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Laboratory and field evaluation of light traps against flying insects

飛翔昆虫向け捕虫器のフィールド試験および実地評価

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1. TITLE

Laboratory and field evaluation of light traps against flying insects

2. OBJECTIVES

To compare the laboratory performance of Light trap A versus light trap B.

To compare the field performance of Light trap A versus the regular fluorescent lamp in attracting flying insects.

3. SUMMARY

The light trap A has better performance than light trap B. Light trap A also showed superior attraction against outdoor flying insects during both day and night evaluation in the field.

1. タイトル

飛翔昆虫向け捕虫器のフィールド試験および実地評価

2. 目　的

捕虫器Bに対する捕虫器Ａと捕虫器Ｂのフィールド試験における性能比較
通常蛍光灯に対する捕虫器Aの実地における飛翔昆虫誘引性能比較

3. 結　果

捕虫器Aは、捕虫器Bよりも性能が高い。実地における日中および夜間評価の双方において、
捕虫器Aは、野外飛翔昆虫の誘引でも優れていた。

4. MATERIALS AND METHODS

4.1 Laboratory evaluation in room size chamber

4.1.1 **Insects**: House flies (*Musca domestica*), fruit flies (*Drosophila melanogaster*), mosquitoes (*Culex quinquefasciatus* and *Aedes aegypti*) and red flour beetle (*Tribolium castaneum*) were laboratory cultures and have been reared in the Urban Entomology Laboratory, Universiti Sains Malaysia for the more than 20 years. They were reared under laboratory conditions of 25 ± 2ºC, 50 ± 5% relative humidity and 12-hour photo period. For the laboratory test, new emerged adults of 3 – 7 days were used in the evaluation.

4.1.2 **Evaluated products**: The sponsor provided the following products to be evaluated: Light trap A and B.

4.1.3 **Test methodology**: The room size chambers measuring 3 × 3 × 3 m were used in this study. The Light trap A was hung approximately 1.5 m above the base level on the wall. The other Light trap B was hung at the opposite side of the first LED lamp trap (Figure 1). A total of 20 insects each (*Cx. quinquefasciatus* and *Ae. aegypti* mosquitoes, house flies *M. domestica*, fruit flies *D. melanogaster*, and red flour beetle *T. castaneum*) were released at the center of the test chamber. At selected time intervals (10, 20, 30 min, 1 hour, etc.), the type of insect and the number of insects caught on each trap were determined. The experiment was repeated 4 times, and the position of the traps was interchanged each time. *T*-tests were used to determine whether the differences in the number of insects caught between the 2 light traps were significantly different. Comparison was made at 95% confidence interval.

4. 材料および方法

4.1 実験室評価

4.1.1 昆虫：

20年以上にわたりマレーシア科学大学都市昆虫研究室で飼育した、実験室培養のイエバエ(Musca domestica)、ショウジョウバエ(Drosophil melanogaster)、蚊(Culex quinquefasciatusおよびAedes aegypti)、コクヌストモドキ(Tribolium castaneum)。25±2℃、相対湿度50±5%、日長12時間の実験室条件下で飼育した。実験室試験では、3日から7日齢の成虫が評価に使われた。

4.1.2 評価する製品：

スポンサーは次の製品を評価用に提供した:捕虫器AおよびB

4.1.3 試験方法：

3×3×3mの部屋サイズの実験室を用意した。捕虫器Aは、床面より約1.5m上の壁際につるした。捕虫器Bは、最初のLED捕虫器とは反対側につるした（図１）。それぞれ合計20匹の昆虫（蚊Cx. quinquefasciatusとAe. Aegypti、イエバエM. domestica、ショウジョウバエD. melanogaster、コクヌストモドキT. castaneum)を、実験室内の中央で放った。規定の時間間隔で（10、20、30分、1時間等)、それぞれの捕虫器に捕獲された昆虫の種類と数を調べた。実験は4回行い、捕虫器の位置は毎回交換した。2つの捕虫器で捕獲した昆虫数に有意差があるか調べるため、事前テストを行った。比較試験の信頼性は95%である。

