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

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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* (Bizi) and *B. nigromeralis* (White & Tsuruta) responded significantly to cue lure 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 cu lure 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 [4]. 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* (Bizi) 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 32°6’ North Latitude and 76°3’ 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™) 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 was 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 baculure 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 Fligh-T™ 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 15 meters 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 [10]. 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).

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

| Name of attractant | *B. dorsalis* | *B. zonata* | *B. cucurbitae* | *B. tau* | *B. scutellaris* | *B. nigrofemoralis* | *B. species*
<table>
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<td>Makshikari</td>
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<td>145.83</td>
<td>21.82</td>
<td>31.03</td>
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<tr>
<td></td>
<td>(7.67)</td>
<td>(12.10)</td>
<td>(4.75)</td>
<td>(5.66)</td>
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<tr>
<td>Methyl eugenol</td>
<td>156.88</td>
<td>320.70</td>
<td>33.57</td>
<td>60.38</td>
<td>0.00</td>
<td>0.00</td>
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<tr>
<td></td>
<td>(12.50)</td>
<td>(17.92)</td>
<td>(5.85)</td>
<td>(7.82)</td>
<td>(1.00)</td>
<td>(1.00)</td>
<td>(1.00)</td>
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<tr>
<td>Cuelure</td>
<td>0.00</td>
<td>0.00</td>
<td>3.30</td>
<td>2.60</td>
<td>55.57</td>
<td>44.77</td>
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<td></td>
<td>(1.00)</td>
<td>(1.00)</td>
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<td>(1.00)</td>
<td>(7.50)</td>
<td>(6.76)</td>
<td>(5.44)</td>
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<td>Baculure</td>
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<td>19.00</td>
<td>7.67</td>
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<td>(1.00)</td>
<td>(1.00)</td>
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<td>(1.00)</td>
<td>(7.50)</td>
<td>(6.76)</td>
<td>(5.44)</td>
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<tr>
<td>CD (P=0.05)</td>
<td>1.61</td>
<td>0.97</td>
<td>0.80</td>
<td>0.73</td>
<td>0.75</td>
<td>0.15</td>
<td>0.61</td>
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</table>

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 | *B. dorsalis* | *B. zonata* | *B. cucurbitae* | *B. tau* | *B. scutellaris* | *B. nigrofemoralis*
<table>
<thead>
<tr>
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<td>264.63</td>
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<td>(18.24)</td>
<td>(13.47)</td>
<td>(18.15)</td>
<td>(16.27)</td>
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<td>Methyl eugenol</td>
<td>651.94</td>
<td>330.64</td>
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<td>603.39</td>
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<td></td>
<td>(25.54)</td>
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<td>(26.35)</td>
<td>(24.57)</td>
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<td>(1.00)</td>
<td>(7.18)</td>
<td>(9.55)</td>
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<td>19.91</td>
<td>30.18</td>
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<td>(1.00)</td>
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<td>(1.00)</td>
<td>(1.00)</td>
<td>(4.57)</td>
<td>(5.58)</td>
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<tr>
<td>CD (P=0.05)</td>
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<td>1.27</td>
<td>1.71</td>
<td>1.23</td>
<td>0.78</td>
<td>0.52</td>
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</table>

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