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Development and standardization of fruit fly traps against *Bactrocera dorsalis* Hendel in Custard apple

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Abstract

Studies were made to standardize methyl eugenol concentration and trap design for *Bactrocera dorsalis* Hendel on custard apple during 2015-16 at University of Horticultural Sciences (UHS), Bagalkot. Among the different concentrations of methyl eugenol, 2 percent was significantly superior in attracting highest number of *B. dorsalis* (5.00 fruit flies/trap/day) compared to its higher dose i.e., 5 percent (4.00 fruit flies/trap/day) and its lower doses. With respect trap design, bottle trap with bottom hole charged with 2 percent methyl eugenol was found superior by attracting highest number of fruit flies (9.66 flies/trap/day) compared to trap with top hole charged with 2 and 5 percent methyl eugenol (0.00 and 1.20 flies/trap/day, respectively). Among the different coloured trap charged with 2 percent methyl eugenol transparent bottle captured significantly highest number of *B. dorsalis* (5.44 fruit flies/trap/day) as compared to yellow, green, blue and white coloured traps (1.44, 0.44, 0.44, 0.44 and 0.22 flies/trap/day, respectively).

Keywords: Fruit fly traps, Trap design, methyl eugenol, *Bactrocera dorsalis* Hendel, Custard apple

1. Introduction

Fruit fly, *Bactrocera* spp. (Diptera: Tephritidae) is one of potential pests that is very detrimental to horticultural production reducing crop yield either through quantitatively or quality [1, 2]. Among 400 species of fruit flies distributed all over the world, *Bactrocera dorsalis* (Hendel) is the most destructive pest [3] causing 25-50 percent fruit loss in custard apple and mango when harvested at the mature ripe stage. The extent of damage may go up to 80 percent in custard apple when the pest incidence occurs in an epidemic form [4, 5].

Among the various alternate strategies available for the management of fruit flies, use of methyl eugenol (ME) traps stands as the most viable, outstanding alternative. Methyl eugenol has both olfactory as well as phagostimulatory action and is known to attract fruit flies from a distance. Methyl eugenol, when used together with an insecticide impregnated into a suitable substrate, forms the basis of male annihilation technique. This technique has been successfully used for the control of several species of *Bactrocera*. The present investigation was undertaken to standardize the lure concentration of methyl eugenol and to develop trap design suitable for trapping fruit flies, *B. dorsalis* in custard apple for further exploration as an eco-friendly component in integrated pest management.

2. Materials and Methods

The experiment was conducted during first fortnight of October 2015 in custard apple orchard at University of Horticultural Sciences (UHS) campus, Bagalkot. Water bottles of one liter capacity were used for the study. The bottles were prepared with four circular holes of 20 mm size on four sides at 8 cm from bottom and a card board block of size 6 x 1.5x 1.5 cm was charged with 10 ml of methyl eugenol solution was tied to one end a loop of iron wire inside the bottle and the other end was passed through the lid and hanged on to three branch at an height of 3 ft above ground. Each bottle was filled with 100 ml water for fly collection. Each trap was separated by 30 ft distance in all the trials. The traps were charged twice at a weekly interval. There were six treatments replicated four times.

2.1 Trap design

The water bottle traps were designed as explained above with two designs with respect holes *viz.*, one with 8 cm from top and another with 8 cm from bottom. The each trap design was charged with 2 and 5 percent of methyl eugenol along with water as control. Experiment totally consisted of six treatments replicated four times.

2.2 Trap colour
Water bottle traps were prepared as explained above with bottom holes. The water bottle traps coated with different coloured paint *viz*., yellow, green, blue, white and transparent (without paint) and charged with methyl eugenol at different concentrations *viz*., 1, 2 and 5 percent and water (as control) for trap type. There were 20 treatments with three replications.

2.3 Observations and statistical analysis
The number of fruit flies trapped in each of the treatment from custard apple orchard was recorded on 1, 2 and 3 days after each charging and the observations recorded and average per trap per day was worked out. The data were subjected to one way ANOVA analysis after subjected to square root transformations.

3. Results and Discussion
3.1 Methyl eugenol concentrations
Fruit fly, *B. dorsalis* showed significant variation in attraction towards different concentrations of methyl eugenol. Bottle traps charged with 2% methyl eugenol attracted significantly highest number of *B. dorsalis* (5 flies/tarp/day) followed by methyl eugenol 5% (4 flies/trap/day) and were statistically at par with each other. Minimum number of fruit flies were attracted to methyl eugenol at 1 and 0.5% (0.75 and 0.50 flies/trap/day). No fruit flies were attracted to methyl eugenol @ 0.1% and control (Table1).

