Efficacy of Tower Medfly Eclosion Systems

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Efficacy of Tower Medfly Eclosion Systems

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A 16-repetition experiment was conducted to evaluate the performance of the “tower” system for eclosion of sterile medflies, Ceratitis capitata (Wiedemann). This system has now replaced the PARC system previously used in Florida S.I.T. programs. In addition to testing the efficacy of these eclosion systems, as compared to the PARC system, quality control was also monitored and evaluated. No significant differences were found between either system in regards to C. capitata yield, weight or flight ability (p < 0.05). Based on these comparative trials, the tower eclosion system appears to be an efficient alternative to the PARC system.

Keywords: tower eclosion system, Ceratitis capitata, sterile insect technique

The Mediterranean fruit fly, Ceratitis capitata (Wiedemann) poses a substantial threat to Florida’s citrus-based agriculture (Warthen et al., 1999; Warthen et al., 1997; Liquido et al., 1991; Leonhardt et al., 1989). The last known occurrences of C. capitata were in the summer months of 1997–98. A thorough control effort was undertaken in the state’s affected areas and the insect was proclaimed to have been eradicated. Sterile insect technique (S.I.T.) was the primary method used in this eradication process. This technique was employed to lesson, and ultimately, eliminate the need to use chemical pesticides as a control method. Currently, 125,000 sterile male C. capitata are distributed using aerial release to each square mile of areas potentially at risk in a Preventative Release Program (PRP) throughout southern and central Florida. To date, these releases continue as a preventive measure in areas deemed at risk of C. capitata introduction in south Florida (Hillsborough, Manatee, Sarasota and Miami-Dade Counties).

A plastic adult rearing container (PARC) system had been the method used for sterile C. capitata eclosion and release in Florida from 1997 through 2001. For a detailed
description of the PARC eclosion system for sterile \textit{C. capitata} see the Parts and Specifications Manual: Auger Sterile Release Machine and Stackable Chill Boxes (USDA-APHIS-PPQ-METHODS, Aircraft and Equipment Operations, Mission, Texas, 1995). Briefly, the PARC system of \textit{C. capitata} eclosion allows pupae to be distributed and portioned within each box for climate controlled eclosion and handling until release. The PARC system, while being extremely effective, is also very labor intensive and time consuming.

Recently, an eclosion tower has been created and placed into use in the Florida PRP to prepare comparable quantities of \textit{C. capitata} pupae in a more time and labor-efficient manner. Each tower is composed of layered, pupae-housing trays (between 60–71 trays in height) stacked in such a way to allow for proper eclosion of the insects in a greatly reduced amount of storage area compared to that of the PARC system.

The tower system has been tested successfully to eclose the Mexican fruit fly, \textit{Anastrepha ludens} (Loew) in southern Texas (Forrester and Worley, 1999, unpublished). This method has now been in use at the Sterile Insect Rearing Facility, Sarasota, Florida since the start of 2002. The tests detailed in this paper represented the first attempt to eclose and release \textit{C. capitata} using the tower eclosion system and were the impetus for initializing their use with sterile medfly on a large scale. The goal was to examine not only the feasibility of using the eclosion tower system for \textit{C. capitata}, but also to determine if this system could achieve similar adult fly yield and quality to that of the PARC system.

TOWER: PREPARATION AND PRE-RELEASE

One tower (consisting of 71 pupal eclosion trays) was prepared twice a week over an 8-week period. Sterile temperature sensitive lethal (TSL) male \textit{C. capitata} were obtained in the pupal stage from MOSCAMED, a Guatemalan rearing facility. Each tower contained a total pupal weight of 15,408 grams (or approximately 2 million \textit{C. capitata} pupae) and was comparable in weight with pupae in 48 standard PARC boxes. PARCs and towers were housed together in the same incubation trailer for a similar period of time so that the contents of each were exposed to similar temperatures (26–28°C) and humidities (60–80 ~ RH). Both systems were chilled at 16°C in a refrigeration chamber allowing for the immobilization of \textit{C. capitata} for aerial release. Flies were released at 5 days after the set-up date. Towers required approximately 1-1/2 hours at 16°C in the cold chamber for immobilization. Once chilled and immobilized, flies from a single tower could be serviced and readied for the aerial release container in one-half hour.

ECLOSED MEDFLY QUALITY

The same quality control measures were applied to flies from both the tower and PARC eclosed flies during this experimental period and compared (Brazzel \textit{et al.}, 1986). These included:

\textbf{Flight Ability}

Flight ability levels were measured by preparing five-100 adult fly samples from the tower system following immobilization. The flight ability test technique consisted of a 10-cm high Plexiglas tube, painted black and placed with its base in a 9-cm diameter Petri dish (Sivinski \textit{et al.}, 2000; Brazzel \textit{et al.}, 1986). The inside of each tube was coated with talcum to prevent flies from climbing out of the tube and confusing final data. The number of flies able to exit the tubes over a period of time was used to calculate the % flight ability. The flight ability numbers measured for each tower replicate was compared with those obtained for medflies of the same release date that were prepared and eclosed in the PARC system.
Fly weight
Adult fly weights were obtained by taking three-2 g samples, each, from the tower and PARC systems after the flies were immobilized and prepared for aerial release. These samples were then completely immobilized using a cold chamber to allow for ease in counting the samples by hand. These fly counts provided a flies per gram estimate for each system during each test repetition.

Fly yield
Yield is the percentage of insects actually eclosed from the initial amount of pupae placed in the system (15,408 g was equivalent to one tower or 48 PARC boxes). Prior to weighing and immediately following immobilization in the cold chamber, flies were removed from their confines (i.e. from the tower trays or PARC boxes) and their pupal shell casings were left behind. What was placed on the scale for weighing represented the yield of actual insects ready for release.

The tower system was set up sixteen times for release and quality control analysis; however, only thirteen of these replicates were viable for release and testing. The PARC system had been in use for years, so immobilization of adult *C. capitata* with this system was routine. However, because no information existed on immobilization of *C. capitata* in the tower, some trial and error was required. On three occasions during these experiments, the towers where left in the refrigeration chamber for too long a period. These insects died under the extended duration and thus were unavailable for testing. This left data from 13 of the 16 replicates for analysis.

No significant differences were found in adult *C. capitata* yield as a result of rearing in either system (*p* = 0.05, ANOVA) based on analysis of thirteen test replicates. The mean *Ceratitis capitata* yield over the thirteen replicates was 65% (SE = 1.9) and 59% (SE = 2.9) in the tower and PARC systems, respectively. It appeared that the trays of the tower system allow the developing flies ample exposure to the agar food supply. At the time of release, adult fly weights from those eclosed in the tower system were not significantly higher than those eclosed in the PARC system (*p* = 0.05, ANOVA) with average weights of 0.0059 (SE = 0.0001) and 0.0057 (SE = 0.0001) mg per fly, for the tower and PARC, respectively.

The compact conditions of the tower trays reduce insect movement to walking. However, the 5 day duration of flies in such close quarters did not appear to affect their ability to fly. No significant differences were found in flight ability from flies tested post-release in either system with average flight abilities of 69% (SE = 2.5) and 79% (SE = 2.5), for the tower and PARC systems, respectively (*p* = 0.05, ANOVA).

Although not significantly superior in any one aspect of *C. capitata* eclosion and release, the results from these data do indicate that in each of the most critical aspects, yield, weight and flight ability, the tower eclosion system is as efficient as the previously used PARC system. Detailed field recovery studies are still required to determine if the current PRP releases of sterile *C. capitata* using this tower system are comparable to historic recovery data of releases using the PARC method.

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REFERENCES