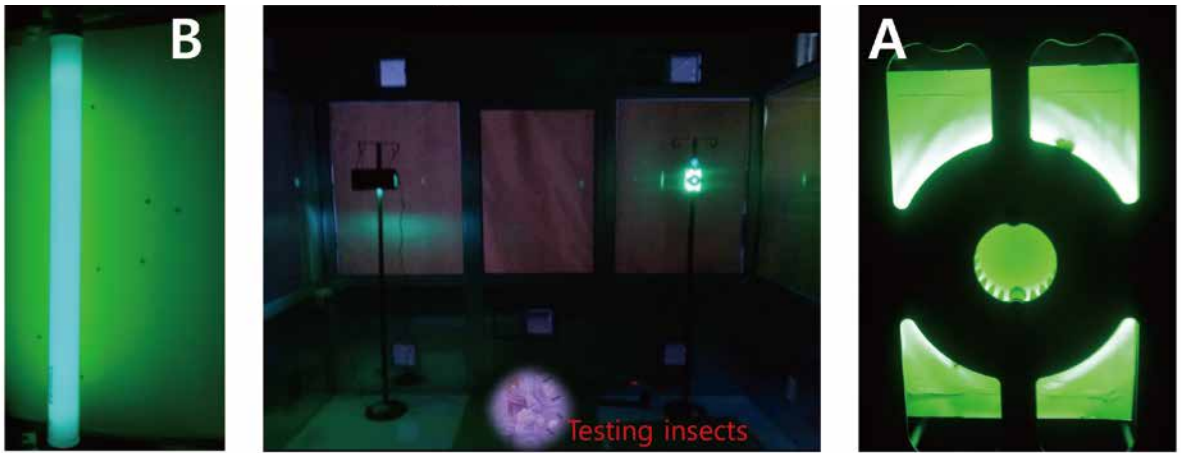


Figure 1: Experiment on Light trap A and B in the 27 m^3 room-size chamber.

図１．27m^3の部屋サイズの実験室における、捕虫器AとBの実験

4.2 **Field evaluation of Light trap A versus regular flourescent light**

4.2.1 **Test methodology**: The light trap A was hung at the same level as the fluorescent lamp with a sticky trap at the corridor of the 2nd floor of a building (Figure 2). Both lights were turned on continuously over an evaluation period of 12hours. Every 12 hours, the sticky trap was replaced with a new one, and the insects found caught on the trap were identified up to family level and counted. The experiment was replicated 4 times. *T*-tests were used to determine whether the differences in the number of insects caught between the 2 light traps were significantly different. Comparison was made at 95% confidence interval.

4.2 通常蛍光灯に対する捕虫器Aの実地評価

4.2.1 試験方法：

建物2階の半屋外の廊下に、粘着シートをつけた蛍光灯と同じ高さに捕虫器Aをつるした（図2）。12時間の評価時間中、両方の照明を継続して点灯した。12時間ごとに粘着シートを新たなものと交換し、シートで捕獲した昆虫を科レベルで同定し数えた。実験は4回繰り返した。2つの捕虫器で捕獲した昆虫数に有意差があるか調べるため、事前テストを行った。比較試験の信頼性95%である。

Figure 2: The field evaluation of the insect attractions to Light trap A versus that of the regular fluorescent light.

図2.　捕虫器Aと白色の蛍光灯の昆虫誘引の実地評価

5. RESULTS AND COMMENTS

5.1 The results on laboratory evaluation on Light trap A and B were shown in Table 1, and Figure 3. There was significant difference ($P < 0.05$) in the number of house flies trapped between Light trap A and that of light trap B with the former being more superior. However, this evaluation also demonstrated that Light trap A caught significantly ($P < 0.05$) more insects than Light trap B (Table 1). Interesting to note here that despite of the larger surface area of the sticky trap in Light trap B, its catch was still lower than that of Light trap A. This indicates that Light trap A is truly a high performance light trap.

5.2 Field evaluation on the attraction of Light trap A and that of the regular fluorescent lamp were compared (Figure 4). In general, Light trap A caught significantly more ($P < 0.05$) insects when compared to the regular fluorescent lamp, for both day ($t = 3.691$, $df = 6$ and $p = 0.010$) and night ($t = 3.057$, $df = 6$ and $p = 0.022$).

