# Chemical Attractant to Trap *Bactrocera latifrons* (Diptera: Tephritidae) in Chilli Field

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***Abstract*—This work aimed to study the attractiveness activity of the mixture of *α*-ionol and *α*-ionone in farmer field. The results showed the absence of *Bactrocera latifrons* but *Bactrocera caudata* were collected from the traps. The highest attractiveness is formula 4 that mixed with *α*-ionol and *α*-ionone is 7:3 and these activity were decreased after week. The other mixture of isophorol and isophorone were compared with *α*-ionol and *α*-ionone mixture in chilli field. The mixture of *α*-ionol and *α*-ionone gave attractiveness higher than the mixture of isophorol and isophorone. The optimum ratio of *α*-ionol and *α*-ionone is 9:1 while the optimum ratio of isophorol and isophorone is 0:10.**

***Index Terms*—*Bactrocera latifrons*, attractant, chilli**

## I. Introduction

*Bactrocera latifrons* is an important pest that damaged vegetables especially *Solanaceae* that contain chilli, tomatoes and eggplants. The crop failure caused by *Bactrocera latifrons* has been evidenced more than once time a year, which can fail a lot of chilli. Female *Bactrocera latifrons* lay an egg in chilli, when the larva come out from their burrows for food which cause the chilli to be rotten, pathogenicity of other pest and disease [1]. Pesticides could be left over on vegetables especially in schedule injection (every week or every month) without any concern such as pest dispersion checking, waste, cost and the environment impacts [2].

Many reports revealed chilli were disrupted by chilli fruit fly 60-80% and yuyee chilli 43.04% [3].

Many chemicals that attract *Bactrocera latifrons* were *α*-ionol, *α*-ionone, isophorol and isophorone (Fig. 1) [4]. The chemical structure skeleton of *α*-ionol (A) and *α*-ionone (B) are resemble, the different part is functional group that *α*-ionol have hydroxyl group and *α*-ionone contain carbonyl group. These similar with the chemical structure of isophorol (C) and isophorone (D) that contain functional group hydroxyl and carbonyl, respectively. The mixture of these chemicals and cade oil were studied for the attractiveness of chilli fruit fly which α-ionol and cade oil trap could be caught 100% in the first week [3]. *α*-Ionol is the one of attractant that was reported the attractive activity [5]. However, *α*-ionone and *α*-ionol were not nearly strong attractant like other well-known tephritid fruit fly lures, methyl eugenol and cue lure.

The new attractants of the Solanaceae fruit fly were derived from *α*-ionone and *α*-ionol that favor attractant for using for *Solanaceae*. The former research present that males *Bactrocera latifrons* were attracted in high percentage with isophorone and isophorol, which have a partial skeletal structure of *α*-ionone/*α*-ionol and their mixtures with *α*-ionol showed higher activity than any of the individual compounds [5]. Furthermore, the derivatives of *α*-ionone and *α*-ionol were synthesized to improve the attractiveness efficiency for *Bactrocera latifrons* [6].

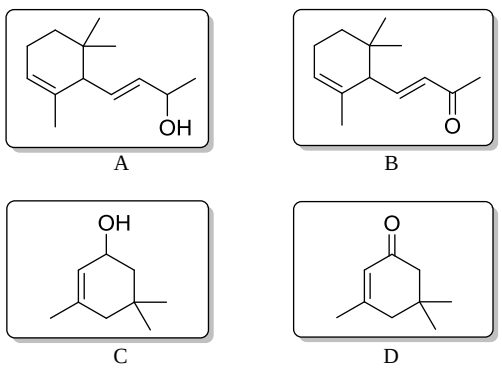


Figure 1. Structure of *α*-ionol (A), *α*-ionone (B), isophorol (C), and isophorone (D)

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Figure 2. *Bactrocera latifrons*

*Bactrocera latifrons* known as the pest for chilli that have the black spot at the tail wing which in Fig. 2. It is similar to *Bactrocera dorsalis* as the pest for fruit that do not have the black spot at the tail wing. From these resemble the farmer favor to use methyl eugenol in the farm for attraction.

## II. Materials and Methods

### A. Chemicals Attractant

$\alpha$-Ionol, $\alpha$-ionone, isophorol and isophorone were obtained from Sigma–Aldrich (Fluka) (St. Louis, MO, USA).

These chemical were mixed by micropipette with 500 micrograms as total weight. The ratio of $\alpha$-ionol and $\alpha$-ionone were shown in Table I and the ratio of isophorol and isophorone were presented in Table II.

### B. Field Trapping with Attractants

The first study was conducted during March to May at the chilli farm in Donmoon village, Nan, Thailand. A total of 33 traps were installed in 3 times of 11 treatments each. The second study was proceed during January to March at chilli field in Rajamangala University of Technology Lanna Nan. A total 66 traps were trapped in 3 times of 22 treatments each. Each treatment contained components mentioning in Table I and Table II on the wool for dispenser with 500 micrograms. The traps were made from the used plastic bottle with 12 inches height and 4 inches width. The cutting of 5 inches from bottlenose and skewered in the remaining part was occurred. Then, the small hole on the top of them was pierced with hot wire and wool that act as dispenser was hung on the wire that shown in the Fig. 3. The mixture of chemicals attractant were dropped into the dispenser. The trap hung in the crop for 30 days. The number of pest were collected every two day and observed dominant characteristic for species classification. The data were subjected to ANOVA and compared means using Duncan's.

