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COTTON FRUIT SIZE OR AGE ON BOLL WEEVIL FECUNDITY AND OVIPOSITION

Allan T. Showler
USDA-ARS
Weslaco, TX

Abstract

Boll weevil, *Anthonomus grandis grandis* Boheman (Coloeoptera: Curculionidae), populations in the Lower Rio Grande Valley of Texas increase strongly during cotton squaring. Boll weevils fed on large (5.5–8-mm-diameter) squares for 7 d resulted in ≥3.8-fold more gravid females that developed 4.8-fold more chorionated eggs per female than weevils fed on match-head-sized (2–3-mm-diameter) squares, or post-bloom, young (5–10-d-old), or old (3–5-wk-old) bolls. In the field, large squares had 7.8- and 25-fold more feeding punctures than match-head-sized squares and bolls, respectively. Greater feeding on large squares, and the associated greater fecundity explain rapid weevil population build-ups observed shortly after large squares become well established.

Introduction

After cotton plants begin to produce squares (buds), boll weevils are attracted to cotton plant volatiles (Neff and Vanderzant 1963, Smith et al. 1965, White and Rummel 1978) and an aggregation pheromone produced by boll weevils already present in the field (Parajulee and Slosser 2001). In terms of reproduction, Isley (1928) reported that diets of squares or small bolls were essential for reproduction, and that boll-fed weevils did not oviposit. The data presented in that study, however, was confined to means, and gradations in square sizes were not examined. In a more recent study, an oviposition preference for large squares was reported, and pinhead squares and large bolls were found to be the least preferred (Greenberg et al. 2004). The purpose of this study was to determine cotton square and boll stages that, as sources of food, contribute most toward overwintered boll weevil egg development and oviposition.

Materials and Methods

Living adult boll weevils were collected in Hercon Scout traps (Hercon Environmental, Emigsville, PA), each with a 10-mg grandlure strip 1–4 wk before cotton was planted in the Lower Rio Grande Valley. Before each assay, 20 females were dissected to determine if egg production was underway, and females used in the assays were assumed to be overwintered, and not to have fed on cotton squares or bolls after overwintering. Individual females were kept with males in petri dishes at a 1:2 female:male ratio for 2 d for mating before being used in the assays. A 1-cm^3 water-soaked ball of cotton lint as a source of water was placed in the dishes, and in each Petri dish in each assay of this study. Cohorts of female boll weevils that had been kept with the males (n = 30), and of females kept alone (n = 30) were dissected after 48 h and the spermatheca was observed for visible differences in color that would indicate whether sperm had been received. Squares and bolls in the laboratory assays were collected from greenhouse-raised cotton plants, and squares were debracted before feeding to the weevils.

Food and Fecundity Assay

A wild female boll weevil was placed in a petri dish with two match-head (2–3-mm-diam.) or large (5.5-8-mm-diam.) squares, post-bloom bolls (1–2 d after petal-fall), young bolls (3-5 d), or old (3–5-wk) bolls; a cotton leaf; or no food (control). Food was replaced every 2 d. In each treatment, the weevils were removed and dissected to count chorionated eggs and to observe the spermatheca for evidence of having received sperm on each of days 1–7 (n = 25/d). Feeding punctures were counted, and evidence of leaf perforation on the leaves was recorded.

Feeding Preference for Differently Sized Squares in the Field

In an 18-ha cotton field in Hidalgo Co., TX, planted 19 March 2002, boll weevil feeding-punctured and total match-head and large squares were counted plants in 2 m of row in each of seven on 14 and 28 May, 8 and 10 wk after planting, respectively. In 2003, a 14-ha commercial field (same variety) planted on 5 March was sampled in the same manner as in 2002 on 10 and 25 June, 14 and 16 wk after planting, respectively.

Statistical Analyses

One-way ANOVA and Tukey's HSD for mean separations (Analytical Software, 1998) were used for data in the lab assay. The two-sample t test was used for analyzing the percentages of feeding punctures on the different square sizes in the field

component. Where data was collected at intervals over time, repeated measures ANOVA was used to detect differences (Analytical Software 1998).

Results and Discussion

None of the female weevils contained eggs before the assays began. After 48 h with two males, spermatheca in the females were darker colored, indicating that mating had occurred, than the transparent spermatheca in females kept alone.

Food and Fecundity Assay

No eggs developed in weevils fed on leaves. There were ≥3.8-fold more (F = 16.80; df = 6, 168; P < 0.0001) gravid females with large squares compared with the other stages of fruit, which were not different (P > 0.05) from one another (Fig. 1). Repeated measures analysis detected significant treatment (F = 36.02; df = 6, 1,224; P < 0.0001). Once females first became gravid on day 3, there were more gravid females on three of the five days (Fig. 2).

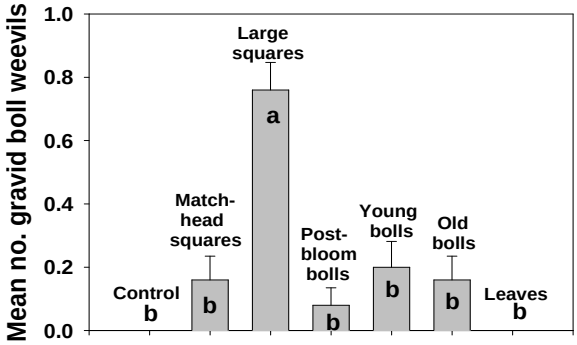

Figure 1. Mean no. (± SE) of gravid boll weevils after being fed on various food sources for 7 d, one-way ANOVA, Tukey's HSD.