3.2 Trap design
Among the two designs of bottle traps tested, bottles with bottom holes and 2% ME trapped significantly highest number of fruit flies (9.60 fruit flies/trap/day) followed by bottom hole with 5% ME (6.60 fruit flies/trap/day). Minimum number of fruit flies were trapped in bottles with top hole and 5% ME (1.20 fruit flies /trap/ day) and there were no fruit flies trapped in bottles with top hole and 2% ME and control (Table 2).

3.3 Trap colour
Studies to test the influence of colour of traps on fruit fly attraction, the transparent trap with 2% ME captured significantly highest number of *B. dorsalis* (5.44 fruit flies/trap/day) followed by transparent traps with 5% ME (4.33 fruit flies/trap/day). The yellow coloured trap with 2% ME attracted 1.44 flies per trap per day. Significantly lowest mean no. of fruit flies were captured in green, white and blue coloured traps (0.11, 0.22 and 0.22 fruit flies/trap/day, respectively) and there were no fruit flies trapped in any of the control treatments (Table 3).

Present studies indicated 2 percent ME as quite optimum concentration for attracting higher number of fruit flies. Contrary to the present findings one percent of methyl eugenol was significantly superior to all other treatments for the control of guava fruit fly *B. dorsalis* in guava orchard in other studies [6]. Traps charged with 0.2 ml methyl eugenol were superior to all the species of fruit flies in mango orchard [7].

Design of the trap is also important for facilitating easy entry and trapping of fruit flies. Cylinder and bottle traps were reported [8] quite efficient in guava (33.05 and 32.75 fruit flies/trap/week) ecosystem while, bottle traps were efficient against mango fruit flies (7.23 fruit flies).

Present results endorse the earlier findings [9] and [10] who observed greater preference of fruit flies towards yellow and transparent traps. Similar results were obtained [11] with medium sized (500 ml) transparent bottle in guava and orange orchards against *B. dorsalis*. *B. correcta* was attracted to green cylinder and red sphere in guava and orange and green sphere in mango, while**,** *B. zonata* to red and transparent bottle traps in mango. Contrary to present findings, significantly more number of flies were attracted to white (16.953 flies/trap) and yellow (15.317 flies/trap) coloured traps followed by green, orange, red and blue, respectively. Lowest number of flies were attracted to blue colour [12].

Influence of trap colour in attracting higher fruit flies has been reported [13]. Where in, yellow and transparent traps attracted significantly high number of *B. correcta* in guava (70.45 fruit flies/trap/week) and mango (5.13 fruit flies/trap/week), respectively. Green and orange coloured traps in guava (3.79 and 3.75 fruit flies/trap/week, respectively) black coloured traps in mango (3.88 fruit flies/trap/week) were attractive to *B. dorsalis*. *B. zonata* was attracted to red coloured traps (3.75 fruit flies/trap/week) in mango ecosystem. When total fruit flies irrespective of species were considered, yellow colour traps were attractive in guava (71.91 fruit flies/trap/week) while black colour traps in mango (8.68 fruit flies/ trap/week). Higher attraction towards yellow traps was reported in earlier studies [14] (18.60 fruit flies / trap) followed by transparent and green colour traps (8.40 and 7.00 fruit flies / trap / week, respectively) which was at par with orange colour traps (4.80 fruit flies / trap / week).

Similar reports of attraction to yellow colour has also been reported [15] when baited with methyl eugenol, followed by green color trap, then the trap without color (control) and the Red traps.

4. Conclusion
Transparent bottle traps with four bottom holes of 20 mm size charged 2% methyl eugenol attracted highest number of *B. dorsalis*. The next best treatment was traps charged with 5% methyl eugenol. The bottles with holes made at bottom (2%) trapped highest number of fruit flies, than the bottles with holes at the top.

