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FIELD EVALUATION OF ALTERNATIVE TRAP DESIGNS AND DISPENSER TYPES TO MAXIMISE THE TRAP CATCH OF CUCURBIT FRUIT FLIES

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ABSTRACT

The melon fly (*Bactrocera cucurbitae* Coquillett) is the most common fruit fly species infesting cucurbit vegetables and often causing significant loss in marketable yields. While the parapheromone- cue lure (4 - (p- acetoxyphenyl)-2- butanone) is globally used as attractant for trapping the adult males of *B. cucurbitae*, there is good scope for improved trap design and/or dispenser types in enhancing their impact in monitoring and/ or mass trapping. The present field studies on trapping the melon fly with cue lure (CL) showed that the white plastic jar type was superior, while the delta trap type was next best among four trap types compared. Among four alternative dispenser types, the larger plywood discs (large, medium) were found to be superior, compared to the small plywood disc which was on par with vial plus wick. When cue lure was deployed without blending, the more promising trap-dispenser combinations was the cylindrical jar in combination with large disc or medium disc, whereas when cue lure was blended (with methyl eugenol), the superior combinations were cylindrical jar with either large disc or vial with wick as dispenser. The implication of the results in choice of alternative traps/lure dispensers in deploying cue lure alone or blended for cucurbit fruit fly catch maximisation is discussed.

Key words: Cucurbit fruit fly, trap design, dispenser type, cue lure, blending, trap catch, cue lure, delta trap

The melon fly (*Bactrocera cucurbitae)* (Coquillett) is the most common fruit fly species causing significant losses in marketable yields (3- 100%) in cucurbit vegetables, (Dhillon et al*.,* 2005). Suganthy et al. (2014a) have documented the cucurbit crop farmers' perception of fruit fly control as a priority input to ensure adequate marketable yields. As an option towards minimising the use of chemical insecticides for fruit fly management, the parapheromone- cue lure (4 - (p- acetoxyphenyl)-2- butanone is globally used as attractant to trap the males of *B. cucurbitae*. The potential of improved trap design and/or dispenser types in their impact in monitoring and/ or mass trapping has been pointed out by Vargas et al. (2009) and Alim et al. (2012). In India, some attention was paid to these R&D aspects in a national R&D project on fruit flies (Stonehouse et al., 2005), and recently Suganthy et al., (2014b) compared some alternative trap types and lure dispensers in improving the catches of the fruit fly species complex in cucurbit ecosystem. Amsa et al. (2014) compared alternative lure dispensers and also tested the scope for synthetic food attractant for cucurbit fruitfly females. The present studies were taken up to identify promising trap types and lure dispensers individually and identify the more promising trap-dispenser combination while deploying cue lure alone and also as blend to maximise *B. cucurbitae* catches in cucurbit ecosystems.

MATERIALS AND METHODS

The field study for comparison of trap designs was carried out in a cucurbit farm at Sethumadai village in Pollachi District near Coimbatore during November-December, 2015. There were five traps designs compared, namely cylindrical white plastic jar (height-14 cm; diameter-10.5 cm) described by Sithanantham (2011), besides triangular section (delta) sticky trap (bottom-11.5 cm; length-22 cm), collapsible (square section) yellow plastic sheet trap (6.5.cm each side; height-11.0 cm), circular plastic plate (diameter-25 cm) sticky trap and a cylindrical transparent jar trap (height-13 cm; diameter- top11.5 cm; bottom-9.5 cm) trap. The cue lure, as attractant, impregnated in the plywood blocks (4x1x1 cm). The traps were kept at an inter-

distance of 20 feet and the treatments were replicated five times. The catches in traps were recorded weekly for four weeks and after each count the positions of the traps within each replication were inter-changed, to minimise position effects. The identity of the melon fruit fly adults caught was ascertained in the samples brought to the laboratory by using the key described by David and Ramani (2011).

The field study to compare lure dispensers was carried out in the same season and location. Four lure dispensers were compared, namely Liquid vial (height-5.5 cm; diameter-3.0 cm) with wick (length-7.0 cm; diameter-1.0 cm) and three sizes of ply wood discs - large (4x4x1 cm), medium (4x2x1 cm) and small (4x1x1 cm). The quantity of Cue lure dispensed was within the maximum holding capacity in each of the four dispensers and estimated as11.0 ml, 3.6 ml, 2.4 ml and 1.8 ml, respectively. The toxicant (malathion) added to the respective dispensers for knock down of the flies arriving in the trap was 5.0 ml, 0.90 ml, 0.65 ml and 0.45 ml. These test dispensers were all tested by placing them inside the standard cylindrical white plastic jar trap (Sithanantham 2011). This study was replicated four times and the weekly catches were recorded for ten continuous weeks. After each week, the positions of the traps within each replication were inter-changed at random.

