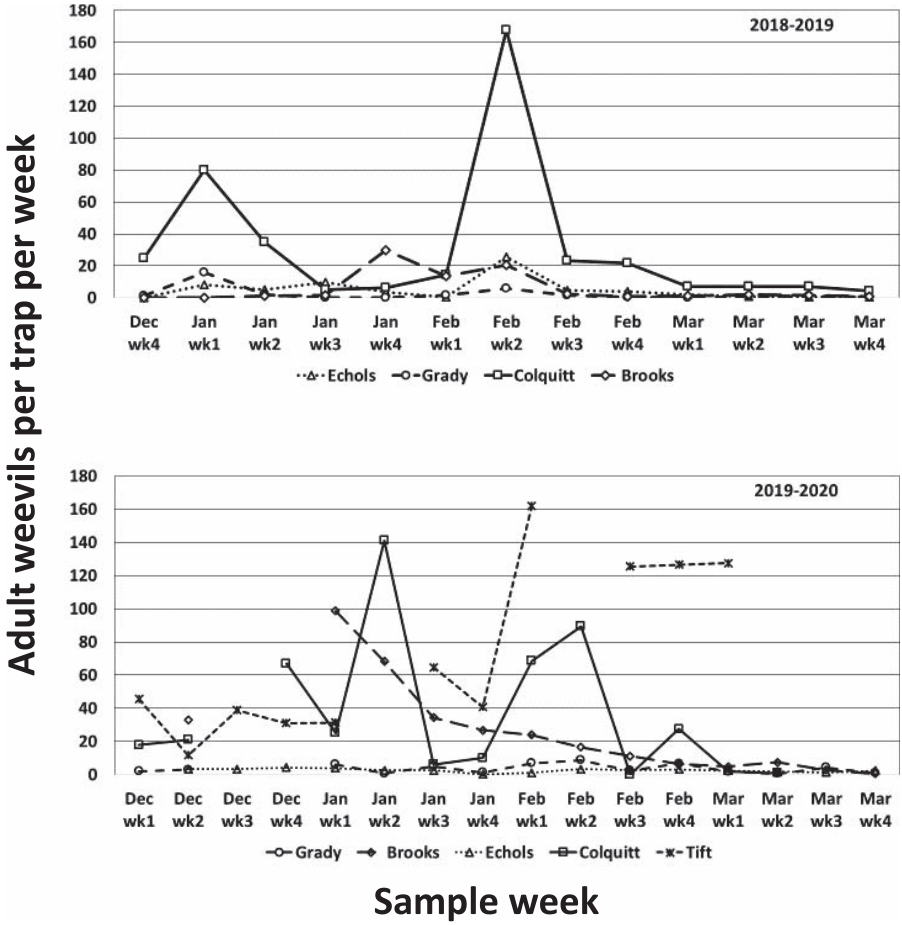

Fig. 2. Pepper weevil adult captures on pheromone-baited sticky traps in southern Georgia during the winters of 2018–2020. Counts are averaged across all fields monitored in each county in each year.

southern Georgia, pheromone traps were established in commercial pepper fields and monitored from December through March during the winters of 2018–2019 and 2019–2020. In 2018–2019, 16 fields were monitored, with four fields each in Echols, Grady, Colquitt and Brooks counties. In 2019–2020, 15 fields were monitored with four each in Grady and Echols counties, three in Colquitt Co., and two each in Brooks and Tift counties. Four pepper weevil traps were established in each field. Traps consisted of a 15.2 × 30.5-cm yellow sticky card and were baited with the standard two-part pepper weevil pheromone from Trece Corporation (Pepper Weevil 4-Station Kit, Trece Corp., Adair, OK). Yellow traps are highly attractive to pepper weevil adults (Riley and Schuster 1994, Southwestern Entomol. 19(2): 93–107). Pepper weevil males produce an aggregation pheromone (Patrock et al. 1992, Florida Entomol. 75(1): 138–144). Eller et al. (1994, J. Chem. Ecol. 20: 1537–

