Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

J E Z S Journal of Entomology and Zoology Studies

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2019; 7(1): 295-298

Received: 12-11-2018
Accepted: 15-12-2018

Sheikh Khursheed
Division of Entomology, Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir, Jammu and Kashmir, India

Desh Raj
Department of Entomology, College of Agriculture CSK Himachal Pradesh Agricultural University Palampur, Himachal Pradesh India

Correspondence
Sheikh Khursheed
Division of Entomology, Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir, Jammu and Kashmir, India

Response of fruit flies, *Bactrocera* spp. to different attractants in mid-hill Himalayas

Sheikh Khursheed and Desh Raj

Abstract
The experiments were conducted at the Entomological Experimental Farm, CSK HP Agricultural University, Palampur and farmer's field Bara (Hamirpur) to evaluate the response of fruit flies to different pheromones. Seven species of fruit flies were captured irrespective of pheromone traps. The pheromones were species specific in terms of attracting different fruit fly species. Four species *viz*., *B. tau* (Walker), *B. cucurbitae* (Coquillett), *B. scutellaris* (Bizzi) and *B. nigrofemoralis* (White & Tsuruta) responded significantly to cuelure traps and poorly to baculure traps. Two species *viz*., *B. zonata* (Saunders) and *B. dorsalis* (Hendel) attracted significantly to methyl eugenol followed by makshikari traps. However, unidentified species (*B. species*) responded only to cuelure traps. The early detection and mass trapping with the use of lures can prove to be one of the options for management of this devastating pest.

Keywords: Fruit flies *Bactrocera* spp., response, lures

1. Introduction
The cucurbits such as cucumber, bitter gourd, pumpkin, pointed gourd, ash gourd, snake gourd, bottle gourd, ridge gourd and sponge gourd are some of the major vegetables grown across India and worldwide. Horticultural production is limited by many biotic and a biotic constraint. Among biotic factors, fruit infesting Tephritidae is one of the most serious constraints affecting horticultural production. They constitute enormous threats to fruit and vegetable production throughout the world [15]. There are about 325 species of fruit flies occurring in the Indian subcontinent, of which 205 are from India alone [9]. The genus *Bactrocera*, is the most serious pest of agricultural importance in various parts of the world [2]. Fruit flies (Diptera: Tephritidae) are commonly occurring along the tropics and subtropics of the globe and cause significant economic damage to fruit and vegetable crops [3]. Apart from direct losses to fruit and vegetable crops; they also reduce the export value of agricultural produce in many countries due of the severe trade quarantines [5]. Fruit flies constitute an important group of pests infesting cucurbit vegetables [10]. Three species viz., *Bactrocera cucurbitae* (Coquillett), *B. tau* (Walker) and *B. scutellaris* (Bizzi) were found attacking cucurbits [11]. Depending on the environmental conditions and susceptibility of the crop species, the extent of losses varies between 30 to 100% [6, 4]. Monitoring of fruit flies is very important in the managing of the flies in crop fields. Monitoring is an action that is used to understand pest activity which is helpful in pest management decisions. Surveillance to determine fluctuations in fruit fly populations is accomplished using traps baited with lures. Trap catches are used to monitor the relative numbers of fruit flies in an area and changes in pest abundance over time. The results of monitoring can be useful in gauging the fruit fly control actions. With highly mobile insects like fruit flies, monitoring is more efficient with traps and male lures [19]. Therefore, the present investigation was carried out with objectives to evaluate the male attractants and then to develop appropriate monitoring and trapping systems based on species-specific responses to olfactory stimuli.

2. Materials and methods
2.1 Response of fruit flies, *Bactrocera* spp. to different lures
The investigations were carried out during summer seasons of 2009 and 2010 at the Entomological Research Farm, CSK Himachal Pradesh Agricultural University, Palampur situated at an altitude of 1290 meters above mean sea level between 32º6' North Latitude and 76º3' East Longitude and farmer's field, Bara (District Hamirpur) situated at 585 meters above