Evaluating performance of trap-dispenser combinations was also carried out (during December 2015 to February 2016) in the same cucurbit farm with eight treatments as below:

T1. Jar trap plus vial with wick (for Lure A); T2. Jar trap plus large size (4x4x1 cm) disc (for Lure A); T3. Jar trap plus medium size (4x2x1 cm) disc (for Lure A); T4. Jar trap plus small size (4x1x1 cm) disc (for Lure A); T5. Delta trap plus large size (4x4x1cm) disc (for Lure A); T6. Collapsible trap plus large size (4x4x1 cm) disc (for Lure A); T7. Jar trap plus vial with wick (for Lure B); T8. Jar trap plus large size (4x4x1 cm) ply wood disc (for Lure B)

This study was replicated four times and the weekly catches were recorded for ten continuous weeks. After each week, the positions of the traps were changed, while maintaining a minimum distance of 20 feet between each trap.

The results from each of these three studies were subjected to ANOVA as described by Gomez and Gomez (1983).

RESULTS AND DISCUSSION

Trap designs

The differences in trap catches between the five treatments were highly significant (at p=0.05). The maximum catches were in cylindrical white plastic jar trap (24±12.11), followed in rank by the delta trap (14.5±4.65) and the circular plastic plate sticky trap (12.25±4.5); whereas, it was considerably lower in the collapsible yellow sheet trap (8±4.24) and the least catches (5.75±2.21) were in the locally used transparent jar trap (Fig. 1).

While the per week overall trap catch ranged between about 6 for transparent trap and 24 for the cylindrical plastic jar trap type, the superiority of the standard plastic jar is in conformity with earlier results of Divya et al. (2011) and Suganthy et al. (2014a) who had also tested trap types with cue lure as attractant. The present result is of considerable practical significance, since the same jar trap type had also been identified as superior for trapping the Oriental fruit fly (*B. dorsalis*) complex with methyl eugenol in tree fruit crops like mango (Sithanantham, 2011). This implies that the benefit of superior catch from this type trap could be availed to maximise the trap catches of both for melon fly species complex in cucurbit crops and also for the oriental fruit fly species complex in tree-fruit ecosystems like mango and guava. The delta trap and circular plate sticky traps, which were next in rank, might be also further studied for alternative dimensions and attributes to improve the trap catch, whereas the collapsible trap and transparent trap which were clearly less efficient are to be discouraged. The trend of weekly catches in the four week observations is indicated in Fig. 2.

These results confirmed the overall consistency in the superiority of the cylindrical trap in all three subsequent weeks.

Lure dispensers

The differences in catches of *B. cucurbitae* were significant among the dispensers, besides weeks and their interaction. The overall weekly catches were maximum in large size (4x4x1 cm) disc (11.62±6.18), followed by and on par with the catches in medium size (4x2x1 cm) disc (9.37±5.81). The catches in liquid vial (6.97±5.23) were significantly less and also on par with the catches in small size (4x1x1 cm) disc (6.22±4.05) (Fig. 3).

