RESPONSE OF TRICHOGRAMMA PRETIOSUM AND T. EVANESCENS1 TO WHITELIGHT, BLACKLIGHT OR NO-LIGHT SUCTION TRAPS

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ABSTRACT

The response of Trichogramma pretiosum Riley and T. evanescens Westwood to blacklight, whitelight, or no-light suction traps in empty 44.7 m³ rooms showed that significantly more (P<0.01) of both species responded to blacklight than to whitelight or no-light traps. About 46% and 69% of the T. evanescens and T. pretiosum, respectively, were caught in the blacklight trap. No significant difference (P>0.05) was found in the response of T. pretiosum to whitelight and no light traps, while significantly more (P<0.05) T. evanescens were caught in the whitelight trap than in the no-light trap. Females, especially those of T. evanescens, appeared to be more responsive than males as more females than males of both species were usually caught. The implications of these findings should be considered in planning releases of Trichogramma for control of storage moths in warehouses.

RESUMEN

El comportamiento de Trichogramma pretiosum Riley y T. evanescens Westwood hacia trampas de succión de luz negra, luz blanca, o trampas sin luz en cuartos vacíos de 44.7 m³, indicó que significativamente (P < 0.01) ambas especies respondieron más a las trampas de luces negras que a las trampas de luces blancas o a las de sin luces. Alrededor de 40% y 60% de T. evanescens y T. pretiosum respectivamente fueron atrapadas en la trampa de luz negra. No se encontró ninguna diferencia significativa (P >

1Hymenoptera, Trichogrammatidae
Traditionally pests of stored-food commodities have been controlled by chemical means, but recently the potential of biological control methods has received more attention. Some studies have suggested that various species of parasitic Hymenoptera might be useful as control agents for stored-product Lepidoptera (Corbet and Rotheram 1965, Reinert and King 1971, Takahashi 1973, Press et al. 1977), and it is well known that eggs of stored-product moths can serve as laboratory hosts for the rearing of Trichogramma (Alden and Farlinger 1931, Morrison and King 1977). In fact, eggs of the Angoumois grain moth, Sitotroga cerealella (Olivier)*, are usually used to produce the large numbers of Trichogramma needed for releases to control field crop pests (Morrison et al. 1976). Thus, Brower (1983) suggested that large numbers of Trichogramma might be released periodically into warehouses to reduce or eliminate populations of stored-product moth pests. However, the effectiveness of parasites in indoor situations has not been studied extensively and many questions need to be answered regarding warehouse releases.

Many parasites and predators seem to be lured to and can often be collected at warehouse windows and around lights (Ghani and Sweetman 1955), and Trichogramma spp. are known to be positively phototactic (Morrison et al. 1976, Martin 1969). To determine the strength of this attractancy to light we tested the response of 2 species of Trichogramma to whitelight, blacklight, and no-light suction traps.

**Material and Methods**

**Exposure Rooms**

Tests were conducted in two adjacent rooms that were each ca. 44.7 m². Several modifications had to be made to the rooms to make them tight enough to confine the small test insects: (1) clear plexiglass shields were built around the light fixtures and electrical outlets, (2) 295 μ-mesh Nitex® screens were placed over the heating and return air ducts, (3) special doors were constructed that could be closed tightly, (4) an anteroom connecting the rooms was built to reduce the chances of any accidental introduction of unwanted insects, and (5) all cracks and crevices were caulked and re-caulked as needed between replicates.

The test conditions of the rooms were kept as constant as was practical. The minimum temperature was 27.2°C; the maximum temperature was not controlled, but it never exceeded 31.4°C. The fluorescent ceiling lights automatically turned on at 0700 h and off at 1900 h which coincided with the

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*B. Lepidoptera, Gelechiidæ
light-dark cycle at which the *Trichogramma* were reared. The relative humidity in the rooms fluctuated between 40-60%.

**Light Traps**

The New Jersey mosquito light traps\(^3\) used in these tests were identical except for their light sources. The whitelight (WL) trap had a 25-watt clear incandescent bulb; the blacklight (BL) trap had a 32-watt, ca. 0.3 m circine fluorescent blacklight lamp (GE FC12T10-BL Rapid Start). The standard wire screen funnel was lined with 295 μ-mesh Nitex® screen and the collection jars contained a small amount of deobase to retain and kill the trapped insects. Both traps were modified so the light source could be turned off with the fan left running, thus creating a no-light, suction trap.

One light trap was suspended from the ceiling of each room in the corner furthest from the door, so that the center of the light source was ca. 0.5 m away from the walls and the ceiling and ca. 2.1 m from the floor. The traps ran continuously during the tests and the collection jars were changed daily.