Figure 3. The trap for chilli fruit fly field trapping

TABLE I. The Amount of $\alpha$-ionol and $\alpha$-ionone Ratio

| Formula | $\alpha$-ionol and $\alpha$-ionone ratio |
|---|---|
| 1 | 10 : 0 |
| 2 | 9 : 1 |
| 3 | 8 : 2 |
| 4 | 7 : 3 |
| 5 | 6 : 4 |
| 6 | 5 : 5 |
| 7 | 4 : 6 |
| 8 | 3 : 7 |
| 9 | 2 : 8 |
| 10 | 1 : 9 |
| 11 | 0 : 10 |

TABLE II. The Amount of Isophorol and Isophorone Ratio

| Formula | isophorol and isophorone ratio |
|---|---|
| 1 | 10 : 0 |
| 2 | 9 : 1 |
| 3 | 8 : 2 |
| 4 | 7 : 3 |
| 5 | 6 : 4 |
| 6 | 5 : 5 |
| 7 | 4 : 6 |
| 8 | 3 : 7 |
| 9 | 2 : 8 |
| 10 | 1 : 9 |
| 11 | 0 : 10 |

## III. Results and Discussion

This study desired to examine the chemical attractant activity in chilli field. From the first study show attractive activity of $\alpha$-ionol and $\alpha$-ionone for chilli fruit fly in field crop for 14 days using formula usage in Table I, the results were shown in Table III. The dominant characteristic of these pest revealed on their wing, back and abdomen, *Bactrocera latifrons* contained small black spot on the wing tail, two yellow line on the back and white line on brown abdomen while *Bactrocera caudata* had black spot on the wing tail bigger than appeared in *Bactrocera latifrons*, three yellow line on the back and white T-shape line on black abdomen. The one important pest is *Bactrocera dorsalis*, their wing no black spot, two yellow line on the back and black T-shape line on brown abdomen. The classification could be classified the pest that were attracted in study trap.

The results in Table III were demonstrated the number of *Bactrocera caudata*. That were trapped by attractant with 11 formula that consist different ratio of components.

In these study *Bactrocera latifrons* disappeared in each trap, only found *Bactrocera caudata* that the pest of pumpkin at the flower stage that beside the chilli field [7]. In first week $\alpha$-ionone could attract *Bactrocera caudata* higher than $\alpha$-ionol. The formula 11 that consist of 100% $\alpha$-ionone gave highest number of pest in first week while formula 4 combined with $\alpha$-ionol and $\alpha$-ionone ratio 7: 3 provided less than 1.5 fold number of pest of formula 11. Decreasing 2 fold of pest was found with formula 5 that blended with $\alpha$-ionol and $\alpha$-ionone ratio 6: 4. The lowest attractiveness ratio of attractant were provided by formula 2 and 3 that gave number of pest less than the highest formula with 4.5 fold. Every formula in first week intimated higher attractiveness than the week after. In second week the amount of pest were decreased with every formula. The number of pest were dropped 18 fold from formula 11 that showed highest number of pest in first week. And, the effectiveness of attractant of formula 4 and 5 were depleted 12 and 8 fold of first week, respectively. Similarly with second week, the third and fourth week afforded low attractiveness activity from first week. The reduction of pest were occurred, especially the mixture that blended with high ratio of $\alpha$-ionone which low boiling point. These reason influenced lower attractiveness activity. The formula 11 and 4 gave high activity, that could be attracted 18.33 and 12.67 *Bactrocera caudata* respectively. While formula 2 and 8 gave low activity, that could be attracted 4 and 5.33 *Bactrocera caudata* respectively.

TABLE III. AVERAGE NUMBER OF BACTROCERA SPP. ATTRACTED TO ATTRACTANT

| Formula | Number of *Bactrocera caudata* | | | |
|---|---|---|---|---|
| | 1st week | 2nd week | 3rd week | 4th week |
| 1 | 9±5.57 | 1.33±2.31 | 1.33±2.31 | 0.67±1.54 |
| 2 | 4±3.61 | 1.33±1.53 | 0.67±0.58 | 0 |
| 3 | 4.67±3.51 | 0 | 0.67±0.58 | 0.33±0.58 |
| 4 | 12.67±13.43 | 1.67±2.89 | 0.67±1.15 | 0 |
| 5 | 8.67±2.08 | 1.67±1.55 | 0 | 1.00±1.00 |
| 6 | 5.67±1.53 | 2.33±2.08 | 1.00±1.00 | 0.33±0.58 |
| 7 | 6.00±1.73 | 1.00±1.73 | 0 | 0 |
| 8 | 5.33±2.52 | 0.67±1.56 | 0.33±0.58 | 0.33±0.58 |
| 9 | 7.67±8.62 | 1.33±2.31 | 1.00±1.00 | 0.33±0.58 |
| 10 | 6.67±7.23 | 2.00±3.46 | 1.00±1.73 | 0 |
| 11 | 18.33±21.39 | 1.00±1.73 | 0 | 1.00±1.00 |

The second study data was showed in Table IV and V. The Table IV indicated the number of *Bactrocera latifrons* were trapped by using the mixture of $\alpha$-ionol and $\alpha$-ionone while the Table V represent the number of *Bactrocera latifrons* were trapped by using the mixture of isophorol and isophorone.

