LACK OF AN IRRADIATION EFFECT ON THE MATING PERFORMANCE OF MASS-REARED MALES OF THE MEDITERRANEAN FRUIT FLY

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The Sterile Insect Technique (SIT) is widely used to suppress infestations of the Mediterranean fruit fly (medfly), *Ceratitis capitata* (Wied.) (Hendrichs et al. 2002). Because the success of an SIT program depends largely on the ability of sterile males to obtain matings, it is critical that the procedures used in rearing and release do not negatively affect their sexual performance. However, many studies (e.g., Lance et al. 2000) have shown that sterile males fare poorly relative to wild males in mating competition for wild females. Consequently, there remains an important need to improve the production protocol used in medfly SIT (Robinson et al. 2002).

There appears general consensus that the irradiation process negatively affects the mating competitiveness of male medflies and that one simple way to lessen this impact, and thereby increase the effectiveness of the SIT, is to reduce the sterilizing dose. However, for the medfly at least, the supporting evidence is less robust than might be assumed. Among the most widely cited studies (Holbrook & Fujimoto 1970; Hooper 1971, 1972; Hooper & Katiyar 1971; Fisher 1997; Lux et al. 2002), we find (i) data describing male mating propensity and not competitiveness, (ii) male mating competitiveness measured with mass-reared females and not wild females (or 'wild-like' females from recently colonized wild populations) in small laboratory cages at high fly densities, and (iii) most data collected from standard bisexual strains and not genetic sexing strains (most notably, temperature sensitive lethal, *tsl*) that are used by current medfly SIT programs. We are aware of only one published article (Wong et al. 1983) that compared the mating success of irradiated versus non-irradiated mass-reared male medflies relative to wild males in competition for wild females on field-caged host trees, and these data showed no effect of irradiation on male mating success. Wong et al. (1982) also reported no difference in dispersal between wild and mass-reared, irradiated males.

Here, we report the results of mating trials conducted in field cages that compared the mating success of non-irradiated and irradiated males from a *tsl* strain competing with wild-like males for wild-like females. Methods used to maintain flies and run the trials follow earlier studies (e.g., Shelly et al. 2004). Owing to the limited availability of wild flies, we used flies from a laboratory colony started with >1000 adults reared from field-collected coffee berries. Eggs from this colony were placed on larval medium over vermiculite for pupation. Adults used in the mating tests were separated by sex before reaching sexual maturity and maintained on a sugar-protein mixture and water. When used, wild-like flies were 7-13 d old, and 6 generations removed from the wild.

Mass-reared flies were from a *tsl* strain produced by the California Department of Food and Agriculture Hawaii Fruit Fly Rearing Facility, Waimanalo, Oahu. Pupae were coated with fluorescent dye, packed into plastic bags, and irradiated (150 Gy with ^{137}Cs source) 2 d before eclosion. To obtain non-dyed, non-irradiated pupae, about 10 ml of pupae (≈ 600 flies) were removed from the holding trays immediately before regular handling. Mass-reared males were maintained on sugar agar gel under the same conditions as wild-like flies and were tested when 5 d old. Although the addition of protein has been found to increase the mating success of sterile males in some studies (e.g., Blay & Yuval 1997), two previous studies (Shelly & Kennelly 2002; Shelly & McInnis 2003) conducted in Hawaii failed to reveal a 'protein effect' for mass-reared males. Consequently, we assume that our estimates of mating competitiveness did not reflect the differing diets offered to wild-like *tsl* males.

On a given test day, we introduced 75 wild-like females, 75 wild-like males, and 75 non-irradiated *tsl* males or 75 irradiated *tsl* males into field tents containing 2 artificial trees at 0800 hours and collected mating pairs over the next 4 h. In all cases, wild-like males were marked 1 d before testing with a paint dot on the thorax. Tests were run on 7 different days (with *tsl* pupae collected on 7 different days) with 4 tents run each day (two with non-irradiated and two with irradiated *tsl* males).

Wild-like males obtained more matings per replicate than non-irradiated (means ± 1 SD: 30.4 ± 10.8 versus 10.1 ± 6.9, respectively, $t = 5.4$, $P < 0.001$) or irradiated males (35.1 ± 13.1 versus 9.7 ± 6.4, respectively, $t = 6.7$, $P < 0.001$). There was no difference between non-irradiated and irradiated *tsl* males in the number ($t = 0.7$, $P = 0.51$) or proportion (25% versus 22%, respectively, $t = 0.9$, $P = 0.38$, data arcsine transformed) of matings obtained per replicate.

Irradiation had no effect on the mating performance of mass-reared male medflies in this study. These results can be interpreted two ways. First, irradiation generally may have no effect on the mating competitiveness of male medflies. Alternately, irradiation may negatively affect mating ability, but its impact may vary with the general

'vigor' of the flies irradiated, being greater for individuals of low quality (D. O. McInnis, personal communication). If this latter explanation is valid, the present results provide a mixed signal relating to medfly SIT. On one hand, the lack of an irradiation effect suggests that the *tsl* flies studied were robust. On the other hand, this lack indicates that the low mating success of *tsl* males (20-25% total matings) is an inherent feature of current production methods (e.g., Cayol et al. 1999; Shelly & McInnis 2003).

Summary

In summary, we found no significant difference in the mating success of non-irradiated and irradiated males from a *tsl* strain competing with wild-like males for wild-like females in field cages. This suggests that the low mating ability commonly observed for sterile male medflies results, not from the irradiation procedure per se, but from long-term domestication and artificial selection associated with the rearing environment.

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