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REPRODUCTIVE DEVELOPMENT OF OVERWINTERED FEMALE BOLL WEEVILS FED VEGETATIVE STAGE COTTON PLANTS

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Abstract

Laboratory studies were conducted to examine reproductive development in overwintered female boll weevils fed cotyledon and 4-leaf stage cotton plants for 4, 7, and 10 d, respectively. Compared with baseline dissections, all but one of the feeding regimes (4-leaf stage plant for 4 d) significantly increased the percentage of weevils containing oocytes with yolk. All feeding regimes significantly increased the total complement of eggs (developing oocytes and chorionated eggs) present in weevils. The largest complement of eggs occurred in weevils fed cotyledon stage plants for 10 d, followed by those fed cotyledon plants for 7 and 4 d, then by those fed 4-leaf stage plants for 10, 7, and 4 d. None of the feeding regimes, however, significantly increased the percentage of weevils with chorionated eggs, or the mean number of chorionated eggs per weevil. Significant differences among treatments, in terms of chorionated egg production, may have been obscured by the variability between runs and the fact that some weevils may have oviposited prior to dissection. Nonetheless, our study demonstrated that female weevils could acquire a substantial level of reproductive development in the absence of fruiting cotton.

Introduction

Overwintered boll weevils commonly infest cotton fields in the spring before cotton plants begin to produce fruiting structures. Several studies (e.g., Grossman 1928, Isley 1928, 1932) have examined reproductive development in female weevils fed different cotton plant structures, and it has become generally accepted that weevils require access to squares or bolls to produce chorionated eggs. Contrary to previous reports, Vanderzant and Davich (1958) reported that newly-eclosed weevils fed only 1-d-old cotton seedlings were capable of producing chorionated eggs. While performing dissections in a field study, we observed a small proportion of weevils (<2%) captured in traps during the spring contained chorionated eggs (C. Suh., D. Spurgeon, J. Westbrook., and J. Esquivel., unpublished data). These weevils were in all likelihood overwintered weevils because they were captured at a time when only seedling cotton was available. These observations suggested that a proportion of the overwintered boll weevil population was capable of producing chorionated eggs in the absence of fruiting cotton. The objective of the present study was to examine reproductive development of overwintered female weevils fed only vegetative stage cotton plants.

Materials and Methods

Overwintered weevils were collected <24 h after capture in pheromone traps established in the Brazos River Bottom near Snook, TX. To ensure that only overwintered weevils were used, collections were restricted to the period between April 2 and May 10, 2001, before fruiting cotton was available in the area. Weevils from each collection were sexed using the tergal notch method (Sappington and Spurgeon 2000), and the females were randomly assigned to treatments. The treatments were: 1) dissected baseline; 2) fed cotyledon-stage plants for 4 d; 3) fed cotyledon-stage plants for 7 d; 4) fed cotyledon-stage plants for 10 d; 5) fed 4-leaf stage plants for 4 d; 6) fed 4-leaf stage plants for 7 d; and 7) fed 4-leaf stage plants for 10 d. Weevils provided cotyledon-stage plants were housed in 20- x 20- x 20-cm screened plexiglass cages, and were provided plants at a ratio of one plant per weevil. Weevils fed 4-leaf stage plants were housed in larger screened cages (20- x 30- x 35-cm) and were provided plants at a ratio of one plant per two weevils. Plants were replaced three times weekly (MWF) throughout the feeding period, and the number of plants provided was adjusted to account for weevil mortality. Plants were grown from seed (DP 436) in one-liter clear plastic deli trays filled with potting soil and maintained in a greenhouse until used in the study. Just prior to feeding, a thin layer of sand was placed over the soil surface to fill gaps in the soil and to provide a contrasting background to facilitate location of weevils on the soil surface. Weevils were held at 29.4 ± 1°C and a photoperiod of 13:11 (L:D) h throughout the feeding period. A water source was provided in the form of a saturated cotton wick extending through the lid of a 29.5-ml diet cup filled with deionized water.

Twenty female weevils were dissected on the day of collection to establish a reproductive development baseline, and 14 female weevils were randomly assigned to each of the other treatments. At the end of each respective feeding period, all live weevils were dissected. The numbers of previtellogenic oocytes, oocytes containing yolk, and chorionated eggs were recorded for each weevil, and the proportions of weevils with oocytes containing yolk and with chorionated eggs were determined. The experiment was replicated six times using a different collection of weevils for each replicate. Egg counts and proportion data were subjected to analysis of variance using the PROC GLM procedure (SAS 1998), and means were separated using the REGWQ option. The model for egg count data included run and treatment as main effects, and a term for their interaction. The model for proportion data only included terms for run and treatment. Proportion data were arcsine square root transformed prior to analysis (Zar 1984).

Results and Discussion

Compared with baseline dissections, all feeding regimes significantly increased the percentage of weevils containing oocytes with yolk (F=19.57; df=6, 30; P<0.001) and the total complement of eggs per weevil (F=36.40; df=6, 539; P<0.001) (Table 1). The highest levels of reproductive development, in terms of total egg complement and percentage of weevils containing oocytes with yolk, tended to occur in weevils fed cotyledon stage plants for 7 and 10 d. None of the feeding regimes, however, significantly increased the percentage of weevils with chorionated eggs (F=0.51; df=6, 30; P=0.793) or the number of chorionated eggs per weevil (F=1.01; df=6, 539; P=0.419) (Table 1). Statistical differences among treatments, in terms of chorionated egg production, may have been obscured by the large variation between replications and/or as a result of weevils ovipositing prior to dissection. In a similar study examining longevity of overwintered weevils fed vegetative stage cotton, an unknown proportion of weevils deposited chorionated eggs on the surface of the soil containing plants used to feed weevils (J. Esquivel, D. Spurgeon, and C. Suh, unpublished data). Vanderzant and Davich (1958) reported similar observations in their study and ultimately used these occurrences to demonstrate that newly eclosed weevils fed only 1-d-old cotton seedlings could produce chorionated eggs. Although production of chorionated eggs by overwintered weevils fed pre-fruiting cotton plants was not statistically demonstrated in our study, our results clearly indicate that overwintered females are capable of substantial reproductive development on cotton plants before squares become available.

Disclaimer

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Table 1. Reproductive development in overwintered female boll weevils fed vegetative stage cotton plants.

Treatment	% ± SE of weevils with:		Mean ± SE number of eggs per weevil	
	Oocytes with yolk	**Chorionated eggs**	**Chorionated**	**Total [a]**
Baseline	3 ± 2 a	1 ± 1 a	0.01 ± 0.01 a	0.5 ± 0.1 a
Cotyledon, 4 d	24 ± 7 bc	4 ± 3 a	0.06 ± 0.04 a	3.2 ± 0.4 c
Cotyledon, 7 d	58 ± 4 d	3 ± 3 a	0.04 ± 0.03 a	4.3 ± 0.3 d
Cotyledon, 10 d	48 ± 8 d	3 ± 3 a	0.04 ± 0.03 a	4.4 ± 0.3 d
4-leaf stage, 4 d	11 ± 3 ab	1 ± 1 a	0.01 ± 0.01 a	1.5 ± 0.3 b
4-leaf stage, 7 d	35 ± 7 cd	2 ± 2 a	0.03 ± 0.03 a	2.6 ± 0.3 c
4-leaf stage, 10 d	43 ± 6 cd	0 ± 0 a	0.00 ± 0.00 a	2.6 ± 0.2 c

Within a column, values followed by different letters are significantly different (REGWQ, $P \leq 0.05$).

[a] Total number of eggs includes previtellogenic oocytes, oocytes with yolk, and chorionated eggs.