5.3 There were more insects from the order Diptera (eg. house flies, phorid flies, fruit flies, filth flies, etc), Hymenoptera (eg. winged ants, bees, wasps, etc), Hemiptera (eg. plant and leaf hoppers, stink bug, etc) caught in the light traps, compared to other insects. Despite moths (order Lepidoptera) were attracted to the light trap A, there were not many of them caught during the field evaluation, possibly due to the small entrance on the light trap for the larger size moths.

5 結果と考察

5.1 捕虫器AとBの実験室での評価結果を表1と図3に示す。捕虫器AとBでは、イエバエの捕獲数に有意な差があり（$P<0.05$）、前者のほうが優れていた。この評価は、捕虫器Aが捕虫器Bよりも有意に（$P<0.05$）多数の昆虫を捕獲したことも示した（表1）。ここで興味深いのは、捕虫器Bの粘着シートの表面積のほうが大きいにもかかわらず、捕虫器Aよりも捕獲数が少なかったことである。このことは、捕虫器Aが真に高性能であることを示唆する。

5.2 捕虫器Aと白色の蛍光灯の誘引性能のフィールド試験結果を比較した（図4）。一般に、捕虫器Aは白色の蛍光灯と比較して、日中（$t = 3.691$、$df = 6$ および$p = 0.010$）と夜間（$t = 3.057$、$df = 6$ および$p = 0.022$）の双方で有意に（$P<0.05$）捕獲昆虫数が多かった。

5.3 他の昆虫と比較して、ハエ目（例：イエバエ、ノミバエ、ショウジョウバエ、チョウバエ等）やハチ目（例：ハアリ、ミツバチ、カリバチ等）、カメムシ目（例：ウンカ、ヨコバイ、カメムシ等）が多く捕虫器で捕獲された。ガ（チョウ目）は捕虫器Aに誘引されたものの、フィールド試験中に捕獲されたものは少なかった。これは大きなガにとって捕虫器の入り口が小さすぎることが原因かもしれない。

5.4 Issues and suggestions for improvements: (1) If Light trap A were to be marketed in the tropical countries, it needs to be of a larger size with larger area of sticky trap. In our evaluation, we found that the sticky trap could be completely covered with insects in less than 12 hours after it was put out. This implies that the trap will have to be changed on more regular basis in its present size. (2) the sticky traps that were provided by the sponsor in this study were truly superior in quality and 'glowed' under the light. As long as they are inexpensive, this should be a good selling point for the light trap products.

5.4 課題と改良提案：

(1)熱帯諸国で捕虫器Aを販売するのであれば、粘着シートの面積が大きい、より大きなサイズの捕虫器が必要である。我々の評価の結果、粘着シートが、設置後12時間以内に完全に昆虫で覆われてしまい得ることがわかった。これは、現在のサイズではもっと定期的に交換しなければならないことを示唆する。 (2)本研究でスポンサーが提供した粘着シートは、非常に品質がよく、照明の下でも、捕虫シートも光って見える。安価であるかぎり、そのことはこの捕虫器製品の良い売りになるだろう。

Chow-Yang Lee

Table 1: Mean number ± SEM of adult insects caught per trap in Light trap A and Light trap B at 24-hour post-treatment.

