



E-ISSN: 2320-7078

P-ISSN: 2349-6800

JEZS 2020; 8(1): 452-454

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Received: 22-11-2019

Accepted: 24-12-2019

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## Influence of number of holes in bottle traps containing methyl eugenol on capturing of fruit flies, *Bactrocera* spp. in peach, pear, guava and kinnow mandarin orchards in Punjab, India

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### Abstract

Fruit flies, *Bactrocera dorsalis* (Hendel) and *Bactrocera zonata* (Saunders) are important insect-pests of fruit crops. Worldwide, fruit fly traps are used for monitoring and management of these fruit flies. Various designs of the traps have been standardized in different agro-climatic zones of the world. We studied the influence of number of holes in bottle trap containing methyl eugenol (PAU fruit fly trap) on capturing fruit flies, *Bactrocera* spp. in peach, pear, guava and Kinnow mandarin orchards at Ludhiana, Punjab during 2015 and 2016. Bottle trap contained 1, 2, 3 and 4 holes per trap made in different directions. Traps with 3 holes were found significantly superior in attracting higher number of fruit flies than those with 1, 2 and 4 holes/traps in all the crops. These results indicated that bottle trap having 3 holes were ideal for capturing fruit flies infesting peach, pear, guava and Kinnow orchards.

**Keywords:** Fruit flies, methyl eugenol, bottle trap, holes

### 1. Introduction

Tephritidae fruit flies (Family Tephritidae: order Diptera) are polyphagous pests as they infest hundreds of host plants leading to poor commercialization in domestic markets and quarantine restrictions from importing countries. They are considered very destructive group of insects that cause enormous economic losses in horticultural crops, especially in a wide variety of fruits, vegetables and flowers<sup>[1]</sup>. Fruit flies are considered as the key pests in peach, pear, guava and Kinnow mandarin fruit production causing yield losses and quality degradation<sup>[2, 3]</sup>. Thus pheromone traps are used to measure the abundance and distribution of fruit flies. Use of methyl eugenol based traps stands as the best alternative to chemicals for the management of fruit flies, as it possesses olfactory as well as phagostimulatory action and is known to attract fruit fly adults from a distance of about 800 m<sup>[4]</sup>. However, attractiveness of the trap is influenced by several factors like colour, design and size of the trap<sup>[5]</sup> and trapping efficiency can be increased greatly by using a suitable trap. Bajaj and Singh<sup>[6, 7]</sup> evaluated methyl eugenol traps that differed in shape and colour. In order to increase the efficiency of these traps in managing fruit flies *Bactrocera dorsalis* (Hendel) and *Bactrocera zonata* (Saunders), a study was done in peach, pear, guava and Kinnow mandarin orchards to access the influence of number of holes in the bottle trap (PAU fruit fly trap) on capturing fruit flies.

### 2. Materials and Methods

The present studies were conducted at College Orchard/Fruit Research Farm, Punjab Agricultural University (PAU), Ludhiana (30° 55' N, 75°54' E), farmers' orchard, village Jainpur, district Ludhiana and Fruit Entomology Laboratory, Department of Fruit Science, PAU, Ludhiana during 2015 and 2016. Bottle traps having 1, 2, 3 & 4 holes/traps were used. The experimental orchards comprise of different fruit crops (Table 1) which were monitored at weekly intervals.

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**Table 1:** Fruiting hosts monitored during the study period

Fruit tree	Botanical name
Peach	<i>Prunus persica</i> L.
Pear	<i>Pyrus pyrifolia</i> L. and <i>Pyrus communis</i> L.
Guava	<i>Psidium guajava</i> L.
Kinnow	King ( <i>Citrus nobilis</i> L.) × Willow leaf ( <i>Citrus deliciosa</i> T.)