The present finding that the large disc caught

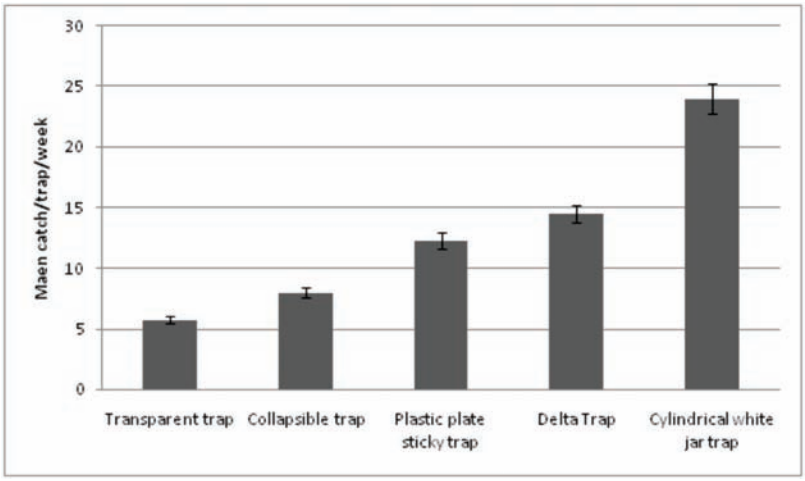

Fig. 1. Comparison of trap types on catches of *B. cucurbitae*

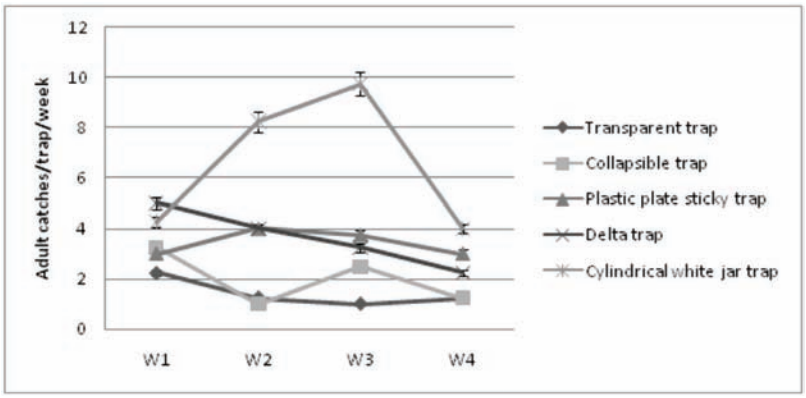

Fig. 2. Comparison of traps for weekly catches of *B.cucurbitae*

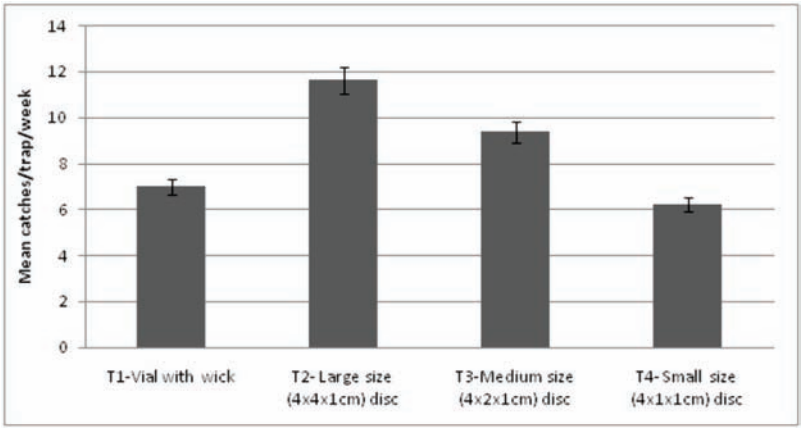

Fig. 3. Comparison of *B. cucurbitae* catches in four lure dispensers

significantly more *B. cucurbitae* than either small disc or vial with wick are in conformity with the findings of Suganthy et al. (2014b). Further, the superior performance of the large disc dispenser being also on par with the medium disc dispensers is in conformity with the findings by Amsa et al. (2014). It is thus evident that the choice of the larger disc could be justified in maximising the catches, the medium disc may be chosen for maximising the cost: benefit ratio, since it required only two-thirds the quantity of cue lure (2.4 ml) compared to large disc (3.6 ml), when considered for performance with periodical replacement interval. The

week-wise catch pattern for the three dispensers confirm that the superiority of the large disc dispenser was consistent (Fig. 4).

This trend further clarified the dependable superiority in performance across the eight week observation period, which confirmed the findings by Suganthy et al. (2014b) that in non-blended cue-lure the large disc (4x4x1 cm) was significantly superior in jar trap combination.

Trap design-lure dispenser combination

The results showed significant overall differences in catches among the eight treatments (trap type-lure dispensers combinations), besides also among the weeks of the study, and the interaction between treatments and weeks. The maximum mean catch (19.35±5.13) was in the combination of improved delta trap with large disc (4x4x1 cm) when cue lure was deployed alone (Fig. 5). This was also significantly greater than the next two combinations for blended cuelure, beingcylindrical trap with vial-wick dispenser (15.07±4.45), which was also on par with same trap type and large disc (4xr4x1cm) combination (15±5.94) when blended with ME (Fig. 5). The next ranking two combinations for unblended CL in cylindrical jar traps were large disc (4x4x1 cm) (13.22±4.94) followed in rank by medium disc (4x2x1 cm) (10.82±4.58). The other three combinations were rather poor in catches and hence did not appear promising, all for unblended CL, namely vial in jar trap (6.85±4.21), small disc (4x1x1 cm) in jar trap (5.95±2.20) and large disc (4x4x1 cm) kept in the collapsible trap (4.87±3.00).

