LACK OF SUITABILITY OF COMMERCIAL LIMES AND LEMONS AS HOSTS OF ANASTREPHA SUSPENSA (DIPTERA: TEPHRITIDAE)

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Caribbean fruit fly, Anastrepha suspensa (Loew), a pest of West Indies origin, was found in fruit of Surinam cherry, Eugenia uniflora L., in Miami Springs, Florida, on 23 April 1965. From this original infestation, A. suspensa spread over much of Dade county by the fall of 1966 (Wcme 1966). Eighty-four species of fruit in 23 plant families were listed as hosts of A. suspensa. Eleven species or cultivars of citrus were found to be infested with A. suspensa (Swanson & Baranowski 1972).

Florida citrus fruit shipped to Japan, California, Texas, and Arizona was required to be fumigated with ethylene dibromide (EDB) before shipping to ensure an A. suspensa free product. The use of EDB as a post-harvest fumigant for citrus was terminated in September 1984 by the Environmental Protection Agency (EPA) (Anonymous 1984). In September 1985, an agreement was negotiated whereby Japan agreed to accept lemons, Citrus limon (L.) Burm. f. from Florida without post-harvest fumigation but not limes, Citrus aurantifolia (Christm.) Swingle, because limes were listed as a host of A. suspensa (Anonymous 1988). The objective of this study was to evaluate whether or not limes and lemons produced in Florida are suitable hosts of A. suspensa.

The test was conducted in the laboratory by placing Persian lime, Bearss lemon, calamondin, and kumquat fruit in a screened cage (100x100x75cm). Calamondin, Citrofortunella mitis (Blanco) J. Ingram & H. E. Moore, and kumquat, Fortunella japonica (Thumb.) Swingle, were present in the cage as the control. The cage contained about 600-800 pupae of A. suspensa which were obtained from USDA-ARS, Miami, Florida. The percent emergence ranged from 80-90% and the sex ratio was approxi-
nately 1.1. As soon as the flies emerged, sugar cubes and moist sponges were placed on the top of the cage to provide food and water. A moist plastic sponge was sprinkled with yeast hydrolysate and hung inside the cage to supply additional protein for the flies. Citrus was collected from the Division of Plant Industry Arboretum, Winter Haven, Florida. Fruit was washed and weighed before being placed in the cage. The number of fruit placed in each cage was determined by availability (Table 1).

One week after fly emergence, freshly collected fruit was placed in the oviposition cage. A week later, the fruit was removed and housed separately for each type of fruit in 2-gallon (8-liter) ice cream containers prepared with a 2 cm layer of white sand put in the bottom. An elevated platform made of wire screen was placed in the container upon which a fruit was placed to keep it above the sand. A piece of 60-mesh nylon organdy covered the container and was secured by a plastic lid from which the center had been removed.

The fruits were left in containers for 5 weeks to allow for larval development and pupation. Two weeks after the start of the incubation period, sand was sifted to obtain any pupae until fruit was discarded. Wet sand was replaced with dry sand to insure maximal pupal survival. Pupae were counted and placed in modified 50-dram plastic snap-cap vials with the bottoms removed and each vial was sealed with a small piece of nylon organdy to prevent emerging adults from escaping. Pupae were allowed to emerge to adult over a period of 3-4 weeks and flies were then counted to determine the percentage of emergence. Three days after fruit was removed from the oviposition cage, one-quarter of the flavedo of one fruit of each type was dissected and the numbers of eggs and larvae were recorded. This process was repeated 4 days later to the same fruit to study the development of any larvae inside the fruit; however, albedo and pulp were further examined if damage from the 2nd instar was found. The oviposition cage was housed in a greenhouse (27±5°C) and the ice cream containers were housed in the laboratory (27±2°C, 14L:10D) at the Division of Plant Industry in Gainesville.

Lime and lemon were acceptable for oviposition by A. suspensa throughout the year, regardless of the state of the fruit, whether green during August-October or starting to ripen in early December. Eggs were deposited in the oil glands or between glands. Most of the eggs hatched to first instars, then died; no mature larvae or pupae were found. Results of the experiment are shown in Table 1. Calamondin and kumquat were acceptable for oviposition and development by A. suspensa. Larvae developed in the pulp and emerged from the fruit for pupation. An average of 2.6 and 12.6 pupae/100g fruit were reared from calamondin and kumquat, respectively. The percent emergence from these pupae was 32% for calamondin and 35% for kumquat. Greany et al. (1983)

<table>
<thead>
<tr>
<th>Type of Fruit</th>
<th>No. of Replications</th>
<th>Average No. of eggs first instar larvae/100 g fruit</th>
<th>Average No. of pupae/100 g fruit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Persian lime</td>
<td>51</td>
<td>3.19 ± 0.95</td>
<td>53.40 ± 141.90</td>
</tr>
<tr>
<td>Bearss lemon</td>
<td>46</td>
<td>3.13 ± 0.49</td>
<td>19.70 ± 23.91</td>
</tr>
<tr>
<td>Calamondin</td>
<td>28</td>
<td>14.35 ± 4.73</td>
<td>269.11 ± 249.66</td>
</tr>
<tr>
<td>Kumquat</td>
<td>23</td>
<td>15.56 ± 3.97</td>
<td>246.41 ± 243.44</td>
</tr>
</tbody>
</table>
found that egg hatchability was 64-74% for Eureka and Lisbon lemons, but lemons were immune to successful development by *A. suspensa*. Lime was considered as a host of *A. suspensa* because a pupa was recovered from a lime during the 3-year study by Swanson & Baranowski (Swanson 1982, personal communication).

Results from this study indicate that Persian lime and Bearss lemon should not be considered as the hosts of *A. suspensa*, and fumigation or other means of disinfection are not necessary.

REFERENCES CITED


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METHOD FOR COLLECTING ARTHROPODS DISLODGED FROM SOYBEAN PLANTS

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In ground cloth sampling in soybean, arthropods are dislodged from the plants onto a cloth and counted either in the field or removed to a container and taken to the laboratory for processing (Kogan & Pitre 1980). Shepard & Carner (1976) dislodged insects onto a polyethylene sheet in order to allow the samples to slide more easily into a container than is permitted by cloth. However, transfer may require two people and often insects escape, especially when sampling high densities of predators in the field (Deighan et al. 1985). We describe a polyethylene ground cloth in the shape of a funnel that facilitates the collection of arthropods.

The “beat funnel” is constructed from four triangular pieces of 2 mil (0.0508 mm) black polyethylene film, duct tape, a one gal. (3.8 liter) paper container (Fonda, Union,

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Fig. 1. Beat funnel construction. A & B, Two isosceles triangles each (a & b) were cut from polyethylene sheets and one of the tips (c & d) removed. C, The four pieces (a, b, a', and b') were taped together with duct tape, with a and b connected to form the funnel. Duct tape was used also to attach the rods and reinforce the 102.3 cm edges. D, A small binder clip was inserted in a horizontal slit at the top of a tube (e) cut from a paper container. E, The paper tube was bent to fit the opening and taped to the polyethylene. A brown paper bag was attached to the tube on the completed beat funnel to collect arthropod samples.