mean sea level between 31°35' North Latitude and 76°16' East Longitude. The dominant crops grown in both the areas are cucurbits and fruits. The traps and sex attractants used in this study were obtained from Pest Control India Pvt Ltd., Mumbai and Spectrochem Pvt. Ltd., New Delhi, respectively. The traps (Fligh-T^{TM}) consists of three parts, yellow colored base, a translucent dom and a slot for insertion of the lure. The base of the traps were filled with the malathion (3ml/liter of water) and a cotton wad charged with 4 to 5 ml of cuelure, makshikari and methyl eugenol, was inserted in the slot under the dom and the dom was fitted over the base. The baclure septa was hanged with nylon thread inside the trap. The effectiveness of four sex attractants *viz*., methyl eugenol, cuelure, baculure and makshikari was evaluated for their attractiveness to different fruit fly species by using the Flgh-T^{TM} traps. The former two lures are available commercially for monitoring and mass trapping of fruit flies in India. The methyl eugenol, cuelure, makshikari are available in liquid form and baculure is available in solid form (septa). The cotton wads were soaked using 5-6 ml of each lure separately and fixed inside the trap and installed at 1.5 meter above the ground level just after transplanting of cucurbits. Each trap was replicated thrice. The traps were replenished with lures separately at fortnight intervals. A distance of 15meters was maintained from trap to trap to rule out the trap interference and the position of traps was changed at weekly intervals to avoid the effect of position of trap on the fruit fly catches. The observations were recorded throughout the growing season.

Fruit flies were collected from all the traps at weekly intervals. The attracted flies were brought to the laboratory in butter paper covers separately and identified up to the species level with the help of keys [16]. The trapped flies were separated species-wise and counted accordingly. The observations were recorded on the basis of number of different fruit fly species attracted to different lures and the data were subjected to ANOVA and the results were tested at P = 0.5, using critical differences (CD) as the test criterion.

3. Results

3.1 Response of fruit flies, *Bactrocera* spp. to different lures at Palampur

The results of present experiments revealed that seven species of fruit flies *viz*., *B. dorsalis, B. zonata, B. cucurbitae, B. tau, B. scutellaris, B. nigrofemoralis* and *B.* species (unidentified species) were found in the irrespective pheromone traps. However, the lures were found to be species specific in terms of attracting different species of fruit flies. Only two species *viz., B. dorsalis* and *B. zonata* were found responding to methyl eugenol and makshikari traps. Four species *viz., B. cucurbitae, B. tau, B. scutellaris*and *B. nigrofemoralis* were observed to be responding to traps with cuelure and baculure. There was a significant difference among these lures in terms of attracting mean number of respective flies per trap per week. The mean number of *B. dorsalis* captured in methyl eugenol traps was significantly high (156.88 flies/trap/week) as compared to 57.95 flies per trap per week in traps with makshikari. Similar trend was observed in case of *B. zonata* which also responded highly to methyl eugenol traps with a mean number of 33.57 flies per trap per week as compared to 21.82 flies per trap in makshikari traps. Similarly, *B. cucurbitae* responded to both cuelure and baculure traps. However, the significantly higher mean number of 3.30 flies per trap per week was captured in traps with cuelure than that of traps with baculure in which a negligible number of flies (0.18/trap/week) was recorded. The observations recorded on response of *B. tau* revealed that the higher mean number of 55.57 flies per trap per week was trapped in traps with cuelure and significantly lower mean number of flies (12.10 flies/trap/week) captured in baculure traps. *B. scutellaris* was also found responding highly to cuelure traps with significantly higher mean number of 28.67 flies per trap per week as compared to 5.67 flies in baculure traps. *B. nigrofemoralis* also responded to both cuelure as well as baculure traps with 196.52 and 64.87 flies per trap per week, respectively. The unidentified species only responded to cuelure traps with a mean number of 3.04 flies per trap per week (table 1).

During 2010, also same species were observed in traps with different pheromones. All the existing species exhibited similar response towards four tested lures as observed in previous study year. In case of *B. dorsalis*, significantly higher mean number of 320.70 flies per trap per week was recorded in traps with methyl eugenol and lowest in traps with makshikari (145.83 flies/trap/week). Similar trend was exhibited by *B. zonata* with significantly maximum mean capture of 60.38 per trap per week in cuelure traps and minimum mean capture of 31.03 flies per trap per week in makshikari traps. The traps with cuelure attracted *B. cucurbitae* (2.60 flies/trap) while baculure traps attracted a negligible number of flies. The maximum mean number of *B. tau* (44.77 flies/trap/week) was found in cuelure traps and minimum number (6.50 flies) in baculure traps. *B. scutellaris*was found to be responding highly to cuelure traps (19.00 flies/trap/week), but poorly to baculure traps (3.00 flies/trap/week). In case of *B. nigrofemoralis*, the significantly higher mean weekly capture of 529.40 flies per trap was observed in cuelure traps as compared to 122.77 flies per trap in baculure traps. However, again unidentified species only responded to cuelure traps with a mean number of 2.43 flies per trap per week (table 1).