One litre capacity bottle traps designated as PAU fruit fly traps recommended by PAU, Ludhiana were used in the present studies [3]. The trap consisted of a plywood dispenser, suspended vertically inside the bottle, aligning with 1, 2, 3 and 4 vents that allowed entry of fruit flies inside the trap. To prepare the trap, water absorbable plywood blocks (7.5 cm × 6.0 cm × 2.0 cm) were immersed in ethyl alcohol, methyl eugenol and malathion solution mixed in a glass jar in the ratio of 6:4:1 (v/v) for 72 hrs. A hole in the plywood piece was made with the help of an electric drill to put wire for hanging on the tree. Holes (1, 2, 3 & 4) were made with the help of a hot electric iron rod on the upper side of the bottle for entry of fruit flies. Bottles were cut from bottom side with the help of a hot knife and plywood piece was hanged inside the bottle with two sides of wire coming out from the top of the bottle. The wire was twisted to make a loop. The traps were hanged on the trees at equidistance, and were fixed in first week of April in peach orchard and subsequently in pear, guava and Kinnow mandarin orchards, and were kept in the respective orchards till the fruit harvesting was over.

Traps were hanged to the fruit trees in the respective orchards using metallic wires at a height of 1-1.5 meter from ground level depending upon the height of fruit tree at a place with minimum exposure to direct sunlight. Red coloured reflecting tape was tied to the tree on which trap was fixed for easy accessibility of trees under the experiment. The lower portion of the traps was removed and all the fruit flies trapped in the trap were collected in the carry bag at weekly interval. The lower cut portion of the trap was again re-fixed with the trap. The fruit flies trapped/trap were counted in the laboratory at weekly interval.

For evaluation of fruit infestation by fruit flies, fifty fruits at random/treatment collected at weekly interval were sorted out as infested fruits, based on ovipositor punctures and healthy fruits. Per cent fruit infestation was worked out. Trap catch and fruit infestation (%) were subjected to completely randomized block analysis by using CPCS1 software [8].

### 3. Results

#### 3.1 Trap Catch

Mean population of male *Bactrocera* spp. captured/trap/week in peach, pear, guava and Kinnow mandarin orchards using PAU fruit fly traps having different number of holes revealed that traps with 3 holes had significantly more population of fruit flies captured as compared to traps with 1, 2 and 4 holes

(Table 2). In peach, pooled mean of all the weekly observations revealed that the number of fruit fly males captured/trap/week was significantly high in traps with 3 holes (56.64 males), while fruit flies captured by traps with 4 holes (38.25 males), 2 holes (20.86 males) and traps with 1 hole (11.78 males) were significantly on par with each other.

In pear, pooled mean of all the weekly observations revealed that the number of males captured/trap/week was significantly high in traps with 3 holes (91.06 males) as compared to 4 holes (50.97 males), 2 holes (43.25 males) and traps with 1 hole (23.72 males) which was significantly on par with each other. In guava, pooled mean of all the weekly observations revealed that the number of males captured/trap/week was high in traps with 3 holes (88.47 males) as compared to traps with 4 holes (69.19 males), with 2 holes (48.78 males) and with 1 hole (34.17 males) which was significantly on par with each other. In Kinnow, pooled mean of all the weekly observations revealed that the number of males captured/trap/week was significantly high in traps with 3 holes (307.45 males) as compared to 4 holes (183.86 males), 2 holes (88.70 males) and traps with 1 hole (49.64 males) which was significantly on par with each other.

#### 3.2 Per cent fruit Infestation

To evaluate the impact of different treatments on capturing of male fruit flies in peach, pear, guava and Kinnow, infested fruits were recorded in different treatments (Figure 1). In peach, pooled mean of all the weekly observations showed that per cent fruit infestation was lowest (4.70%) in traps with 3 holes as compared to traps with 4 holes (5.08%), traps with 1 hole (5.25%) and traps with 2 holes (6.03%). Similar results were found in pear, guava and Kinnow mandarin. In pear, pooled mean of all the weekly observations showed that per cent fruit infestation was lowest (6.75%) in traps with 3 holes compared to traps with 2 holes (7.06%), traps with 1 hole (7.39%) and traps with 4 holes (7.42%).

In guava, pooled mean of all the weekly observations showed that per cent fruit infestation was lowest (15.53%) in traps with 3 holes compared to with 4 holes (17.06%), with 1 hole (17.72%) and with 2 holes (18.64%). In Kinnow, pooled mean of all the weekly observations showed that per cent fruit infestation was lowest (10.81%) in traps with 3 holes compared to 4 holes (11.30%), 2 holes (11.88%) and 1 hole (12.47%).

