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AN IMPROVED METHOD FOR REARING WESTERN FLOWER THRIPS *FRANKLINIELLA OCCIDENTALIS*

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The western flower thrips *Frankliniella occidentalis* (Pergande) (Thysanoptera: Thripidae) is a major pest throughout the world (Kirk & Terry 2003). These thrips are efficient vectors of tomato spotted wilt virus that can infect a wide range of horticultural crops (Wijkamp et al. 1995). Bioassays to evaluate western flower thrips control methods generally require a consistent supply of healthy thrips.

Loomans & Murai (1997) reared thrips in various styles of cages using whole plants and plant parts as food. Foods commonly used include germinated broad beans, bean cotyledons (Murai & Loomans 2001), dwarf French bean plants, green bean pods, and bean leaves (Steiner & Goodwin 1998). Factors such as micro-climate, quality and longevity of the host culture medium, and infestations from predatory or fungivorous mites pose challenges to the development of a successful rearing protocol (Loomans & Murai 1997). Cage design is critical for maintaining microclimate, and choice of pupation medium can restrict or eliminate mite infestations and subsequent loss of larvae and pupae.

We found that previously described methods were highly prone to mite infestations. In addition, the methods were often inefficient and some required considerable specialized equipment. Here we synthesize elements of several rearing methods summarized in Loomans & Murai (1997) and describe a protocol for rearing western flower thrips using whole Persian cucumber fruits as a host plant.

The laboratory population was initiated from adults collected in a flowering lucerne (*Medicago sativa*) field. The culture was maintained at 26 ± 3°C and 37 ± 7% relative humidity in a room (4 m W × 2 m D × 3.7 m H) that received natural light from a large window. Additional lighting was provided by six 120-cm cool white fluorescent lights (Polylux XLr F36W/860; GE Lighting, Smithfield, NSW, Australia) positioned 45 cm above the culture boxes with a photoperiod of 16:8 (L:D). A tray of water (40 × 30 × 8 cm) in the room increased humidity.

Cages were modified 8.5-L (22-cm cube) plastic food storage boxes. Rectangles (12 × 7 cm) cut out of 2 opposite walls in the box were covered with silk material secured with glue and tape. The open top of the box was sealed with clingwrap pulled tight and secured with a strong rubber band (Fig. 1a). Each box contained three 25-mL plastic pill-cups filled with wet cotton rolls (1 cm diameter, 3.8 cm long, Luna Cotton Rolls size 2; Coltène/Whaledent, Langenau, Germany), 1 paper towel wick spread with honey, and a small paper dish containing 0.5 g crushed bee pollen. A segment of absorbent paper towel was placed in