As combinations for the best dispenser, namely the large disc (4x4x1 cm), the delta trap type trap (Delta-Plus) was found to be significantly superior to the alternative trap types in at least six out of the eight week period of observation (Fig. 6). This impressive superiority of Delta trap as an alternative to the hitherto promising cylindrical jar trap is an important information. Further, this result is also in conformity to similar findings of superiority of Delta trap over the cylindrical jar type observed by Suganthy et al. (2014b)

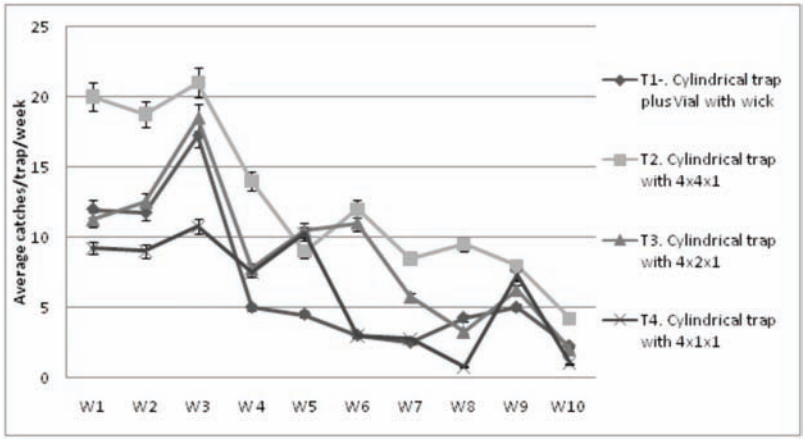

Fig. 4. Comparison of *B. cucurbitae* catches in four lure dispensers

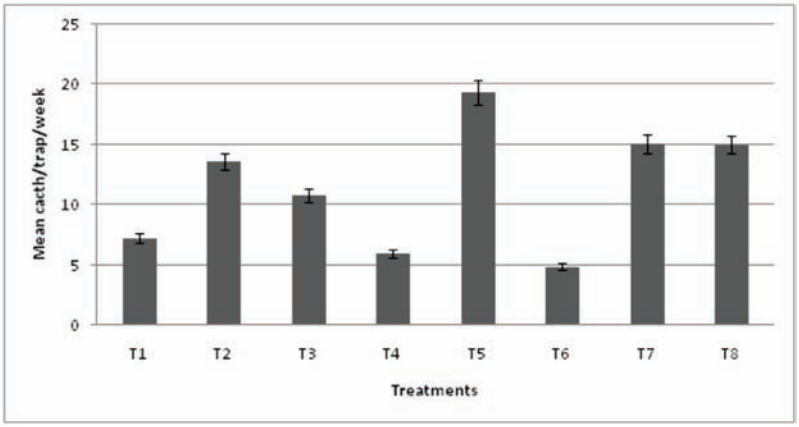

Fig. 5. Comparison of traps design with lure dispensers

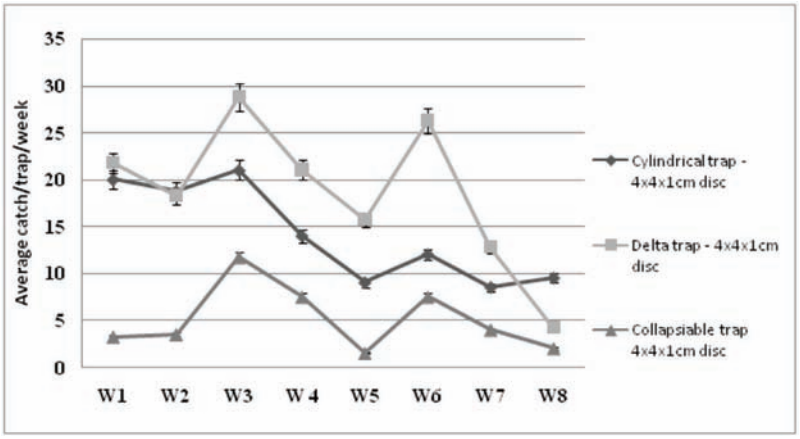

Fig. 6. Comparison of trap catch in jar trap between alternative lure dispensers (4x4x1 cm disc)

