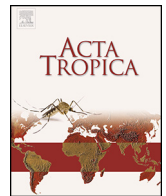




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## Relative performance of surveys for the Old World screwworm fly, *Chrysomya bezziana*, in Iraq based on fly trapping and myiasis monitoring

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### ABSTRACT

Fly traps are being used to monitor populations of Old World screwworm (OWS) flies in Iraq. We evaluated trapping systems for seasonality and trap type and compared the results with monitoring of OWS flies using myiasis on animals. Fly catches increased during spring and autumn with low catches during the hot, dry summer and the cold winter. The effectiveness of the sticky trap/Swormlure and LuciTrap/Bezzilure for OWS flies could not be determined because no OWS were caught during the comparison period in 2009. The LuciTrap caught more flies of all other species than the sticky trap during this comparison. The numbers of myiasis detected on animals in Iraqi provinces from 1996 to 2013 are provided. The high numbers of myiasis in most provinces in the late 1990s were followed by lower numbers and subsequent apparent elimination in about half of the provinces. Myiasis were detected mainly in sheep (77.0%) and goats (16.7%). A temporal comparison of OWS fly detection with traps and animal myiasis in Babil province demonstrated a similar sensitivity and a weak correlation between the two methods. We recommend that both fly trapping and inspection of animals for myiasis are used for the detection or monitoring OWS fly populations and that Iraq and the international organisations initiate an area-wide integrated OWS fly program, including the sterile insect technique, with the aim of eradicating the OWS fly from Iraq.

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### 1. Introduction

The Old World screwworm (OWS) fly, *Chrysomya bezziana* (Villeneuve) (Diptera: Calliphoridae) is an obligate parasite of mammalian hosts throughout Africa, the Middle East Gulf region, the Indian subcontinent, south-east Asia and New Guinea (Spradbery, 1994; Welch and Hall, 2013). Female OWS flies lay eggs on the edges of wounds on live mammals and the larvae burrow into and feed on live tissue causing deep myiasis. OWS causes serious economic, health and welfare problems particularly in livestock, but also in domestic animals and humans (Spradbery, 1994; Welch and Hall, 2013).

In the Middle East OWS flies have been reported at least intermittently in many countries (Siddig et al., 2005 and references therein). In Iraq the first record of OWS fly myiasis was in a cow in 1996 (Abdul-Rassoul et al., 1996). In subsequent years the numbers of myiasis in Iraq grew rapidly (almost to 50,000 in 1997) (Al-Taweel et al., 2000), resulting in an international program by the Arab Organization of Agricultural Development (AOAD), the Food and Agricultural Organization of the United Nations (FAO), the International Atomic Energy Agency (IAEA) and the Office International des Epizooties (OIE) to control this outbreak (Al Izz, 2002). As a result of this effort field veterinary services and clinics recorded details of animal myiasis in all susceptible Iraq provinces and trapping for adult OWS fly was undertaken in selected locations.

Although most detections of the OWS fly in the Middle East has been through monitoring of livestock for myiasis, trapping for adult flies has also been used to investigate the seasonal variations of myiasis-causing (including the OWS fly) and other flies in Saudi Arabia (Alahmed et al., 2006). Recently an improved trapping

Abbreviations: OWS, Old World screwworm.

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system for the OWS fly, a modified LuciTrap with Bezzilure-2 attractant, was reported (Urech et al., 2012). LuciTrap/Bezzilure-2 (four traps with fortnightly trapping periods) had a better sensitivity for detecting the OWS fly (0.85) than inspections of cattle herds (74 animals, sensitivity 0.30 (Urech et al., 2014).

Trapping of the OWS fly was initiated in Iraq as part of the international program after the 1996 invasion (Abdul-Rassoul et al., 1996). The sticky trap with Swormlure-4 (Spradbery, 1981) was used until 2009. In 2009, a comparison between the sticky trap and the LuciTrap with Bezzilure was started with the aim of determining whether the improved performance of LuciTrap could be confirmed under the drier climatic conditions prevalent in the Middle East. A pairwise rotation of the two traps was used for this comparison. The monthly trapping with sticky traps from 2008 to 2009 provided information on seasonal variations in the trapped fly species in Iraq. The number of myiasis in animals was recorded in Iraq from 1996 onwards through veterinary hospital records and veterinarian reports. We have compiled these records by province and for Babil province, where most trapping was conducted, we examined the temporal relationship between the records of myiasis on animals and the catches of OWS flies in traps.

## 2. Materials and methods

### 2.1. Traps and attractants

A sticky trap (Spradbery, 1981) with yellow sticky pads (Starkey's, Wangara WA 6065, Australia) and Swormlure-4 attractant (Mackley and Brown, 1984) or a modified LuciTrap with Bezzilure-2 (Urech et al., 2012) were used (no roof over LuciTrap but including dichlorvos pest strips). Swormlure-4 was dispensed from 100 ml glass bottles with a cotton wick (pulled up 10 mm) and Bezzilure-2 was placed into 50 ml HDPE bottles with a custom made insert (Bioglobal, Brisbane QLD 4000, Australia) and cotton wicks (Bezzilure-2 B wick pulled up 15 mm).

