Influence of Experience on Acceptance of Artificial Oviposition Substrates in *Ceratitis capitata* (Wiedemann).

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ABSTRACT

Naive, non-irradiated, laboratory-reared *Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae) females from a colony in culture for more than 300 generations had a much greater propensity than naive wild-origin *C. capitata* females to attempt oviposition in 100 mm diameter hollow pre-punctured plastic yellow spheres used in collecting *C. capitata* eggs. Ovipositional experience of lab-cultured females for 3 days with host fruit caused a reduction in propensity to bore into the spheres. Nonetheless, this propensity remained greater than that of naive or fruit-experienced wild-origin females. Our findings therefore suggest consideration of the nature of prior ovipositional experience of *C. capitata* when using artificial egg-collecting devices.

The sterile insect technique has been of considerable value in suppressing populations of the Mediterranean fruit fly (medfly), *Ceratitis capitata* (Wiedemann) (Rhode et al. 1971, Fisher et al. 1985, Harris et al. 1986). One method of measuring the impact of released lab-cultured sterile medflies on wild populations is periodic assessment of percent hatch of eggs laid in host fruit by wild females (Wong et al. 1986). Finding medfly eggs in host fruit can be time-consuming. As a substitute for host fruit in field cage tests, McInnis (1989) employed hollow plastic yellow spheres perforated with numerous small holes capable of receiving medfly eggs. Such spheres are baited interiorly with guava-juice-soaked sponges and hung in various sorts of host trees in locales where flies are released. Another important use of spheres of this sort lies in collecting eggs conveniently in tests comparing behavioral quality traits of wild and various selected lab-cultured strains of medflies (McInnis 1989).

Here, we asked whether prior ovipositional experience of wild and non-irradiated lab-cultured medfly females with real host fruit might affect the propensity of either type of fly to accept plastic yellow spheres for egglaying. Previous research has revealed that wild medflies are capable of learning characters of host fruit and, upon alighting, may reject fruit of unfamiliar chemistry or size (Cooley et al. 1986, Papaj et al. 1988). In contrast, non-irradiated lab-cultured medfly females appear somewhat less able than wild females of learning and remembering characters of host fruit with which they have had prior ovipositional experience (Papaj et al. 1987).

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MATERIALS AND METHODS

Wild flies were reared from infested Jerusalem cherries *(Solanum pseudocapsicum)* collected from the slopes of Mauna Loa volcano on the island of Hawaii. Lab-reared flies were from a stock in continuous culture for more than 300 generations at the USDA Fruit Fly Laboratory on the island of Oahu. From eclosion, females and males were held together by origin at ca. 25°C, 60% RH, and 13L: 11D photoperiod, in cages supplied with food (sucrose and yeast hydrolysate) and water. Our experiment began when the females reached maturity: 12-14 days old for wild females; 8-10 days old for lab-reared females. Prior to the experiment the flies had never been exposed to fruit or oviposition devices.

For the experiment, flies of each origin were separated into 3 cages (40 females and 8 males per cage). The protocol of exposing flies to real host fruit was similar to that of Cooley et al. (1986) and Papaj et al. (1987). On Day 1, 2 water-rinsed sweet oranges, *Citrus sinensis* (Rutaceae) (85 ± 5 mm), were introduced into Cage 1. Each was punctured 40 times with an insect pin to facilitate oviposition in the fruit flesh. At the same time, 40 water-rinsed mock oranges, *Murraya paniculata* (Rutaceae) (8 ± 2 mm diameter), were introduced into Cage 2. Each was punctured twice with an insect pin. Cage 3 contained no fruit (i.e. the flies remained naive to fruit). Midway through Day 2, fruits in Cages 1 and 2 were replaced with fresh specimens. This regime was identical for groups of both wild and lab flies.

On Day 4, 32 females from each cage were assessed for propensity to accept uninfested sweet oranges (10 pin punctures per fruit), uninfested mock oranges (2 pin punctures per fruit), and 100 mm diameter yellow plastic spheres (Euro-Matic Ltd., Leominster, MA). The spheres were identical to those employed by McInnis (1989). Each was punctured with 50 holes (0.5-1.0 mm diameter) and baited interiorly with a sponge soaked in fresh guava juice. At 0900 h, all fruit were removed from the exposure cages. Assays were conducted from 1000-1800 h.

For assaying, each female was selected at random and transferred gently to a cage devoid of anything except assay fruit. Each was offered (allowed to walk or hop onto) a single assay fruit (or sphere) and permitted to remain there until it either accepted the fruit (attempted to oviposit in it) or rejected the fruit (left without attempting to oviposit or remained on the fruit without boring for 5 min). After being tested on one fruit type, the fly was allowed 3 min before presentation of the next fruit type. The order of fruit presentation was alternated so that each test fruit type was presented first an equal number of times. Oviposition was prevented by removing a female that attempted to oviposit before the ovipositor was extended into a fruit or plastic sphere.