**Test Insects**

Two species of *Trichogramma* were used in this test, *T. pretiosum* Riley and *T. evanescent* Westwood. *T. pretiosum* cultures were obtained from the Cotton Insects Research Laboratory, College Station, TX; and they originated from a field collection in Arkansas. *T. evanescent* cultures were obtained from the Southern Grain Insects Research Laboratory, Tifton, GA; and they had originated in Poland. Both species were reared for many generations at the Savannah Laboratory on the eggs of the almond moth, *Cadra cautella* (Walker)\(^4\), in a controlled environment at 27±2°C and 60±5% RH with a 12L:12D light cycle. Large numbers of almond moth eggs were collected by placing 0- to 2-day-old adults in inverted 3.8-liter jars with screen bottoms. Eggs were removed after 24 h, sifted to remove debris, and placed in open plastic petri dishes for exposure to adult *Trichogramma*. The 0- to 24-h-old almond moth eggs were exposed by placing the open petri dish in a closed 3.8-liter jar along with an open petri dish containing large numbers of parasitized almond moth eggs that contained *Trichogramma* 0- to 24-h before emergence. The almond moth eggs were exposed to *Trichogramma* adults for 8 h and then removed from the exposure chambers.

One day before adult *Trichogramma* emergence, parasitized almond moth eggs were counted into groups of 200, and each group was glued to a labeled 9 cm filter paper disk and placed in a petri dish. Dishes containing each species were then placed in the center of either the WL or BL room, or were reserved as controls. The parasitized eggs were placed in the rooms at ca. 1400 h. Emergence of control insects held at the aforementioned controlled conditions usually started by 0800 h the following morning.

Trap catches were removed each morning for 6 days and the specimens were separated by species, sexed, counted, and recorded. The 2 species were

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\(^3\)Manufactured by Hausherr's Machine Work, R. D. 1, Old Freehold Road, Toms River, NJ 08753.

\(^4\)Lepidoptera, Pyralidae.
tested simultaneously and 4 replicates were run for each light trap both with and without the trap lights on.

After 6 days, the petri dishes were removed from the light-trap room and from the control cabinet, and the eggs were examined microscopically to determine percentage of *Trichogramma* emergence. Control adults were counted and random samples of 50 adults from each replication were sexed to determine sex ratio for each of the 2 species. Significance of the data was determined by comparing sample means with Student's t-test of paired observations.

**Results**

Parasitized control eggs averaged 97.4% emergence and a male:female ratio of 1:1.31 for *T. pretiosum* and 97.9% emergence and a sex ratio of 1:1.02 for *T. evanescens*. Over 99% of the eggs that had emergence holes produced only a single *Trichogramma* adult. The average percentage of emergence in the WL and BL rooms, respectively, was 97.7 and 97.4 for *T. pretiosum* and 98.1 and 97.9 for *T. evanescens*. The sex ratios or number of emerged adults could not be determined in the experimental rooms.

BL traps were significantly more attractive (P<0.01) to both species of *Trichogramma* than WL traps, which were only about one-third as effective in catching either species (Table 1). However, significantly more (P<0.05) *T. pretiosum* than *T. evanescens* were caught in both WL and BL traps. Also, significantly more females than males of *T. pretiosum* were caught by both BL (P<0.01) and WL (P<0.05) traps. BL traps caught significantly more (P<0.05) *T. evanescens* females than males, but there was no significant difference between catches of males and females in WL traps.

When the traps were operated with their lights off but the suction fans on, there were no significant differences (P>0.05) between the 2 types of traps for either species (Table 1). However, there was a consistent trend for the WL type of trap to catch more insects than the BL type of trap. This non-significant difference may have been caused by the greater restric-

**TABLE 1. TOTAL NUMERICAL RESPONSE OF MALES AND FEMALES OF Trichogramma pretiosum AND T. evanescens TO WHITELIGHT, BLACKLIGHT OR NO-LIGHT SUCTION TRAPS OVER A 6 DAY TRAPPING PERIOD. (MEAN OF 4 REPS)**

<table>
<thead>
<tr>
<th>Trap type and light sources</th>
<th>Species response</th>
<th>Response by sex</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>* T. pretiosum *</td>
<td>T. pretiosum *</td>
</tr>
<tr>
<td></td>
<td>* T. evanescens *</td>
<td>δ *</td>
</tr>
<tr>
<td>Lighted WL</td>
<td>41.8 * 25.5 **</td>
<td>16.0 * 25.8 **</td>
</tr>
<tr>
<td>Lighted BL</td>
<td>123.8 * 61.1 **</td>
<td>42.0 81.8 **</td>
</tr>
<tr>
<td>No-light WL</td>
<td>36.8 * 13.8 **</td>
<td>19.0 ns 17.8 ns</td>
</tr>
<tr>
<td>No-light BL</td>
<td>25.1 * 9.3 **</td>
<td>10.8 ns 14.3 ns</td>
</tr>
</tbody>
</table>

*Significance between pairs of values in rows or in columns is indicated by: ns = none. * = P<0.05, ** = P<0.01 as determined by Student's t-test.
tion of airflow by the large, circular BL bulb. This pattern of greater catch by the WL type trap was opposite from the pattern found when the trap lights were on. Significantly more (P<0.01) T. pretiosum than T. evanescens were caught in both traps. Males and females of T. pretiosum were caught with equal frequency in the no-light traps, but significantly more (P<0.05) females than males of T. evanescens were caught in both no-light traps.

