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Repellency and oviposition deterrence effects of plant essential and vegetable oils against female Queensland fruit fly *Bactrocera tryoni* (Froggatt) (Diptera: Tephritidae)

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Abstract Eight plant essential oils and five vegetable oils were evaluated under laboratory conditions for their repellency and oviposition deterrence effects against female Queensland fruit fly *Bactrocera tryoni*, using artificial substrates and apple fruits. The results showed that vegetable oils were more effective than essential oils in deterring oviposition. The oil with most potential was that of safflower *Carthamus tinctorius*. This vegetable oil, at a concentration of 10 mL/L, significantly reduced oviposition in apples by 56.4% in a 24 h choice test, but none of the tested essential and vegetable oils had a significant effect on oviposition in apples in a no-choice test. Based on the number of fruit flies landing on treated apples, vegetable oils were not repellents but deterred oviposition. The likely mechanism is that safflower and other vegetable oils created a slippery surface, and females were unable to make punctures in the fruit for egg deposition. Essential oils, especially lemon-scented tea tree *Leptospermum petersonii*, peppermint *Mentha piperita* and honey myrtle *Melaleuca teretifolia*, repelled female *B. tryoni*, but their persistence on apple fruits was very low, only for a few hours.

Key words cottonseed, linseed, neem, palm, safflower.

INTRODUCTION

Queensland fruit fly *Bactrocera tryoni* (Froggatt) causes serious problems for horticultural industries within Australia and for international trade (Heather & Hallman 2008). It occurs in the eastern part of Australia, including Queensland, New South Wales and Victoria (Osborne *et al*. 1997), and infests more than 200 fruit and vegetable species (Hancock *et al*. 2000). *B. tryoni* is occasionally recorded in South Australia, but establishment is prevented by eradication and restriction of fruit entry (Hancock *et al*. 2000; Maelzer *et al*. 2004). Outbreaks of *B. tryoni* have also occurred in Perth, Western Australia, but were eradicated (Horticultural Policy Council 1991). In early 2011, *B. tryoni* was detected in an urban area at Highgate, Perth (Western Australia Department of Agriculture and Food 2011), suggesting that *B. tryoni* remains a potential threat to the other parts of Australia.

Synthetic insecticides such as the organophosphates dimethoate and fenthion can be used as cover sprays for preharvest control of *B. tryoni* infestations. However, because of potential human dietary risks, the use of dimethoate on certain horticultural crops and all food-producing plants in the home garden was suspended in Australia for 1 year from 6 October 2011 (Australian Pesticides and Veterinary Medicines Authority 2012). The suspension period was then extended to 5 October 2013. Fenthion is also likely to be suspended or banned in the near future. Therefore, botanical alternatives for fruit fly control need to be identified, as they are generally safer for humans and the environment than synthetic insecticides.

Few studies have evaluated the effect of natural products against *B. tryoni*. Hassan (1998) reported that neem seed kernel extract, applied by dipping, was toxic to *B. tryoni* eggs and larvae, with first and second instars more susceptible than third instars and eggs. He also found that the plant extract was active as an oviposition deterrent to female *B. tryoni*. Liu *et al*. (2002) demonstrated that the nC20–22 fraction of nC23 horticultural mineral oil, strongly reduced oviposition by *B. tryoni* on tomato fruit.

Essential and vegetable oils have not been evaluated for their biological activity against *B. tryoni*. Essential oils are reported to be active against many domestic (Cheng *et al*. 2007; Pavela 2008; Yoon *et al*. 2009; Nerio *et al*. 2010) and agricultural pests (Hori 1998; Guerra *et al*. 2007; Gonzalez *et al*. 2010; Olivero-Verbel *et al*. 2010; Yang *et al*. 2010), including tephritids such as *Ceratitis capitata* (Wiedemann), *Bactrocera dorsalis* Hendel and *Bactrocera cucurbitae* Coquillet (Mareggiani *et al*. 2008; Chang *et al*. 2009; Kimbaris *et al*. 2009; Barroso *et al*. 2010). However, little is known of the control properties of vegetable oils, with the exception of neem oil. The objective of this study was to evaluate repellency and oviposition deterrence effects of eight essential oils and five vegetable oils against female *B. tryoni*, using artificial substrates and apple fruits.

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