Effect of the Height and Distribution Pattern of Pheromone-Baited Traps on the Capture of Scyphophorus acupunctatus (Coleoptera: Dryophthoridae) on Blue Agave (Asparagales: Asparagaceae)

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Effect of the height and distribution pattern of pheromone-baited traps on the capture of *Scyphophorus acupunctatus* (Coleoptera: Dryophthoridae) on blue agave (Asparagales: Asparagaceae)

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Scyphophorus acupunctatus Gyllenhal (Coleoptera: Dryophthoridae) is considered the main insect pest of wild and cultivated agaves in Mexico (González Hernández et al. 2007). The chemical ecology of *S. acupunctatus* has previously been investigated in order to develop a pheromone-based trapping system for monitoring this pest on blue agave (*Agave tequilana* F. A. C. Weber; Asparagales: Asparagaceae) (Ruiz-Montiel et al. 2003, 2008; Rodríguez-Rebollar et al. 2012). A previous study has shown that pheromone-baited traps may be used for monitoring *S. acupunctatus* populations in blue agave commercial plantations in Mexico (Figueroa-Castro et al. 2013). However, other factors need to be optimized before this system can be used commercially. In the present study, we investigated the effect of the height and distribution pattern of traps on the capture of *S. acupunctatus* on blue agave.

The trap used in the experiments consisted of a 4 L white plastic bucket with 4 circular holes (4.0 cm diameter) made 1 cm above the trap base. On each of these holes, a transparent plastic cone (3.5 cm long, 4.0 cm entry and 3.0 cm exit diameters) was attached to the inner wall of the bucket. Traps were baited with a dispenser of synthetic aggregation pheromone of *S. acupunctatus* (FeroComps, Mexico City, Mexico) and with 200 g of recently cut agave tissue. The plant material was placed inside a plastic bag with holes and sprinkled with malathion insecticide (Malathion 1000®, Anajalsa, S. A. de C. V., Jalisco, Mexico) (10 mL/L of water). The pheromone dispenser was changed monthly and the agave tissue every 15 d.

The 1st experiment was performed in a 6-yr-old blue agave plantation (20.7666667°N, 103.9500000°W; 1,444 m asl), and the 2nd experiment was conducted in a 2-yr-old blue agave plantation (20.7166667°N, 103.9166667°W; 1,314 m asl). Both plantations were located at Ahualulco de Mercado, Jalisco, Mexico.

In the 1st experiment, we evaluated the effect of trap height on the capture of weevils by using 2 treatments: 1) trap placed at ground level, near to an agave plant; and 2) trap placed over the crown of an agave plant (about 50 cm), with the leaves of the crown previously cut for placing of the trap on the agave plant. The experiment was established in a completely randomized design, each treatment with 4 replications. The distance between traps was 100 m. Traps were checked 5 times (weekly from 23 Oct to 28 Nov 2011). On each date, we emptied the traps and collected the captured weevils.

In the 2nd experiment, we evaluated the influence of the distribution pattern of traps on the catches by using 4 treatments: 1) traps placed in a triangle pattern with an inter-trap distance of 100 m; 2) traps placed in a square with an inter-trap distance of 100 m; 3) traps placed in a triangle with an inter-trap distance of 200 m; and 4) traps placed in a square with an inter-trap distance of 200 m (Fig. 1). The experiment was established in a completely randomized design with a factorial arrangement. Due to the available space, treatments 1 and 2 had 12 traps each whereas treatments 3 and 4 had 6 traps each. Traps were checked every 3 wk from 13 Jun to 25 Jul 2013 (i.e., on 2 observation dates). The response variable was the average number of captured agave weevils per trap. Weevils captured in both experiments were taken to the laboratory to be counted and sexed (Ramírez-Choza 1993).

All statistical analyses were performed using SAS statistical software (SAS Institute 2004). The data were analyzed by 2-way analysis of variance (ANOVA) using Proc GLM, where the effect of treatments and the interaction effect (distance × distribution pattern) were tested. Before the ANOVA, data were checked for normality (Shapiro–Wilk test) and homogeneity of variances (Bartlett test), and data transformations were not necessary. Treatment means were separated with a Tukey test (a = 0.05). A chi-squared test was used to determine if there were differences in the sex ratios of weevils caught.

We found that trap height did not influence the number of weevils caught (F = 0.00; df = 1, 6; P = 0.952). Traps placed at ground level captured on average (± SE) 180.65 ± 22.45 weevils per trap per

