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**Walking Velocity and Estimated Distance of the Armored Scale Crawler *Rhizaspidiotus donacis*[1], a Biological Control Agent for *Arundo donax***

Joshua A. Villarreal[2,3], Alexis E. Racelis[2], and John A. Goolsby[4]

Arundo scale, *Rhizaspidiotus donacis* (Leonardi) (Hemiptera: Diaspididae), is an armored scale biological control agent established on the invasive weed, *Arundo donax* L. (Poaceae; Arundinoideae) at several locations along the Rio Grande in Texas (Goolsby et. al. 2009, Moran and Goolsby 2010, Goolsby et al. 2011, Villarreal et al. 2016). The arundo scale is having significant impact on the target weed in areas where it established (Goolsby and Moran 2019), and no non-target plant use was observed (Goolsby et al. 2020). Armored scale crawlers usually live for less than a day and settle within 1 m of their sessile mother (Beardsley and Gonzalez 1975). Their low level of dispersion led to biological studies of the arundo scale in quarantine before release to quantify aspects of its biology that influenced dispersal. We measured walking velocity, estimated the potential distance a crawler could travel during a 12-hour period, and variations of the attributes for crawlers that emerged over time from different geographical accessions. The information was used to prioritize populations for release at field sites or nearby rearing facility. Three accessions of *R. donacis* crawlers from France, Italy, and Greece were evaluated (Table 1). Crawlers of each accession were isolated as individuals in gelatin capsules on Monday, Wednesday, and Friday mornings and kept for observation in the laboratory at 23ºC and 50% relative humidity. Crawlers in gelatin capsules were observed with the aid of a dissecting microscope (Leica MZ-16). Distances walked were measured using a stage micrometer during 10-second periods.

Arundo scale crawlers walked at an average velocity of 0.47 mm per second, which is similar to measurements of crawlers of black scale, *Saisettia olea* Bern.,

Table 1. Velocity and Estimated Walking Distances of Crawlers of Arundo Scale in Three Accessions of *Rhizaspidiotus donacis* from Europe

| Origin/ | Mean velocity (mm/second) by day | | | Repli- | Theoretical max (m) | |
|---|---|---|---|---|---|---|
| Accession # | Monday | Wednesday | Friday | cations | 3 hours | 12 hours |
| Rivesaltes, France M12040 | 0.32 ± 0.01a | 0.56 ± 0.01a | 0.56 ± 0.02a | 95 | 5.18 | 20.74 |
| Donna Lucata, Italy M12041 | 0.45 ± 0.02b | 0.57 ± 0.02a | 0.73 ± 0.01b | 95 | 6.30 | 25.20 |
| Nea Artaki, Greece M12016 | 0.22 ± 0.01a | 0.38 ± 0.01b | 0.40 ± 0.02a | 95 | 3.60 | 14.40 |

Means followed by different letters in a column are significantly different ($P$ = 0.05).

[1]*Rhizaspidiotus donacis* Leonardi (Hemiptera: Diaspididae)
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walking on wax paper at 0.38 mm per second (Quayle 1911). The estimated distance walked by black scale crawlers in 12 hours was 9.1 m, which is similar to arundo scale that ranged from 14.4 to 20.7 m (Table 1). Arundo scale crawlers from different European accessions showed significant differences in mean velocity walked and potential estimated maximum distance during 3 and 12 hours and for days during the week they emerged. Differences might reflect the nutrition of the plant host. All accessions were harvested from *A. donax* stands with high population levels of *R. donacis*, so rhizomes and ramets might have been significantly depleted of nutrient reserves which influenced the vigor of crawlers. As expected, crawlers collected on Mondays had the least vigor because some might have been as old as 3 days. Arundo scale crawlers seemed to be capable of traveling as far as 20 m which is the maximum height of an *A. donax* stem. Although we did not estimate distance for more than 12 hours, the period of time represents the typical life span of an arundo scale crawler (Beardsley and Gonzalez 1975). Dispersal of arundo scale is limited to movement of the crawlers over short distances and displacement of infested rhizomes during flood events. Considering the limited dispersal ability of *R. donacis*, additional rearing and release might be needed to achieve maximum benefit from this key agent where the weed is invasive and especially over the 350 river miles of the Rio Grande along the Texas-Mexico border.

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