3.2 Response of fruit flies, *Bactrocera* spp. to different lures at farmer's field (Hamirpur)

The results obtained at farmer's field revealed that same species except unidentified species of fruit flies were observed in traps with different lures as that of Palampur during both the study years. During 2009 cropping season, all the treatments showed significant difference in terms of their response on mean number of flies trapped per trap per week. The significantly higher mean number of *B. dorsalis* with 651.94 flies per trap per week was found responded to methyl eugenol traps as compared to 332.18 flies to makshikari traps. *B. zonata* had responding in similar fashion with significantly maximum mean number of 695.27 flies and 328.85 flies per trap per week to methyl eugenol and makshikari traps, respectively. *B. cucurbitae* and *B. tau* responded highly to cuelure traps (50.91 and 37.01 flies / trap / week) and poorly to baculure (19.91 and 5.65 flies / trap/week, respectively). Cuelure was also found to be the most effective to attract significantly higher mean number of fruit flies, *B. scutellaris* and *B. nigrofemoralis* with 9.53 and 9.80 flies as compared to 4.28 and 5.97 flies per trap per week in baculure traps, respectively (table 2).

During 2010 cropping season, all the existing species were found responding in a similar way to respective pheromone traps as in the first study year. The maximum number of *B. dorsalis* was captured in methyl eugenol traps with 330.64 flies and minimum number of 180.52 flies per trap per week

in makshikari traps. Methyl eugenol was found again to be the best attractant which recorded significantly highest mean number of *B. zonata* with 603.39 flies per trap whereas makshikari proved less effective with 264.63 flies per trap per week. Similarly, *B. cucurbitae*, *B. tau*, *B. scutellaris* and *B. nigrofemoralis* were observed to be responding efficiently to cuelure traps with mean number of 90.35, 39.39, 22.00 and 104.33 flies per trap per week, respectively. However, all these four species responded poorly to baculure traps with significantly lowest mean number of 30.18, 7.67, 3.17 and 40.93 flies per trap per week, respectively (table 2).

4. Discussion

It can be inferred from the results of present investigation that the four evaluated lures proved to be specific in terms of attracting the fruit flies and showed significant difference in terms of mean number of flies attracted per trap per week. The *B. dorsalis* and *B. zonata* were observed to be responded only to methyl eugenol and makshikari traps. However, methyl eugenol was proved to be the most effective resulting in highest number of flies trapped per trap per week. Four species *viz*., *B. cucurbitae*, *B. tau*, *B. scutellaris* and *B. nigrofemoralis* were found to be responding to cuelure and baculure traps, but cuelure was the superior which recorded significantly highest number of flies per trap per week than that of baclure. On the other hand, unidentified species responded only to cuelure traps. These results are supported by the findings of various previous workers. Metcalf and Metcalf [13] reported that males of numerous *Bactrocera* and *Dacus* species are known to be highly attracted to either methyl eugenol or cuelure. Hardy [7] also reported that ninety per cent fruit fly species are strongly attracted to either of these attractants. Similar observations had made by other workers also (Lee and Chen;Metcalf *et al*.; Thomas *et al*.; Singh *et al*. Vargas *et al.* [12, 14, 19, 18, 20]. However, Babu and Viraktamath [1] reported that lowest number of *B. cucurbitae* also responded to methyl eugenol traps. This difference might be due to colour or shape of the trap which they had used in their experiment, as Ranjitha and Viraktamath [16] observed varied response of fruit flies to different colour and shapes of traps. The commercially produced lures *viz*., makshikari and baclure were observed significantly less effective to attract the flies. These results are supported by the findings of Verghese *et al.* [21] who used three indigenous attractants with three established attractants and observed maximum number of different flies trapped in methyl eugenol and cuelure traps than indigenous attractants. *B. tau* was found to be responding only to cuelure followed by baculure. Hasyim *et al.* [8] also reported that *B. tau* responded to cuelure traps in passion orchard. The makshikari and baculure are commercially available and cheaper than methyl eugenol and cuelure. The mass trapping with the use of lures can prove to be one of the options for management of this devastating pest. These lures could be used depending on presence of fruit fly species and crop grown in a particular area.