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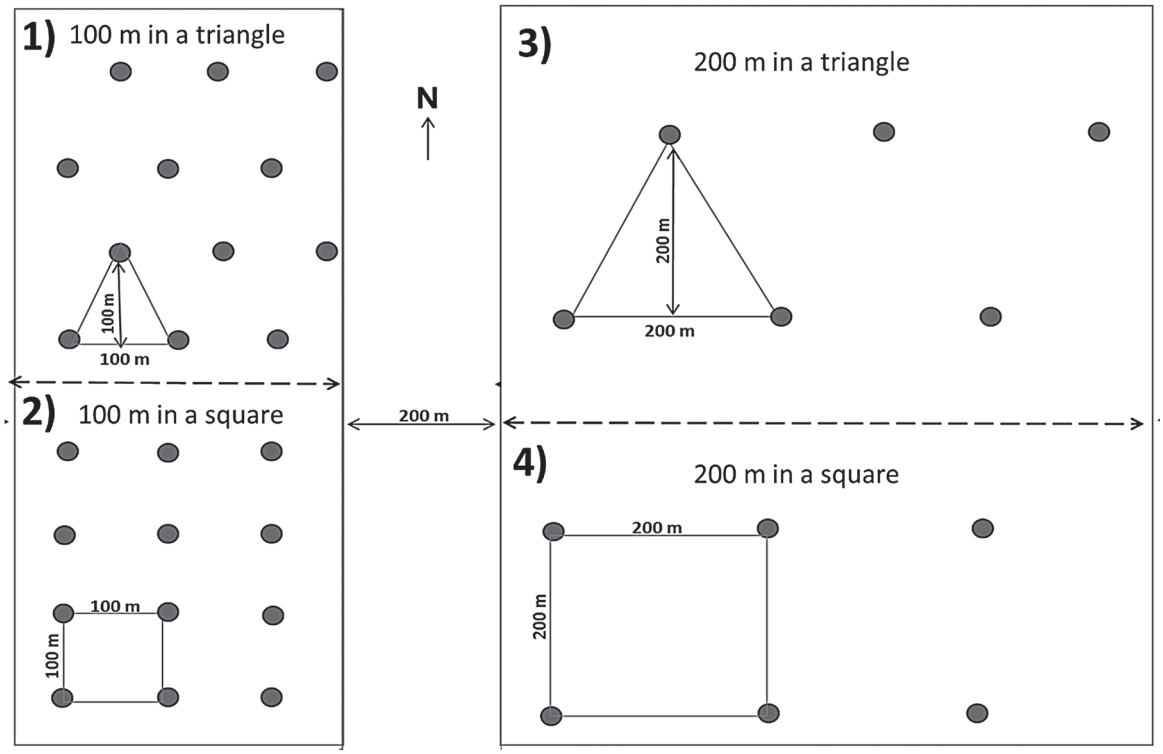

Fig. 1. Distribution and arrangement of traps in the experiment of distribution pattern of traps, using 4 treatments: 1) traps placed in a triangle pattern with an inter-trap distance of 100 m; 2) traps placed a square with an inter-trap distance of 100 m; 3) traps placed in a triangle with an inter-trap distance of 200 m; and 4) traps placed in a square with an inter-trap distance of 200 m.

week, and 88% of the captured weevils were females. Traps placed over agave crowns captured on average 185.70 ± 33.70 weevils per trap per week, and 90% of the captured weevils were females. Similar results were found for *Metamasius hemipterus sericeus* (Olivier) (Coleoptera: Dryophthoridae) (Giblin-Davis et al. 1996). In contrast, for other weevil species, it has been reported that trap height had an effect on the number of captured weevils. For example, Oehlschlager et al. (1993) found that traps placed at ground level captured more American palm weevils, *Rhynchophorus palmarum* Herbst (Coleoptera: Dryophthoridae), than traps placed at heights of 1.7 and 3.1 m. Sansano Javaloyes et al. (2008) reported that buried traps captured a greater number of red palm weevils, *Rhynchophorus ferrugineus* Herbst (Coleoptera: Dryophthoridae), in comparison with traps placed at 1.5 m height.

In the 2nd experiment, we found that weevil captures were influenced by treatments (F = 5.67; df = 3, 32; P = 0.0031) (Fig. 2). The analysis of separate effects showed that the distance between traps affected the number of captured weevils (F = 14.61; df = 1, 32; P = 0.0006) whereas the spatial distribution pattern of traps did not (F = 2.39; df = 1, 32; P = 0.132). There was no interaction effect between distance and distribution pattern (F = 0.23; df = 1, 32; P = 0.632). McMahon et al. (2010) found that distribution patterns (line, triangle, and square) of traps baited with 20 mg of ispdienol did not influence the catches of *Ips pini* (Say) (Coleoptera: Curculionidae). Our finding that traps placed 200 m apart captured more weevils than traps placed 100 m apart may be due to traps placed at shorter distances competing in trapping weevils (interference effect).

More females than males were captured in both the 1st (χ^2 = 4,476.39, P < 0.0001) and the 2nd experiments (χ^2 = 1,142.29, P < 0.0001). This finding is in agreement with previous results obtained with *S. acupunctatus* (Ruiz-Montiel et al. 2008; Rodriguez-Rebollar et al. 2012; Figueroa-Castro et al. 2013, 2016).

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Summary

The effect of height and distribution pattern of traps on the capture of *Scyphophorus acupunctatus* Gyllenhal (Coleoptera: Dryophthoridae) on blue agave (Asparagales: Asparagaceae) in commercial plantations was studied. Results showed that the trap height and the distribution pattern did not have an effect on the number of captured weevils per trap. In contrast, the inter-trap distance had an effect on the number of captured weevils per trap. For monitoring this weevil in blue agave commercial plantations, we recommend to use the pheromone and agave tissue–baited traps placed at ground level, at 200 m distance between traps, and distributed in a square distribution pattern.

