

Plant Essential Oils as Ecofriendly Pesticides for Controlling the Peach Fruit Fly

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ABSTRACT

Peach fruit fly is one of the most dangerous insect pests facing fruit production in the world. Plant oils are group of the most promising materials and compounds for controlling fruit flies, especially peach fruit fly, where it is ecofriendly and does not produce harmful effects on human health.

INTRODUCTION

Tephritidae famous as true fruit flies (*Diptera*), are a large group of flies include more than 4500 species described. The genus *Bactrocera*, one of these family members which include about 500 species, which are phytophagous. The Peach fruit fly (PFF) is considered one of the most dangerous fruit pests belong to *Bactrocera* genus which have wide distribution all over the world especially in Egypt, as it is spread in most areas of the Republic due to its adaptation to various climatic regions, high polyphagia and rapid reproduction [1]. It attacks a wide range of hosts (over 50 cultivated and wild plant species) such as: guava, mango, peach, apricot, fig and citrus [2].

CURRENT CONTROL METHODS

During the twenty first century, the uses of alternative methods are new trends rather than the use of conventional pesticides such as: organophosphorus compounds (i.e., malathion, diazinon and nailed) in order to reduce risk of insecticide treatment. Many technologies have developed for wide-area control of Tephritidae fruit flies and related species throughout Asia, Africa and the Pacific (**Table 1**).

Table 1. Modern control methods used for control of flies.

Methods	References
Clouding cover sprays	Roessler [3]
Protein bait sprays	Prokopy et al. [4]
Soil drenches	Stark and Vargas [5]
Male annihilation	McInnis et al. [6]
Sterile insect releases	Vargas et al. [7]
Releases of natural enemies	Vargas et al. [7]
Cultural controls	Allwood et al. [8]
Essential oils	Ali [9]

Use of essential oils as control methods

The use of organic and ecofriendly materials is now an urgent necessity, especially when problems arise from the expansion of pesticide use. Essential oils are one of the most promising substances in the control of insect pests, especially peach fruit fly (**Table 2**). There are many essential oils used in management of fruit flies as described below:

Fecundity: Akhtar et al. [10] tested the toxic effects of neem

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seeds, turmeric and sweet flag rhizomes on settling response and fecundity of *B. zonata*. His results indicate that, turmeric extracts inhibited egg laying and development of pupae and adults.

Table 2. Plant essential oils used for controlling peach fruit fly.

English name	Scientific name	Main component	Targeted pests	References
Onion	<i>Allium cepa</i>	Quercetin-3-lucoside, isorhamnetin-4-glucoside, xylose	<i>B. zonata</i>	Ali [9]
Garlic	<i>Allium sativum</i>	Aliin, allicin, ajoene, allylpropyl		
Clove	<i>Syzygium aromaticum</i>	Methyl amyl ketone, methyl salicylate		
Peppermint	<i>Mentha piperita</i>	Piperine, chavicine		
Basil	<i>Ocimum basilicum</i>	Estragole anetholelinalool		
Castor	<i>Ricinus communis</i>	Ricinoleic acid, Oleic acid, Linoleic		
Eucalyptus	<i>Eucalyptus obliqua</i>	Alpha pinene, beta pinen-alpha Phellandrene		
Watercress	<i>Nasturtium officinale</i>	Sulforaphane, Di Indolyl methane		
Ginger	<i>Zingiber officinale</i>	Gingerols		
Mustard	<i>Sinapis alba</i>	Erucic acid, oleic acid		
Neem	<i>Azadirachta indica</i>	Someldenin, nimbin, nimbinene, 6-desacetylnimbinene, nimbandiol, immobile, nimocinol, quercetin	Akhtar et al. [10]	
Sweet flag	<i>Acores calamus</i>	Lectins, sesquiterpenoids, lignans and steroids	Akhtar et al. [10]	
Turmeric	<i>Curcuma longa</i>	Curcumin, desmethoxycurcumin and bisdemethoxycurcumin	Akhtar et al. [10] Rehman et al. [14]	
Valerian	<i>Valeriana officianalis</i>	Valerian alkaloids actinidine (Ia) and valerianine (Ib), valerenic acid (IIa)	Jilani et al. [11]	
Colocynth	<i>Citrullus colocynthis</i> L.	Linoleic acid, oleic acid, catechin, gallic acid, isosaponarin, isovitexin and isoorientin	Rehman et al. [14]	
Saussurea costus	<i>Saussurea lappa</i>	1-beta-hydroxycolaritin, 5-alpha-hydroxy-beta-costic acid		
Indian valerian, jatamansi	<i>Valeriana jatamansi</i>	Patchouli alcohol, maaliol, seychellene, calarene/ β -gurjunene, α -santalene		

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Harmel	<i>Peganum harmala</i> L.	Harmine, harmaline, harmalol, harman, harmalidine, ruine and tetrahydroharmine	
Tobacco	<i>Nicotiana tabacum</i>	Nornicotine, myosmine, anabasine, anatabine and isonicotene	
Eucalyptus	<i>Eucalyptus obliqua</i>	Alpha pinene, beta pinen-alpha Phellandrene	
Clove	<i>Eugenia caryophyllata</i>	Carvacrol, thymol, eugenol and cinnamaldehyde	Arancibia et al. [12]
Citronella	<i>Cymbopogon nardus</i>	Citronellal, limonene, linalool and isopulegol	
Garlic	<i>Allium sativum</i>	Aliin, allicin, ajoene, allylpropl	<i>Musca domestica</i> Cheraghi Niroumand et al. [13]

TOXIC AND GROWTH INHIBITION

Valeriana officianalis in ethanol and petroleum ether extracts had significant toxic and growth inhibiting effects on fruit fly [11]. While neem formulation has a significant effect against *B. zonata* eggs. Aranciba et al. [12] reported that the essential oil of clove has a good insecticidal activity against *C. capitata* that can be used to improve quality of fruit and for food products. *Allium sativum* has been demonstrated as numerous insecticidal activities on a wide range of insect species, for example, its juice had insecticidal activity against *Delia radicum* and *Musca domestica* [13]. Besides, in a recent study, a group of oils were used to control the pupa stage of the peach fruit fly. Eucalyptus oil showed remarkable superiority over other oils, as well as morphological changes, where the oils caused deformities in the adult flies resulting from treated pupa [9].

Repellent

Rehman [14] found that the petroleum ether extract of *C. longa*, ethanol and acetone extract of *P. harmala* were the most promising repellent against peach fruit fly *B. zonata* in a free choice bioassay. Neem oil and eucalyptus leaf solution showed high repellent action against the peach fruit flies as compared to neem seed powder solution and tobacco leaf solution [15].

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