COMPARISON OF FLIGHT ABILITY CYLINDERS FOR QUALITY ASSESSMENT OF MASS REARED QUEENSLAND FRUIT FLY *BACTROCERA TRYONI* (FROGGATT) (DIPTERA: TEPHRITIDAE)

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Summary

To ability of mass reared Queensland fruit flies to fly out of two sizes of flight ability cylinders was assessed under standard conditions. Significantly more flies successfully flew out of the 14 cm FAO/IAEA/UDSA (2003) flight ability cylinder compared to the 9 cm diameter cylinder that had been in use at the Australian mass-rearing facility. In light of this difference and to harmonize with the international standards, the FAO/IAEA/USDA (2003) cylinder has been adopted at the mass-rearing facility and at all local field release sites.

Keywords: insect quality parameters, sterile insect technique, flight ability

INTRODUCTION

The Elizabeth Macarthur Agricultural Institute (EMAI) mass rearing facility for Queensland fruit fly (Qfly), *Bactrocera tryoni* (Froggatt) located at Camden, NSW has been operating since 1996. Many of the known quality assessment procedures used at the Okinawa melon fly Sterile Insect Technique (SIT) program were adopted when the facility first opened (Jessup and Cruickshank 1999). The test for flight ability verified whether newly emerged insects were able to fly up and out of a cylinder 10 cm in height and 14 cm in diameter. This is different to the current standard flight ability cylinder (FAC) recommended by FAO/IAEA/UDSA (2003), which is the same height but is only 9 cm in diameter. Some facilities receiving flies from EMAI have used the FAO/IAEA/UDSA (2003) methods as has Collins *et al*. (2008, 2009). With different facilities using different tests it has been impossible to make direct comparisons that might be used to assess effects of transport and local conditions of each facility. To ascertain comparability and to determine whether one test might be more suitable for adoption by all facilities, we compared the current 14 cm diameter EMAI cylinder and the 9 cm diameter cylinder recommended by FAO/IAEA/UDSA (2003).

MATERIALS AND METHODS

Fruit flies for testing were reared as described by Dominiak *et al*. (2008). Mean pupal weight was 11.0 mg (range 10.5 to 11.7mg). Flight tests were conducted at 25°C (± 1°C) and 65% (± 5%) relative humidity. Although the rooms also have a skylight (Deece *et al.* 2000) artificial lighting provided 12h light, 10h dark with 1h ramping up and down to simulate dawn and dusk. Pupae from 15 weekly production batches (18 February 2008 to 26 May 2008) were tested. Both untreated and irradiated (sterile) pupae were used. Untreated pupae were retained in the EMAI laboratories, and were not dyed, irradiated or subjected to any transport stress. Irradiated pupae were dyed and transported (about 2h each way) by air-conditioned car for treatment at the Australian Nuclear Science and Technology Organisation (ANSTO), Lucas Heights. These pupae were irradiated by a Co_{60} GATRI in-ground gamma irradiator at a nominal dosage of 73±2Gy in anoxic normal air and then returned to EMAI.

The EMAI FAC was made out of 10 cm high x 14 cm diameter black paper card. The IAEA FAC was made from clear acrylic tubing 10 cm high x 9 cm in diameter wrapped in black paper. The walls of each FAC were lightly coated with unscented talcum powder to prevent non-flying flies walking out of the container. Each FAC was held inside a netting cage (25 cm x 40 cm x 25 cm high) in which white sugar, yeast hydrolysate enzymatic powder and water had been placed under a light at the furthest most point from the cylinder to encourage flies to fly out of the FAC. For each assessment, two replicates of 100 untreated and 100 irradiated pupae were placed in petri dishes lined with a black filter paper. A 10 cm (EMAI) or 14 cm (IAEA) diameter FAC was placed over each sample.

Once all the adults had emerged, usually one week after setting the experiment, the contents of the FAC were sorted. Percentage eclosion was calculated by dividing the number of empty pupal cases inside each FAC by the total number of pupae (100). Flight ability was assessed as the proportion of emerged flies which escaped each FAC divided by total number of emerged flies. Differences in the percentage eclosion and proportion of flies able to escape the FAC were tested by a two-way analysis of variance using GenStat software (Payne *et al*. 2008).

RESULTS

Emergence rates were unaffected by placement within either flight tube. Significantly (P≤0.001) fewer (83%) irradiated pupae emerged compared to untreated pupae (87%)(Table 1) and these eclosion rates are generally in keeping with Dominiak *et al* (2007a, 2008). Irrespective of whether the flies were untreated or sterile, significantly (P≤0.001) fewer flies escaped from the EMAI (14 cm) FAC compared to the IAEA (10 cm) FAC. The difference was most pronounced for the irradiated flies (Table1).

Table 1. The percentage eclosion and mean proportion of untreated and irradiated Queensland fruit flies escaping from EMAI (14 cm diameter) and IAEA (10 cm diameter) flight ability cylinders.

Flight Ability Cylinder (FAC)	Untreated	Irradiated
	Percentage eclosion	
EMAI	87.1b	82.4a
IAEA	86.9b	82.9a
Mean±SE	87.0±0.70	82.6±0.70
	Proportion of hatched flies that escaped the FAC	
EMAI	0.87b	0.74a
IAEA	0.96d	0.92c
Mean±SE	0.91±0.007	0.83±0.007

DISCUSSION

As has been demonstrated previously (Dominiak *et al.,* 2007b, Campbell *et al.* 2009) the processing (dyeing, irradiation and transport effects) of mass-reared fruit flies prior to release significantly decreased mean percentage pupal eclosion. Irrespective of treatment, fewer flies escaped from the EMAI (14 cm) cylinder than from the IAEA (10 cm) cylinder. Perhaps the smaller light source from the narrower IAEA cylinder is more attractive to flies. Perhaps the wider EMAI cylinder creates a more diffuse light source that confuses the flies and prevents some from reaching the top. It might be inferred from the results reported here that the flight abilities reported in Dominiak *et al.* (2002, 2007a, 2008) using the 14 cm diameter FAC may have underestimated flight ability by about 11% had the new standard procedure been in place.

Although there are clear advantages to standardising the tests used to verify fitness of laboratory reared fruit flies, different facilities continue to use different FAC standards. The 10 cm x 9 cm IAEA FAC has been used for *C. capitata* (Salvato *et al*. 2003, Barnes *et al.* 2007), *B. philippinensis* Drew and Hancock 1994 (Resilva *et al.* 2007), *B. zonata* Saunders (Siddiqui *et al.* 1998), *B. dorsalis* Hendel and *B. correcta* Bezzi (Orankanok *et al.* 2007). However Ekesi *et al.* (2007) reported that a 20 cm high x 9 cm FAC was used for *B. invadens* Drew, Tsuruta and White and *B. curcurbitae* Coquillett (McInnis *et al.* 2004). Chang *et al.* (2006) tested *B. dorsalis* using 20 cm x 8.5 cm FAC and *Anastrepha obliqua* Macquart was tested using 12 cm x 12 cm FAC (Toledo *et al.* 2004).

The differences reported here demonstrate that a standardized approach is needed to make meaningful comparisons between facilities. Following this trial, the EMAI production facility and field release programs in New South Wales, Victoria and South Australia have now been supplied with the IAEA (9 cm) FAC for flight ability assessments. This will allow measurements to be more easily compared with those reported by other SIT release facilities internationally

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