Key Words: trapping; agave weevil; placement of traps; monitoring

Sumario

Se estudió el efecto de la altura de colocación y el patrón de distribución de trampas para la captura de *Scyphophorus acupunctatus* Gyllenhal en plantaciones comerciales de agave tequilero. Se encontró que la altura

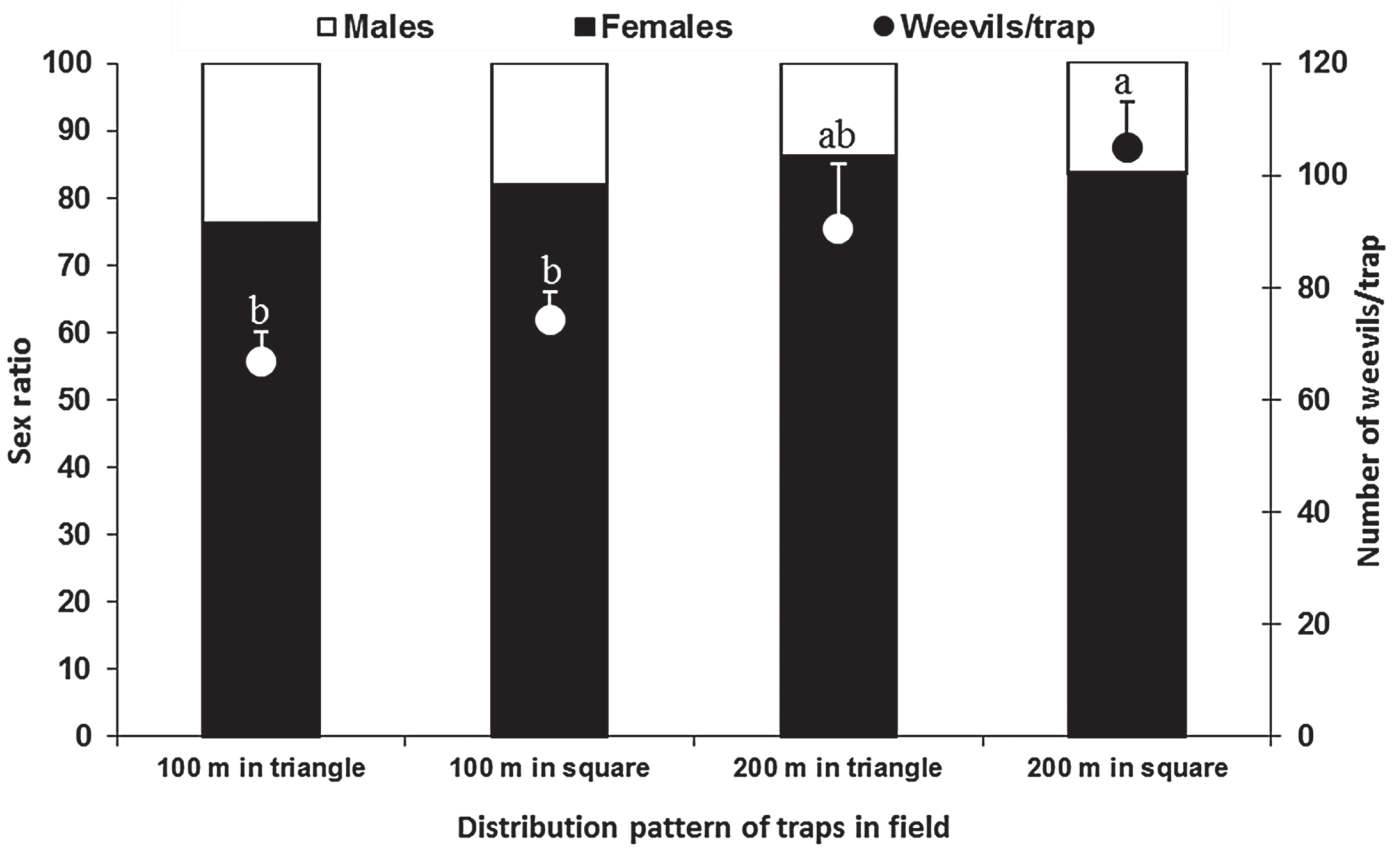

Fig. 2. Mean (+ SE) numbers and sex ratios of *Scyphophorus acupunctatus* weevils captured per trap with various distribution pattern of traps in the field. Treatments with similar letters are not significantly different (Tukey's test, a = 0.05).

y el patrón de distribución de trampas no tuvieron efecto en el número de picudos capturados por trampa. En contraste, la distancia entre trampas tuvo efecto en el número de picudos capturados por trampa. Para el monitoreo de este picudo en plantaciones comerciales de agave tequilero, se recomienda usar estas trampas cebadas con feromona de agregación sintética y tejido de agave, colocadas a ras de suelo, a una distancia de 200 m entre trampas y con un patrón de distribución espacial en cuadrado.

Palabras Clave: trampeo; picudo del agave; ubicación de trampas; monitoreo

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