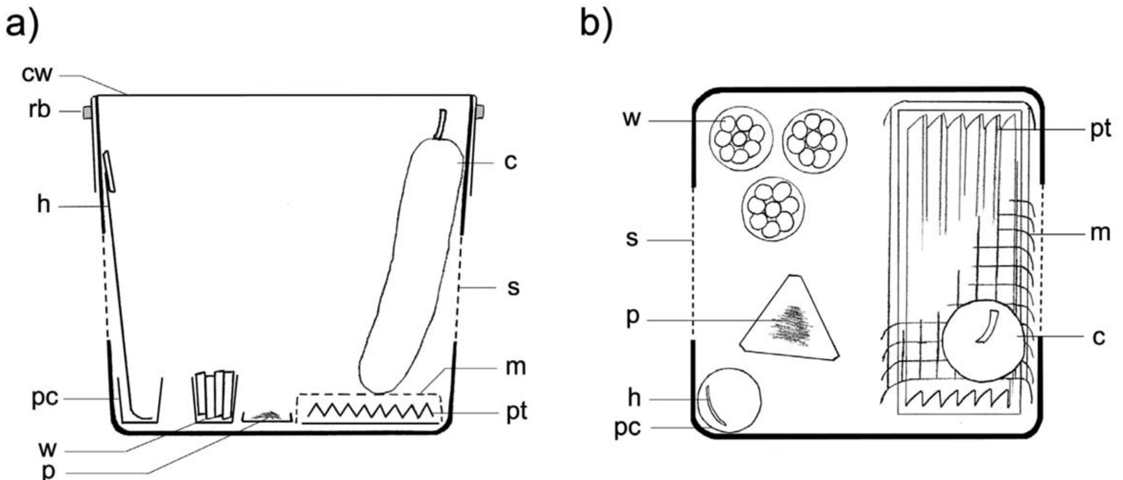

Fig. 1. Cross-section (a) and top view (b) of the prepared culture box. Legend: *c* = cucumber, *cw* = clingwrap, *h* = honey wick, *m* = metal mesh, *p* = pollen, *pc* = pill cup, *pt* = paper towel layers, *rb* = rubberband, *s* = silk windows, *w* = wet cotton rolls.

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the base of the box and a fan-folded piece of paper towel was placed on top beneath a metal mesh platform (Fig. 1b).

An oviposition box was set up as described above and approximately 400 female and 50 male adults were introduced. Three Persian cucumber fruits, purchased weekly from a local grocery store, were sterilized in 400 ppm sodium hypochlorite solution for 3 min, rinsed twice with water, dried with paper towel, and placed vertically upright on the metal mesh platform (Fig. 1a). The cucumbers remained in place for 3-4 d, after which they were removed (adults present on the fruits were gently blown back into the box) and replaced with fresh, washed cucumbers. This starts the next batch of eggs and subsequent larvae that will be 3-4 d younger than the previous batch. By regularly replacing the cucumbers, replenishing water in pill-cups, and adding newly emerged adults as necessary to maintain numbers (a small battery operated aspirator was used for transferring adults between boxes), the oviposition box only required complete cleaning and reprovisioning every 3-4 weeks.

The 3 cucumbers with eggs that were removed from the oviposition box were placed into a newly prepared box for larval emergence. One fresh washed cucumber was added to the box as extra food for emerging larvae. Most of the resulting larvae had pupated after 2 weeks. The cotton rolls were then remoistened, and the cucumbers and mesh platform were removed, and any attached pupae were gently brushed off in box. Emerging adults can survive on the honey and pollen for approximately 1 week until they are used either for bioassay or to replenish the oviposition box.

The culture only requires approximately 20 min attention twice a week. Within 3 weeks of continued ovipositing effort (allowing 3-4 d per group of cucumbers), 5 separate age cohorts of thrips can be generated: eggs, first instars, second instars, pupae, and adults. With good quality cucumbers, approximately 1000 adults can be reared from 3 cucumbers in a single generation.

Persian cucumbers are an effective culture medium for providing moderate numbers of western flower thrips. Beans and bean leaves tended to wilt in temperatures promoting thrips growth, but cucumbers generally remained viable for the entire lifecycle of the thrips and maximized larval emergence from the oviposition effort.

Laboratory thrips cultures often have used whole plants growing in pots, including cucumbers (Hulshof et al. 2003), chrysanthemums (van Dijken et al. 1994) and eggplants (Tagashira & Hirose 2001). However, whole plants and soil are often a source of contaminants. Detached fruit rather than potted plants reduces the opportunity for contamination. Timing of transfers of cucumbers between boxes effectively broke the life cycle of potential contaminants. Substituting a thick paper towel for vermiculite often used in other rearing protocols, considerably reduced mite problems yet still provided suitable pupation sites.

Condensation and subsequent drowning of larvae occasionally occurred in culture boxes. The main cause was a temperature difference between the outside and inside of the box and usually could be avoided with a well-controlled climate room. Condensation usually occurred only in those boxes with excessive numbers of larvae and/or too many cucumbers in the box.

Purchasing commercially available (not organically labelled) cucumbers, rather than maintaining organically grown cucumber crops, introduced an element of variability into the culture that occasionally resulted in lower larval emergence. We suspected this was due to pesticide contamination, post harvest treatment, or the variety of Persian cucumber. The culture generally recovered easily when a new batch of cucumbers was substituted.

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Summary

This culture method for western flower thrips creates a simple artificial environment with Persian cucumber fruits rather than complex host plant structures. In addition, replacing soil/vermiculite with thick paper towel reduces the opportunity for fungal contamination and mite infestation. The method requires little specialized equipment and minimal interference in the thrips lifecycle yet it can produce consistent numbers of thrips separated into age specific cohorts.

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