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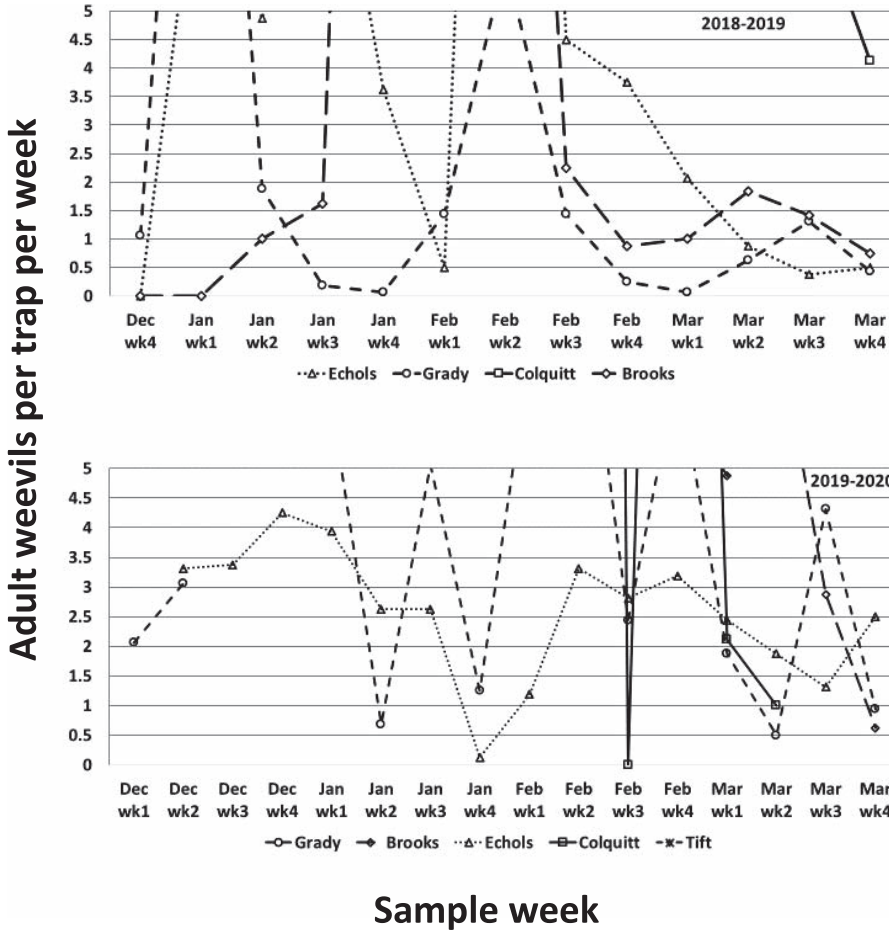

Fig. 3. Pepper weevil adult captures on pheromone-baited sticky traps in southern Georgia during the winters of 2018–2020. Counts are averaged across all fields monitored in each county in each year and scaled to emphasize locations with zero capture for any week.

1555) identified the components of the aggregation pheromone and field trialed a synthetic blend which proved efficacious. Traps and pheromone were monitored weekly and replaced every 2 wk.

Fig. 1 presents the number of weevils per trap per week averaged across all locations for each year. While the general trend indicates sustained populations through the winter with decreasing numbers through February and March, of greatest importance is the fact that weevils were continuously present at some level through March. As spring pepper fields are commonly transplanted beginning in March in southern Georgia, this clearly indicates that pepper weevils successfully overwintered and could potentially infest the subsequent spring-planted crop. In fact, at least some of the reduction in catch in March both years is likely a result of

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crop competition with the traps and overwintering populations were likely higher than indicated by the reduced numbers on trap after initiation of transplanting.

Fig. 2 presents the trap data with counts averaged by county. Colquitt Co. showed the most consistent catches of weevils in both years, although Tift Co. had high capture levels late in the single year it was included. Overall, all counties trapped showed similar trends with weevil captures declining in the spring but with some population remaining as the spring pepper production season began. This is obvious in Fig. 3, with only Grady Co. averaging zero on a single week in March of 2019 followed by some capture the following 3 wk and no county with zero capture for any week in March in 2020.

Further evidence of successful overwintering over most of southern Georgia is seen in the individual field data. In 2018–2019, 15 fields were monitored though March. Of these, none had zero captures for all 4 wk, two had zero captures for 3 of the 4 wk, and one had zero captures for 2 of the 4 wks. In eight of the 15 fields, weevils were captured all 4 wk of March. In 2019–2020, 13 fields were monitored throughout March, with one field showing zero captures for all 4 wk and one field with a single week of zero captures. In 11 of the 13 fields, weevils were captured every week in March.

The pepper weevil trapping data collected during the winters of 2018–2020 clearly show that weevil adults overwintered throughout southern Georgia and presented a potential threat to the subsequent year's spring crop. While intensive management practices reduced the impact of pepper weevil in 2019 and 2020, widespread field infestations further suggested that weevils had successfully overwintered throughout the area. These data and field experiences have impacted pepper pest management in this area, with growers generally applying one or more insecticide applications at or near transplanting to prevent weevil establishment followed by additional preventive sprays in combination with intensive targeted scouting. A renewed interest in timely crop destruction after final harvest has been noted with most growers and will hopefully have a significant positive impact on weevil management and reduce overwintering potential.

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