Table 1: Evaluation of different concentrations of methyl eugenol in attracting *Bactrocera Dorsalis*

Treatments	No. of fruit flies trapped/trap/day
T1- Trap charged with 0.1% methyl eugenol	0.00^{b} (0.70)
T2- Trap charged with 0.5% methyl eugenol	0.50^{b} (0.96)
T3- Trap charged with 1% methyl eugenol	0.75^{b} (1.09)
T4 - Trap charged with 2% methyl eugenol	5.00^{a} (2.32)
T5 - Trap charged with 5% methyl eugenol	4.00^{a} (2.09)
T6- Bottle trap charged with water (Control)	0.00^{b} (0.70)
SEm±	0.45
CD @5%	1.36

Means followed by the same letters do not differ significantly at p=0.05 by DMRT

Figures in parentheses indicates transformed value (√x+0.5)

Table 2: Evaluation of trap design against *Bactrocera dorsalis*

Treatments	No. of fruit flies trapped/trap/day
T1-Top hole (2%) ME	0.00^{c} (0.70)
T2-Top hole (5%) ME	1.20^{c} (1.21)
T3-Top hole with water (Control)	0.00^{c} (0.70)
T4-Bottom hole (2%) ME	9.60^{a} (3.15)
T5- Bottom holes (5%) ME	6.60^{b} (2.65)
T6-Bottom holes with water (Control)	0.00^{c} (0.70)
SEm±	0.47
CD @5%	1.39

Means followed by the same letters do not differ significantly at p=0.05 by DMRT
Figures in parentheses indicates transformed value (√x+0.5)

Table 3: Evaluation on the efficacy of different coloured traps in capturing fruit flies, *Bactrocera dorsalis*

Tr. No	Treatments	ME Conc. (%)	Mean No. of fruit flies attracted/trap/day at			Mean No. of fruit flies/ trap
			1 DAI	2 DAI	3 DAI	
T1	Yellow	1	1.00 ^{c} (1.17)	0.33^{d} (0.87)	0.00^{d} (0.70)	0.44^{cde} (0.94)
T2		2	2.66^{bc} (1.76)	1.00^{d} (1.17)	0.66^{cd} (0.87)	1.44^{c} (1.35)
T3		5	2.00^{bc} (1.58)	0.66^{d} (1.05)	1.33^{bc} (1.26)	1.33^{cd} (1.33)
T4		Control (Water)	0.00^{c} (0.70)	0.00^{d} (0.70)	0.00^{d} (0.70)	0.00^{e} (0.70)
T5	Green	1	1.33^{bc} (1.28)	0.66^{d} (0.99)	0.00^{d} (0.70)	0.66^{cd} (1.04)
T6		2	1.00^{c} (1.17)	0.00^{d} (0.70)	0.33^{cd} (0.87)	0.44^{cde} (0.98)
T7		5	0.33^{c} (0.87)	0.00^{d} (0.70)	0.00^{d} (0.70)	0.11^{e} (0.77)
T8		Control (Water)	0.00^{c} (0.70)	0.00 ^{d} (0.70)	0.00^{d} (0.70)	0.00^{e} (0.70)
T9	Blue	1	0.66^{d} (0.99)	0.66^{d} (1.05)	0.33^{cd} (0.87)	0.55^{cde} (1.02)
T10		2	0.66^{c} (0.87)	0.66^{d} (1.05)	0.00^{d} (0.70)	0.44^{cde} (0.95)
T11		5	0.33^{c} (0.87)	0.33^{d} (0.87)	0.00^{d} (0.70)	0.22^{de} (0.84)
T12		Control (Water)	0.00c (0.70)	0.00^{d} (0.70)	0.00^{d} (0.70)	0.00^{e} (0.70)
T13	White	1	0.66^{c} (1.05)	0.33^{d} (0.87)	0.66^{cd} (1.05)	0.55^{cde} (1.02)
T14		2	0.66^{c} (0.99)	0.00^{d} (0.86)	0.00^{d} (0.70)	0.22^{de} (0.83)
T15		5	1.66^{bc} (1.35)	0.33^{d} (0.87)	0.33c^{d} (0.87)	0.77^{cde} (1.09)
T16		Control (Water)	0.00c (0.70)	0.00^{d} (0.70)	0.00^{d} (0.70)	0.00^{e} (0.70)
T17	Transparent	1	4.66^{ab} (2.22)	2.33^{c} (1.67)	2.00^{ab} (1.49)	2.99^{b} (1.84)
T18		2	7.33^{a} (2.72)	6.33^{a} (2.61)	2.66^{a} (1.76)	5.44^{a} (2.39)
T19		5	6.33^{a} (2.45)	3.66^{b} (2.04)	3.00^{ab} (1.58)	4.33^{a} (2.17)
T20		Control (Water)	0.00^{c} (0.70)	0.00^{d} (0.70)	0.00^{d} (0.70)	0.00^{e} (0.70)
SEm±			1.07	0.41	0.37	0.41
CD @ 5%			3.06	1.19	1.07	1.17

DAI= day after trap installation Means followed by the same letters do not differ significantly at p=0.05 by DMRT
Figures in parentheses indicates transformed value (Vx+0.5)

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