Table 1: Response of fruit flies, *Bactrocera* spp. to different lures in cucumber and bitter gourd fields at Palampur

Name of attractant	Number of fruit flies/trap/week*													
	B. dorsalis		*B. zonata*		*B. cucurbitae*		*B. tau*		*B. scutellaris*		*B. nigrofemoralis*		*B.* species	
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
Makshikari	57.95 (7.67)	145.83 (12.10)	21.82 (4.75)	31.03 (5.66)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
Methyl eugenol	156.88 (12.50)	320.70 (17.92)	33.57 (5.85)	60.38 (7.82)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
Cuelure	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	3.30 (2.07)	2.60 (1.89)	55.57 (7.50)	44.77 (6.76)	28.67 (5.44)	19.00 (4.46)	196.52 (14.04)	529.40 (22.99)	3.04 (2.01)	2.43 (1.85)
Baculure	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.18 (1.08)	0.16 (1.08)	12.10 (3.61)	6.50 (2.74)	5.67 (2.57)	3.00 (1.99)	64.87 (8.07)	122.77 (11.12)	0.00 (1.00)	0.00 (1.00)
CD (P=0.05)	1.61	0.97	0.80	0.73	0.75	0.15	0.61	0.38	0.40	0.49	1.40	1.86	0.19	0.11

Figures in the parentheses are square root transformed values
*Mean of 3 replications

Table 2: Response of fruit flies, *Bactrocera* spp. to different lures in cucumber and bitter gourd fields at Bara (Hamirpur)

Name of attractant	Number of fruit flies/trap/week*											
	B. dorsalis		*B. zonata*		*B. cucurbitae*		*B. tau*		*B. scutellaris*		*B. nigrofemoralis*	
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
Makshikari	332.18 (18.24)	180.52 (13.47)	328.85 (18.15)	264.63 (16.27)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
Methyl eugenol	651.94 (25.54)	330.64 (18.19)	695.27 (26.35)	603.39 (24.57)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
Cuelure	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	50.91 (7.18)	90.35 (9.55)	37.01 (6.15)	39.39 (6.31)	9.53 (3.24)	22.00 (4.76)	9.80 (3.28)	104.33 (10.24)
Baculure	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	19.91 (4.57)	30.18 (5.58)	5.65 (2.55)	7.67 (2.10)	4.28 (2.29)	3.17 (2.03)	5.97 (2.64)	40.93 (6.47)
CD (P=0.05)	1.10	1.27	1.71	1.23	0.78	0.52	0.59	0.89	0.29	0.75	0.36	0.76

Figures in the parentheses are square root transformed values
*Mean of 3 replications

5. Conclusion

The aim of the present study was to determine the response of different existing fruit fly species to these lures which could be recommended in future for the suppression of fruit flies at large scale accordingly by mass trapping. The early detection and mass trapping of fruit flies can be achieved by the use of different pheromones. Furthermore, studies undertaken suggested that olfactory receptor responses for plant

kairomones in the form of cuelure and methyl eugenol may lead to behavior modification, which could be exploited for their management. Substantial reduction in fruit infestation of both vegetables and fruit crops could be achieved when pheromone traps installed prior to the determined peaks of flies' population and in combination with other control methods.

6. Acknowledgment

We would like to thank University authority for providing fellowship to the first author. We are also thankful to farmer for his kind cooperation and warm hospitality during field visits.