In Table IV, the chemical attractants classified into 2 groups first is IN, which accommodated $\alpha$-ionol and $\alpha$-ionone, second is SP, which contained isophorol and isophorone. In each group mixed together followed the ratio in Table II and III. The highest attractiveness of *Bactrocera latifrons* with IN is formula 2 that contained $\alpha$-ionol and $\alpha$-ionone is 9:1 that showed average total number of 6 pests in 30 days, while the least of them are formula 3 and 6 that contained $\alpha$-ionol and $\alpha$-ionone with 8:2 and 5:5 respectively that provided average total number of 1.67 pests in 30 days which less than 3.6 fold of the highest formula. The highest attractiveness of *Bactrocera latifrons* with SP is formula 11 that only consist of isophorone with average total number of 2.33 pests in 30 days, while the lowest attractiveness is formula 1, 2, 6, and 7 with average total number 0.33 pests in 30 days, less than the highest formula 7 fold. The average total number of *Bactrocera latifrons* were attracted by IN is higher than SP in each formula. From these result the chemical attractants can aggress with low attractiveness. However, these indicated specific activity to entrapped *Bactrocera latifrons* in chilli field.

TABLE IV. AVERAGE OF TOTAL NUMBER OF *BACTROCERA LATIFRONS* ATTRACTED TO ATTRACTANT $\alpha$-IONOL AND $\alpha$-IONONE (IN)

| Formula | Total Number of *Bactrocera latifrons* | | |
|---|---|---|---|
| 1 | 3.00 | ± | 2.00 |
| 2 | 6.00 | ± | 3.46 |
| 3 | 1.67 | ± | 1.53 |
| 4 | 2.33 | ± | 0.58 |
| 5 | 4.33 | ± | 1.53 |
| 6 | 1.67 | ± | 2.08 |
| 7 | 4.33 | ± | 2.08 |
| 8 | 2.67 | ± | 2.52 |
| 9 | 3.67 | ± | 0.58 |
| 10 | 2.33 | ± | 2.08 |
| 11 | 3.33 | ± | 1.53 |

TABLE V. AVERAGE OF TOTAL NUMBER OF *BACTROCERA LATIFRONS* ATTRACTED TO ATTRACTANT ISOPHOROL AND ISOPHORONE (SP)

| Formula | Total Number of *Bactrocera latifrons* | | |
|---|---|---|---|
| 1 | 0.33 | ± | 0.58 |
| 2 | 0.33 | ± | 0.58 |
| 3 | 1.33 | ± | 1.53 |
| 4 | 1.00 | ± | 1.00 |
| 5 | 0.67 | ± | 0.58 |
| 6 | 0.33 | ± | 0.58 |
| 7 | 0.33 | ± | 0.58 |
| 8 | 0.67 | ± | 0.58 |
| 9 | 0.67 | ± | 0.58 |
| 10 | 0.67 | ± | 0.58 |
| 11 | 2.33 | ± | 2.31 |

The research about the attraction of *Bactrocera latifrons* were studies for the decade the highest effectiveness was reported by $\alpha$-ionol and cade oil usage but not gave high attractiveness like methyl eugenol and cuelure that active to *Bactrocera dorsalis* and *Bactrocera curcubitae* [8]-[10], and cade oil is too difficult in Thailand commercial. With the recent revealed activity of isoeugenol that could baited *Bactrocera latifrons* but still less than $\alpha$-ionol and cade oil [5]. Although, in these study the attractiveness of IN is higher than SP which opposed the previous studies these activity in the laboratory that gave moderate attractiveness that the mixture of isophorol and isophorone is higher than the mixture of $\alpha$-ionol and $\alpha$-ionone. The previous study reported $\alpha$-ionol and $\alpha$-ionone and their derivatives could be attracted *Bactrocera latifrons* [5], especially 3-oxo-ionone and 3-oxo-ionol that were synthesized from microbial conversion could be attract higher than $\alpha$-ionone and $\alpha$-ionol [11]. Although, these attractants, $\alpha$-ionone and $\alpha$-ionol could be attracted fairly otherwise it response for these attractant with short time [12]. The improvement of attractive activity will be study in continuously with blending of other attractant or volatile chemical substances by using $\alpha$-ionol as base.

## IV. Conclusions

The mixture of chemical attractant $\alpha$-ionol and $\alpha$-ionone could active to *Bactrocera caudate* and *Bactrocera latifrons* which pest for pumpkin flower stage and chilli. Moreover, both of mixture of $\alpha$-ionol and $\alpha$-ionone and mixture of isophorol and isophorone gave low attractiveness but specific in chilli field.

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