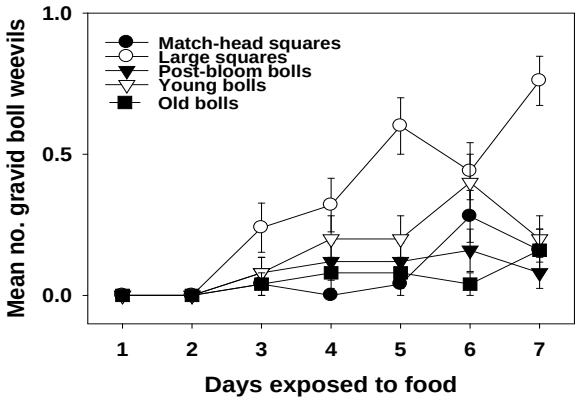

Figure 2. Mean no. (± SE) of gravid boll weevils after being fed on various food sources for each of seven consecutive days, n = 25. Because no gravid boll weevils were found in the control and leaf treatments, those results are not shown.

After 7 d, there were ≥4.3-fold more eggs per female with large squares than in other treatments (F = 15.24; df = 6, 168; P < 0.0001) (Fig. 3). There were more eggs in weevils fed on match-head squares than the control and the leaf-fed weevils (P ≤ 0.05), both of which had no eggs. Repeated measures analysis detected treatment (F = 52.73; df = 6, 1,224; P < 0.0001) effects. On days 3-7 when developing eggs were present, more eggs per female were found with large square treatment than in other treatments (Fig. 4).

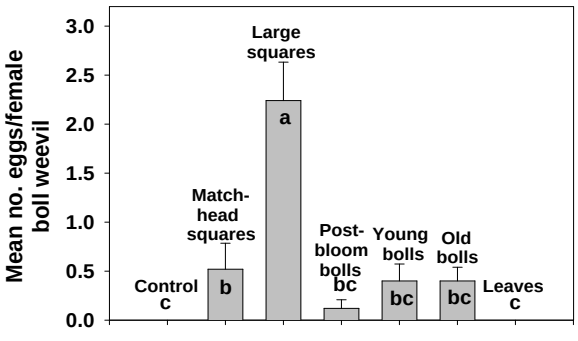

Figure 3. Mean numbers (± SE) of chorionated eggs/ female boll weevil after being fed on various food sources for 7 d, one-way ANOVA, Tukey's HSD, n = 25.

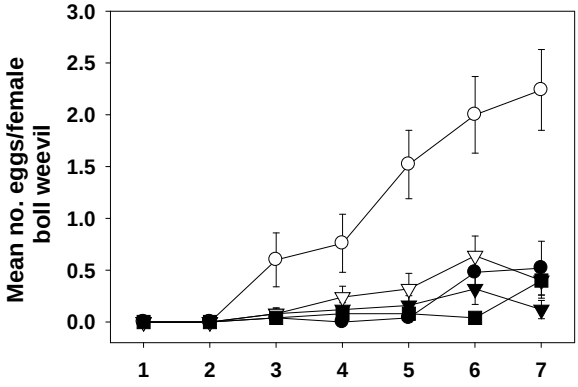

Figure 4. Mean numbers numbers (± SE) of chorionated eggs per female after being fed on various food sources for each of

seven consecutive days, n = 25. Because no gravid weevils were found in the control the leaf treatment, those results are not shown.

Feeding Preference for Differently Sized Squares in the Field There were 84.3 ± 10.8 match-head and 127.4 ± 14.3 large squares in the 2002 samples with 0.28 ± 0.28 and 4.43 ± 0.92 feeding punctures per 2 m row, respectively. Percentage of feeding damage was 7.8-fold greater in the large squares than in the match-head squares (t = 4.12; df = 1, 12; P = 0.001) (Fig. 5). There were 33.4 ± 6.1 match-head and 46.7 ± 4.6 large squares in 2003, with 0.14 ± 0.14 and 5.1 ± 2.1 feeding punctures, respectively. Percentage feeding-punctured squares was 25-fold greater in the large squares (t = 3.92; df = 1, 12; P = 0.002) (Fig. 5).

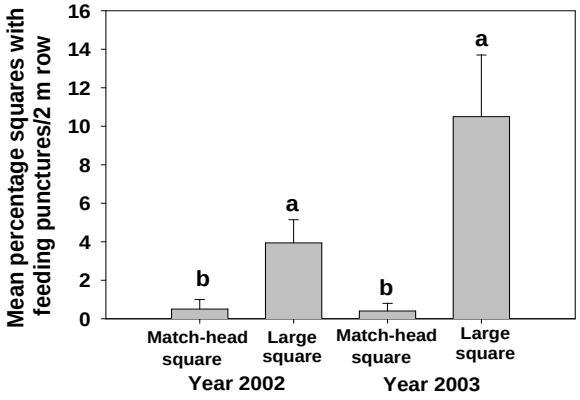

Figure 5. Mean percentages (± SE) of differently sized cotton squares with boll weevil feeding punctures/2 m row in a commercial cotton field, Hidalgo County, TX. Cumulative for 14 and 28 May 2002, and 10 and 24 June 2003 are presented, n = 7, two sample t-test within each year.

Development of eggs depends on cotton fruiting bodies as food resources (Hunter and Hinds 1905, Isley 1928). Our study shows that, if fed squares or bolls, boll weevils begin developing eggs at the same time, but large squares facilitate faster egg production than bolls or match-head squares. The feeding preference assay demonstrated that females feed more on large than match-head squares. Thus, greater feeding on large squares accelerates the rate of reproduction in field conditions.

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