7. References

1. Babu KS, Viraktamath S. Population dynamics of fruit flies on cucurbits in North Karnataka. Pest Management and Economic Zoology. 2003; 11(1):53-57
2. Bhagat KC. 2014. Fruit fly fauna (Insecta: Diptera) of Jammu & Kashmir Himalaya, India: check list and biodiversity. International Journal of Food, Agriculture and Veterinary Sciences.2003; 4(1):18-23.
3. Chinajariyawong AS, Kritsaneepaiboon, Drew RAI. Efficacy of protein bait sprays in controlling fruit flies (Diptera: Tephritidae) infesting angled luffa and bitter gourd in Thailand. The Raffles Bulletin of Zoology. 2003; 51(1):7-15.
4. Dhillon MK, Naresh JS, Singh R, Sharma NK. Influence of physico-chemical traits of bitter gourd, *Momordica charantia* L. on larval density and resistance to melon fruit fly, *Bactrocera cucurbitae* (Coquillett). Journal of Applied Entomolgy. 2005; 129(7):393-399.
5. Elekçioglu NZ. Fruit flies of economic importance in Turkey, with special reference to Mediterranean fruit fly, *Ceratitis capitata* (Wied.) Türk Bilimsel Derlemeler Dergisi. 2013; 6(2):33-37.
6. Gupta D, Verma AK. Population fluctuations of the maggots of fruit flies *Dacus cucurbitae* Coquillett and D. tau (Walker) infesting cucurbitaceous crops. Advances in Plant Sciences. 1992; 5:518-523.
7. Hardy DE. Review of economic fruit flies of the South Pacific region. Pacific Insects. 1979; 20:429-432.
8. Hasyim A, Muryati, Istianto M, de Kogel WJ. Male fruit fly, *Bactrocera tau* (Diptera: Tephritidae) attractants from Elsholtziapubescens Bith. Asian Journal of Plant Sciences. 2007; 6(1):181-183
9. Kapoor VC. Taxonomy and Biology of Economically Important Fruit Flies of India. Israel Journal of Entomology. 2005; 35:459-475.
10. Khursheed S, Raj D. Bio-efficacy of certain insecticides and biopesticides against melon fruit flies, Bactrocera spp. Pest Management in Horticultural Ecosystems. 2012; 18(2):143-148.
11. Khursheed S, Raj D. Population buildup of fruit flies, *Bactrocera* spp. (Diptera: Tephritidae) in relation to host availability associated with cucurbits in mid-hill Himalayas. The Ecoscan. 2015; 9(3, 4):731-774.
12. Lee SL, Chen YL. Attractancy of synthetic compounds related to methyl eugenol for oriental fruit fly and melon fly. Journal of Pesticide Science. 1977; 2(2):135-138
13. Metcalf RL, Metcalf ER. Fruit flies of the family tephritidae. In: Plant Kairomones in Insect Ecology and Control (RL Metcalf and ER Metcalf, eds), Chapman and Hall, Inc. London, United Kingdom. 1992, 109-152.
14. Metcalf RL, Mitchell WC, Metcalf ER. Olfactory receptors in the melon fly, *Dacus cucurbitae* and the oriental fruit fly, *Dacus dorsalis*. Proceedings of National Acadamic Science USA. 1983; 80:3143-3147
15. Mohamed AS. Biology, host and Host Plant R, elationship of two Psyttalia species (Hymenoptera: Braconidae): Parasitoids for Fruit Flies (Diptera: Tephritidae) in Kenya. Ph.D. Thesis, University of Gezira, 2003.
16. Ramani. Biosystematic studies on fruit flies with special reference to the fauna of Karnataka and Andaman and Nicobar. Ph. D thesis, Department of Entomology, University of Agricultural Sciences, Bangalore, India. 1997, 214.
17. Ranjitha AR, Viraktamath S. Response of fruit flies to different types of traps in mango orchard. Pest Management in Horticultural Ecosystems. 2005; 11(1):15-25.
18. Singh SB, Singh HM, Singh AK. Seasonal occurrence of fruit flies in Eastern Utter Pradesh. Journal of Applied Zoological Research. 2007; 18(2):124-127.
19. Thomas J, Faleiro R, Vidya CV, Satarkar VR, Stonehouse JM, Verghese A *et al*. Melon fly attraction and control by baits in Central Kerala. Pest Management in Horticultural Ecosystems. 2005; 11(2):110-112
20. Vargas R, Mau R, Wong L. Fruit fly monitoring. USDA. www.extento.hawaii.edu/fruitfly, 2014.
21. Vargas RI, Burns RE, Mau RFL, Stark JD, Cook P, Pinero JC. Captures in methyl eugenol and cuelure detection traps with and without insecticides and with a farma tech solid lure and insecticide dispenser. Journal of Economic Entomology. 2009; 102(2):552-557.
22. Verghese A, Nagarraju DK, Sreedevi K. Comparision of three indigenous lures/baits with three established attractants in case of fruit flies (Diptera: Tephritidae). Pest Management in Horticultural Ecosystems. 2005; 11(1):75-78.