**Table 2:** Mean population of fruit fly males captured in bottle traps having different number of holes in peach, pear, guava and Kinnow

Treatments	Mean fruit flymales/trap/week			
	Peach	Pear	Guava	Kinnow
Traps with 1 hole	11.78 (3.37)	23.72 (4.49)	34.17 (5.54)	49.64 (6.65)
Traps with 2 holes	20.86 (4.38)	43.25 (5.91)	48.78 (6.75)	88.70 (8.17)
Traps with 3 holes	56.64 (7.04)	91.06 (8.96)	88.47 (9.31)	307.45 (15.48)
Traps with 4 holes	38.25 (4.77)	50.97 (5.47)	69.19 (6.88)	183.86 (10.32)
CD (p=0.05)	(2.07)	(2.03)	(2.16)	(3.55)

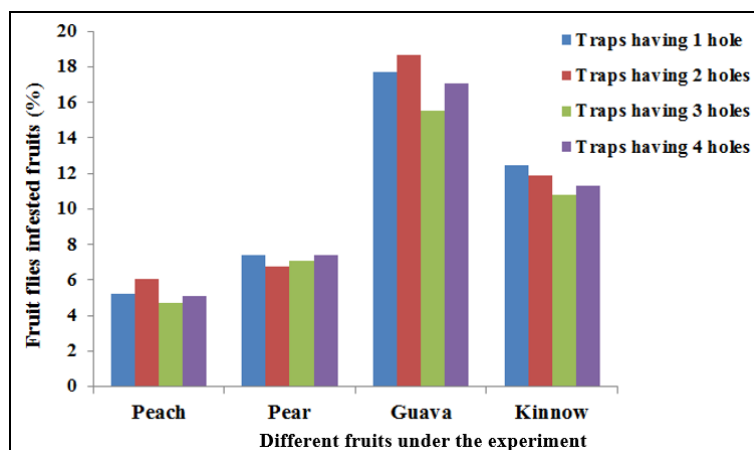
Figures in parentheses are  $\sqrt{n+1}$  transformation

#### 4. Discussion

The present study is in corroboration with Epsky *et al.* [9] who reported that highest capture of fruit flies was in green 3 holes traps as compared to 6 holes trap. However, Ravikumar and Viraktamath [10] in their experiment on number of holes in an 1000 ml capacity pet bottle trap containing methyl eugenol in guava and mango orchards, reported that bottle traps with 4 holes of 20 mm diameter were found significantly superior in attracting higher number of adults of *B. dorsalis*, *B. correcta* and *B. zonata* than those with 1, 2, 3, 5 or 6 holes/ trap.

Similarly, Shankar *et al.* [11] conducted field studies in

Andhra Pradesh, India to determine the effect of the number and size of holes on traps on the capturing efficiency of *Bactrocera* spp. (*B. dorsalis*, *B. correcta* and *B. zonata*) in mango. Their results showed that higher fruit fly numbers were trapped in the treatment bottles with 4 holes with 20 mm size (9.37 flies/trap/week) followed by the trap with one hole (9.33 flies/trap/week). The effect of hole size revealed that fruit fly adults were attracted to the traps with 8 mm diameter holes (9.33 flies/trap/week), which was attributed to the quick dispersal of para-pheromone methyl eugenol and the influence of weather factors.



**Fig 1:** Per cent fruit fly infested fruits of peach, pear, guava and Kinnow mandarin with bottle traps having different number of holes

#### 5. Conclusion

It can be concluded from this study that methyl eugenol based PAU fruit fly traps with 3 holes had captured significantly high population of male fruit flies, *B. dorsalis* and *B. zonata* as compared to traps with 1, 2 and 4 holes in peach, pear, guava and Kinnow mandarin orchards. Per cent damage was lowest in traps with 3 holes than traps with 1, 2 and 4 holes.

#### 6. Acknowledgement

Authors are grateful to Head, Department of Entomology and Head, Department of Fruit Science, Punjab Agricultural University, Ludhiana, Punjab for providing necessary facilities.

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