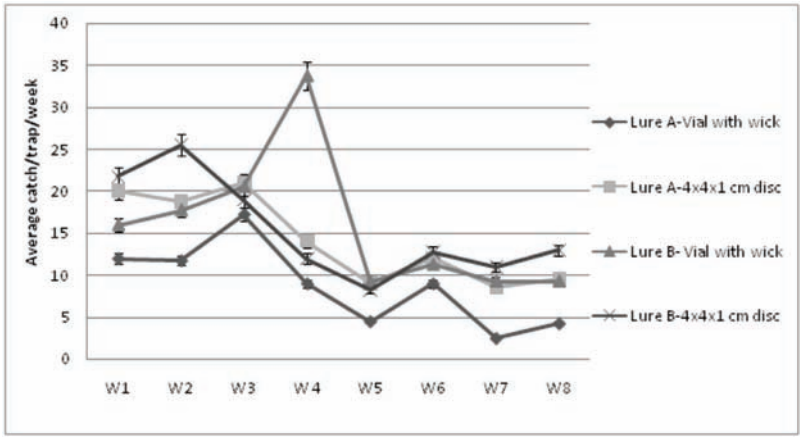

Fig. 7. Comparison of trap combination with alternative lure dispensers for unblended (A) and blended (B) cue lure

when comparing them of course with the smaller disc (4x1x1 cm).Of course, there is need and scope to ascertain whether such trend is also likely with alternative dispenser types for the individual species in the *B. cucurbitae* complex.

Further, the relative trap catches in the cylindrical trap for unblended cue lure (A), followed a descending order for the dispensers as 4x4x1 cm disc > 4x2x1 cm disc > vial with wick > 4x1x1 cm disc, suggesting that when CL alone was dispensed, the catch could be maximised by large disc and not by vial with wick (Fig. 7) or other disc sizes. This result is also in conformity with the results of Suganthy et al. (2014b).

The consistent superiority of large discover vial in the cylindrical jar types was clearly evident in unblended cue lure (lure A), rather than in blended cue lure (Lure B) (Fig. 7). Our present results are also in agreement with earlier studies by Suganthy et al. (2014b) which had indicated that the extent of difference in catch between blended and non-blended cue lure for overall catch of fruit flies was more for smaller disc rather than for larger disc. It is therefore evident that the consistency of superior trap-lure combinations needs to be further studied for blended cue lure.

The present results have clarified that as trap type combination for the same lure dispenser and CL blending deployed, there was overall more catches indicating more attraction and/ or retention of the *B.cucurbitae* males in the hitherto recommended cylindrical jar trap, compared to the latter two trap types. The present results with cue lure for melon fly trapping also indicate that cylindrical jar traps in combination with large disc (4x4x1 cm) caught more (7.0) compared to vial with wick (2.5) which is also in conformity with the findings of Divya et al. (2011) and Suganthy et al. (2014b), besides concurring also Gajalakshmi et al. (2012) that this same combination

was also superior for methyl eugenol attractant deployed to trap the *B. dorsalis* complex. The presently observed superiority of the combination of large disc (4x4x1 cm) in cylindrical white jar trap (15.4) which was followed in rank by combination with delta trap (11.3) and the collapsible trap (6.8), respectively, is also comparable in trend to the findings of Suganthy et al. (2014b).

Interestingly, the benefit of blending CL with ME, although appearing to be greater with large disc dispensers (15.3) compared to vial dispensers (13.8), both were on par. Therefore, for blended CL (with ME), both these lure dispensers can be reckoned to be comparable in enabling increased catches of *B. cucurbitae*. Our results are also in conformity with the report by Shelly et al. (2004) on differential performance among lure dispensers in contrasting trap types for *B. cucurbitae* and *B. dorsalis* in Hawaii. Further studies on the adult behaviour in relation to trap design attributes and the nature of synergy effects of blending of cue lure on related neuro-physiological responses could provide further insight into the interactions of trap design and dispenser types in the context of cue lure being deployed alone versus as blend (with methyl eugenol) towards maximising the fruit fly trap catches in cucurbit ecosystem.

For the melon fly, the superior trap design for the attractant -cue lure (CL) was found to be the white plastic jar type, while the delta trap type was next in rank. Among the dispenser types for cue lure, larger plywood discs (large, medium) appeared to be superior, while the small disc was on par with wick and vial dispenser type. When cue lure was deployed without blending, it was confirmed that the superior trap-dispenser combination was cylindrical jar with large or medium disc. As combination for large disc, when deploying unblended cue lure, the two alternative trap types were found to be significantly inferior to cylindrical jar type. However, when cue lure was blended with methyl eugenol, it appeared that large disc or vial with wick would be nearly equally efficient.

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