The temporal pattern of Trichogramma catch was probably influenced by emergence pattern, flight propensity, trap type, and species. For T. pretiosum most catch occurred on the 2nd day (Table 2) in lighted traps with very little catch on the 3rd and 4th days and none on the 5th or 6th days. The catch was somewhat delayed in the no-light traps and fewer insects were trapped. T. evanescens responded most strongly to the WL trap on the 1st day and catch decreased thereafter (Table 2). Response to the BL trap and to no-light traps was very similar in this species with the greatest catch occurring on the 2nd day.

**DISCUSSION**

General observations of Trichogramma spp. usually show a movement toward or aggregation near light sources (Martin 1969, Morrison et al. 1976). However, to our knowledge no controlled studies of this phenomenon have been published until now. This study showed that T. pretiosum and T. evanescens moved several meters to a BL source, but that an incandescent WL source was only minimally attractive. More than 41% and 63% of the emerged T. evanescens and T. pretiosum adults, respectively, were caught by the BL traps, but less than 22% of either species was caught by the WL traps. This observation supports the supposition of Costas (1941) that WL only increases the activity and dispersion of Trichogramma, but not oriented movement. Previous observations of positive phototactic behavior of Trichogramma may have resulted from increased movement or attraction to the UV portion of most WL sources. Females of T. pretiosum were caught significantly more often than males by both BL and WL traps, but the interpretation of this finding must be tempered by the fact that the sex ratio of this species was skewed in favor of females. Equal numbers of females and males of T. pretiosum were caught in the no-light traps. Females of T. evanescens were caught significantly more often than males in

**TABLE 2. PERCENTAGES OF Trichogramma pretiosum AND T. evanescens ADULTS CAUGHT IN WHITE LIGHT, BLACK LIGHT AND NO-LIGHT SUCTION TRAPS DURING 5 DAYS OF OPERATION.**

<table>
<thead>
<tr>
<th>Day</th>
<th>T. pretiosum</th>
<th>T. evanescens</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lighted WL</td>
<td>Lighted BL</td>
</tr>
<tr>
<td>1</td>
<td>28.7</td>
<td>22.2</td>
</tr>
<tr>
<td>2</td>
<td>62.3</td>
<td>61.7</td>
</tr>
<tr>
<td>3</td>
<td>8.4</td>
<td>8.5</td>
</tr>
<tr>
<td>4</td>
<td>0.6</td>
<td>1.6</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
the no-light traps. Females are apparently more active fliers than males of this species since the sex ratio was near unity in the controls. Females of other species of parasitic wasps have also been shown to be very attracted to BL sources (Hagstrum and Sharp 1975, Cline et al. 1983).

A comparison of the response of *T. pretiosum* with that of *T. evanesceens* showed some species specific differences. A significant difference (P<0.05), was found between the number of *T. evanesceens* caught by the WL trap with the light on and the number caught with the light off. In contrast, there was no significant difference (P>0.05) between the numbers of *T. pretiosum* caught by the WL trap with the light on or off. Of course, because of the strong response to BL, both species were caught significantly more often by the BL trap than by the no-light trap.

The release of large numbers of insectary-reared *Trichogramma* into commodity storages for control of moth populations has been proposed (Brower 1983). Recently, 2 species of *Trichogramma* have been found naturally parasitizing almond moth eggs in peanut storages in Georgia (Brower, in press). In order to maximize the chances of success, the findings reported here indicate that BL traps should not be used concurrently with *Trichogramma* releases. If monitoring of moth populations is essential then pheromone traps or perhaps WL traps could be used. It might also be desirable to eliminate or reduce UV sources such as open windows, doors, skylights, etc. to reduce *Trichogramma* loss to the outside. However, the warehouse should probably not be kept in total darkness because *Trichogramma* may not find or parasitize their hosts in total darkness (Costas 1941, Orphanides and Gonzalez 1970, Ashley et al. 1973). If light traps are to be used to sample for the presence of or to monitor populations of *Trichogramma*, then BL traps should be selected rather than WL traps because of the greater response to BL.

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Mention of a commercial or proprietary product does not constitute an endorsement by the USDA. Revised for publication 18 February 1984.

**REFERENCES CITED**