### 2.2. Trapping locations and protocols

Traps were placed in two areas: (1) near Babylon (Babil province, two locations N32°32'21" E44°20'57" and N32°33'50" E44°38'10") and (2) 15 km north of Baghdad (one location N33°9'55" E44°13'57"). All locations were channel irrigated cropping areas with the following main crops: date palms, orange trees, corn, green bean, okra, eggplant, melons and cucumber. Livestock was also an important commodity for milk and meat production. The number of animals at risk of OWS fly infestation at the two Babylon locations were (locations 1/2, 119/225 km<sup>2</sup>, respectively): cattle 1500/1200, sheep 4560/3180, goats 640/500, donkeys 180/150, horses 132/118 and dogs 380/320. Four traps (separated by 150–200 m) were placed at each location and activated for one week. Sticky traps were used once per month from March 2008 to December 2009 in Babylon and from March 2008 to February 2009 near Baghdad (standard OWS fly trap). From May to December 2009 four sticky traps and four LuciTraps were used at both locations in Babylon for one week each month (with a minimal inter-trap distance of 100 m). The sticky traps and LuciTraps were deployed in pairs and their positions exchanged within pairs at each activation for a comparison of their efficacy for OWS and non-target flies. From 2010 onwards, four LuciTraps only were used once every three months (in the first week of March, June, September and December) at both Babylon locations for further evaluation of the LuciTrap in Iraq. Trapping periods were 7 days for all traps. Temperature and rainfall were obtained from Babil Province Meteorological Station.

### 2.3. Fly processing and identification

Flies on sticky pads were identified on pads where possible or removed from pads using petroleum ether. Flies from LuciTraps were dried at ambient temperature before identification. The flies were identified and counted following the keys by Spradbery (1991) and Zumpt (1965). All trap catches are reported as flies per trap per week. Arithmetic averages were used except for the direct comparison between the sticky trap and LuciTrap (Babylon, May to December 2009, eight Sticky traps, eight LuciTraps, eight weekly periods). For this comparison, a paired Student's *t*-test (two tailed) was carried out with transformed (square root  $x+0.5$ ) values and back-transformed means are reported. A transformation was required to normalize the overdispersed data.

### 2.4. Myiasis records

The number of myiasis were obtained from the Veterinary Service Company (VSC), Ministry of Agriculture. In response to the detection of OWS fly infestation in Iraq in 1996, VSC set up a national team (five veterinarians and an assistant in each province) to coordinate and lead the OWS fly program. Myiasis records were obtained by VSC from three sources: From veterinary hospitals and clinics extracting larvae from animal myiasis presented to them (larvae identified by Central Laboratory); field veterinarians conducting provincial surveys; visits to animal owners by veterinarians from clinics or hospitals. The OWS fly program was severely disrupted from March 2003 to January 2004 because of the invasion of Iraq and subsequent war activities. Host myiasis rates were calculated using data from 2001 to 2013 ( $n=3248$ ).

For the comparison of trap catches and numbers of myiasis on animals, the total numbers of flies and myiasis for each quarter from 2008 to 2013 were used. A linear regression using the least squares method (constant  $\neq 0$ ) was used to test for a correlation between trap catches and myiasis.

## 3. Results

### 3.1. Seasonality of trap catches

The average weekly sticky trap catches of common fly species, minimum and maximum temperatures and monthly rainfall in Babil Province (Babylon) are shown in Fig. 1. During the hot and dry summer and the coldest winter months fly populations were very low. Two seasonal fly population peaks in spring and autumn were observed (Fig. 1). Seven OWS flies were trapped in Babil province during 2008 and 2009. In March and April 2008 there were large catches (a few hundred) of *Musca domestica* recorded but these catches dropped off markedly afterwards. The results from the Baghdad location showed an almost identical seasonal pattern (data not shown) with two OWS flies caught in October 2008.

Small numbers of *C. bezziana* (except in 2010 when no OWS flies were caught) and larger numbers of other flies were caught in the LuciTraps in Babil province each year from 2010 to 2013, and the average weekly trap catches over four years were: *C. bezziana* 0.11, *Chrysomya megacephala* 15.5, *Chrysomya albiceps* 13.5, *Lucilia sericata* 18.6, *Calliphora vicina* 4.9 and Sarcophagidae 27.9.

### 3.2. Comparison of sticky trap and LuciTrap

A structured comparison between the standard sticky trap with Swormlure (Spradbery, 1981) and the new modified LuciTrap with

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