

Mechanism and effectiveness of safflower oil against female Queensland fruit fly *Bactrocera tryoni*

Y. Hidayat^{1,2*}, N. Heather¹ & E. Hassan¹

¹School of Agriculture and Food Sciences, University of Queensland, Gatton, QLD 4343, Australia, and ²Department of Plant Pests and Diseases, Padjadjaran University, Bandung, West Java 40600, Indonesia

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Abstract

Queensland fruit fly, *Bactrocera tryoni* (Froggatt) (Diptera: Tephritidae), infests many horticultural fruit crops in the eastern part of Australia. Farmers usually apply synthetic insecticides to control this pest. Little is known on the use of plant products especially vegetable oils for fruit fly control although they are considered to be safer than synthetic insecticides. In this study, safflower oil was investigated for its mechanism and effectiveness against female *B. tryoni*. In a laboratory test, safflower oil treatments (2.5 and 5.0 ml l⁻¹) reduced the number of fly punctures on treated artificial fruits, no matter whether pre-punctures were present or absent. Safflower oil treatments also reduced the number of fly landings and eggs laid, but only when the treated artificial fruits were without pre-punctures. These results confirmed that safflower oil is active against female *B. tryoni* mainly by preventing this fruit fly from making oviposition punctures, not by discouraging them from depositing eggs or by repelling them. The slippery nature of safflower oil is considered to be responsible for a reduction in the susceptibility of artificial fruit to fruit fly punctures. Further investigation using fruit-bearing tomato plants (a no-choice test) in a glasshouse situation revealed that safflower oil application at concentrations of 10 and 15 ml l⁻¹ reduced the number of oviposition punctures but failed to reduce the number of eggs laid. To increase efficacy of safflower oil under field conditions, multiple tools may be needed to reduce fruit fly populations and oviposition behaviour, such as the addition of trap-crops, provision of artificial oviposition sites, or mixing the insecticides with the oil.

Introduction

Queensland fruit fly, *Bactrocera tryoni* (Froggatt) (Diptera: Tephritidae), is a major pest of horticultural fruit crops in Australia. This fruit fly is present in Queensland and in other eastern mainland states (Osborne et al., 1997), costing fruit growers damage loss, sprays, and disinfestation (Sutherst et al., 2000). Bait and cover spray are the two most common measures for fruit fly control in the field. With few exceptions (Raga & Sato, 2006), insecticidal protein baits usually do not cause immediate death (Manrakhan et al., 2013). Therefore, if the baits are ingested by mature flies, oviposition on fruits is still possible to occur (Roessler, 1989), but in a reduced number (Yee, 2011). A feature of bait sprays is that they are applied only to part of the foliage of host plants or to adjacent vegetation. This

means that a gravid female fly may oviposit in a number of unprotected fruits before encountering a bait spray treated surface. For this reason, bait sprays are more effective in large scale orchard or field situations where they will reduce the total population of gravid females below the level at which unacceptable infestation levels will occur. In general, a cover spray will result in faster population reduction than toxic bait application as shown in the laboratory (Raga & Sato, 2006, 2011). In addition to direct (topical) exposure, cover spray may kill flies through tarsal contact and/or ingestion of residue (Yee & Alston, 2012). Another advantage of some chemical cover sprays is that they can kill eggs and larvae in the infested fruits, though this effect depends not only on toxic but also on penetrative properties of the insecticides (Wise et al., 2009). Nevertheless, alternative methods to control fruit flies are required due to recent and future restrictions on these chemicals.

Safflower, *Carthamus tinctorius* L. (Asteraceae), is an annual herbaceous plant originally grown for its flowers as a source of fabric dye, food colour, flavour, and medicines,

*Correspondence: Y. Hidayat, Department of Plant Pests and Diseases, Padjadjaran University, Bandung, West Java 40600, Indonesia. E-mail: yusup.hidayat@uqconnect.edu.au