RESULTS

Naive wild females bored into mock oranges almost as frequently (56%) as into sweet oranges (72%) and significantly more often than into plastic spheres (0%). Mock-orange-exposed wild females bored into mock oranges

significantly more often (81%) than into sweet oranges (38%) or plastic spheres (0%). Sweet-orange-exposed wild females bored into sweet oranges significantly more often (78%) than into mock oranges (9%) or plastic spheres (3%).

Unlike naive wild females, naive lab females bored into sweet oranges significantly more often (78%) than into mock oranges (22%) or plastic spheres (41%). Unlike mock-orange-exposed wild females, mock-orange-exposed lab females bored significantly more often into sweet oranges (78%) than into mock oranges (53%) or plastic spheres (16%). Like sweet-orange-exposed wild females, sweet-orange-exposed lab females bored significantly more often into sweet oranges (69%) than into mock oranges (6%) or plastic spheres (9%).

TABLE 1. Acceptance by wild-collected and lab-cultured medfly females of 2 species of real test fruit (mock orange = MO, sweet orange = SO) or plastic yellow spheres (PYS) after 3 days of exposure to one species of real fruit or with no previous exposure to any fruit (= naive).

			% females accepting test fruit*		
Strain	Exposure	N	MO	SO	PYS
Wild	MO	32	$81a_1$	$38b_2$	$0c_1$
	SO	32	$9b_3$	$78a_1$	$3b_1$
	Naive	32	$56a_2$	$72a_1$	$0b_1$
Lab	MO	32	$53b_1$	$78a_1$	$16c_2$
	SO	32	$6b_2$	$69a_1$	$9b_2$
	Naive	32	$22b_2$	$78a_1$	$41b_1$

*Values in each column (row) within a strain followed by the same letter (number) are not significantly different at the 0.05 level using pairwise two-way G-tests.

DISCUSSION

Except for the somewhat lesser propensity here of naive and mock-orange-exposed lab females to bore into mock oranges, the results of this study agree closely with those of Papaj et al. (1987), who used an experimental protocol nearly the same as that used here and who tested wild medflies from the island of Maui and non-irradiated lab medflies from the same culture used here. Thus, we can be quite confident that the nature of fly response to plastic yellow spheres here is representative of the response pattern of wild medflies from Hawaii and non-irradiated lab-reared medflies from the USDA culture on Oahu.

Our findings indicate that naive non-irradiated lab-cultured females have a much greater propensity to accept 100 mm diameter plastic yellow spheres than do naive wild females. This finding is consistent with an earlier

finding (Prokopy et al. 1984) that naive non-irradiated lab-cultured females are much more inclined to accept 115 mm diameter yellow grapefruit, *Citrus paradisi*, than are naive wild females, possibly owing to the fact that progenitors of the lab flies had oviposited into holes in large (95 mm diameter) plastic cylinders for at least 100 successive generations. Exposure of lab-cultured females for 3 days to either mock orange or sweet orange fruit resulted in significantly lesser propensity (compared with naive females) to accept the plastic yellow spheres. This suggests that non-irradiated lab-cultured flies, after release onto host trees and after a few days of ovipositional experience with naturally-growing host fruit, may learn to reject plastic egg-collecting spheres to a substantial degree. However, our findings also indicate that the degree of rejection of plastic egg-collecting spheres by host-fruit-experienced, non-irradiated lab-cultured females is unlikely to be as great as the degree of rejection of such spheres by host-fruit-experienced wild females. The net result of such a disparity in effect of prior ovipositional experience on acceptance of 100 mm diameter plastic yellow spheres by non-irradiated lab-cultured vs. wild females could be a disproportionately large number of eggs (relative to numbers of females present) deposited in the spheres by non-irradiated lab-cultured flies. Whether irradiated lab-cultured flies respond the same way as non-irradiated flies has not been determined.

On the basis of these findings, we suggest that researchers using plastic spheres for collecting eggs from medflies (wild and/or lab-cultured) on host trees in nature (1) use a size of sphere that approximates closely the size of host fruit borne by the tree in which the sphere is hung, and (2) incorporate into the interior and/or on the surface of the sphere an extract of surface chemicals from the species of fruit where the sphere is to be hung. These recommendations stem from present knowledge that suggests the most important host fruit characters contributing to fruit-learning by medflies are fruit size and fruit surface chemistry, with fruit color and form playing little or no role (Papaj et al. 1989, Prokopy et al. unpub).

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