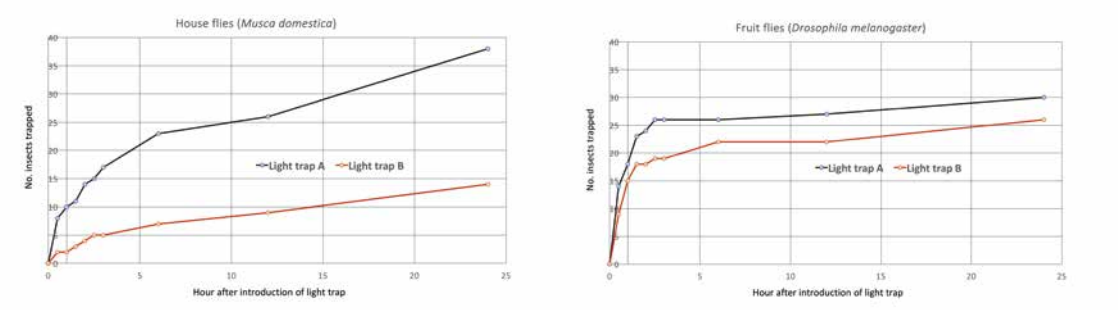
Insect	Mean number ± SEM		t	df	p
	Light trap A	Light trap B			
House flies	9.5 ±0.9	3.8 ±1.1	4.087	6	0.006*
Fruit flies	7.3 ±1.0	6.3 ±0.6	0.828	6	0.439
House mosquitoes	0	0	0	6	1.000
Tiger mosquitoes	0.3 ±0.3	0.3 ±0.3	0	6	1.000
Red flour beetle	0	0	N/A		
Total insects	17.0 ±1.6	10.3 ±1.2	3.420	6	0.014*

*Denotes a significant difference ($P < 0.05$) in the mean number of adult insects caught/trap between light trap A and light trapB.

表１．　24時間設置後の捕虫器Aと捕虫器Bの成虫捕獲数の平均値±標準誤差

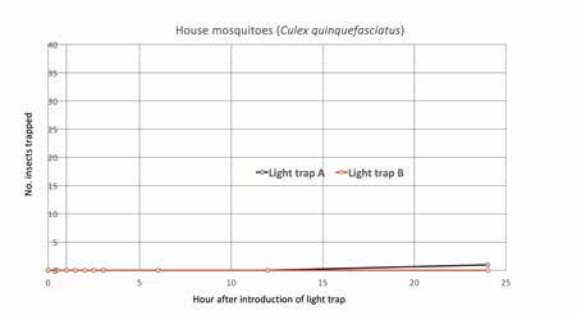
昆虫	平均値±標準誤差		t	df	p
	捕虫器A	捕虫器B			
イエバエ	9.5 ± 0.9	3.8 ± 1.1	4.087	6	0.006*
ショウジョウバエ	7.3 ± 1.0	6.3 ± 0.6	0.828	6	0.439
イエカ	0	0	0	6	1.000
ヒトスジシマカ	0.3 ± 0.3	0.3 ± 0.3	0	6	1.000
コクヌストモドキ	0	0	N/A		
合　計	17.0 ± 1.6	10.3 ± 1.2	3.420	6	0.014*

*は、捕虫器Aと捕虫器Bの成虫捕獲数の平均値に、有意差（P<0.05）があることを示す。

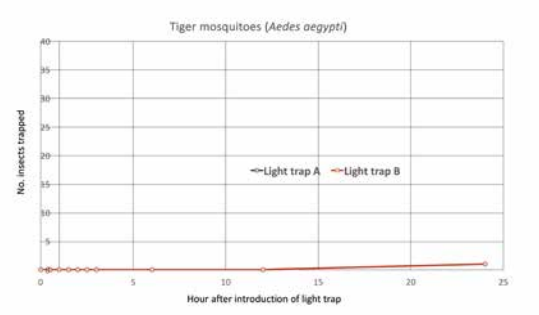


(A)

(B)



(C)



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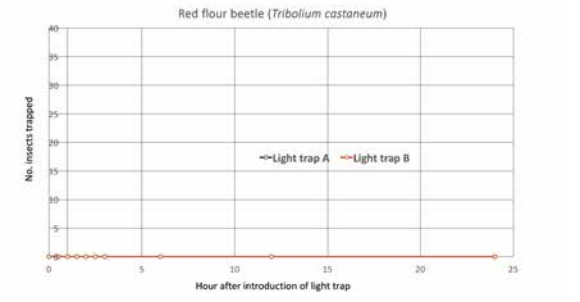


(E)

Figure 3: The cumulative number of flying insects trapped (based on 4 replicates) in Light trap A and light trap B in laboratory evaluation: (A) house flies, (B) fruit flies, (C) house mosquitoes, (D) tiger mosquitoes, (E) red flour beetle.

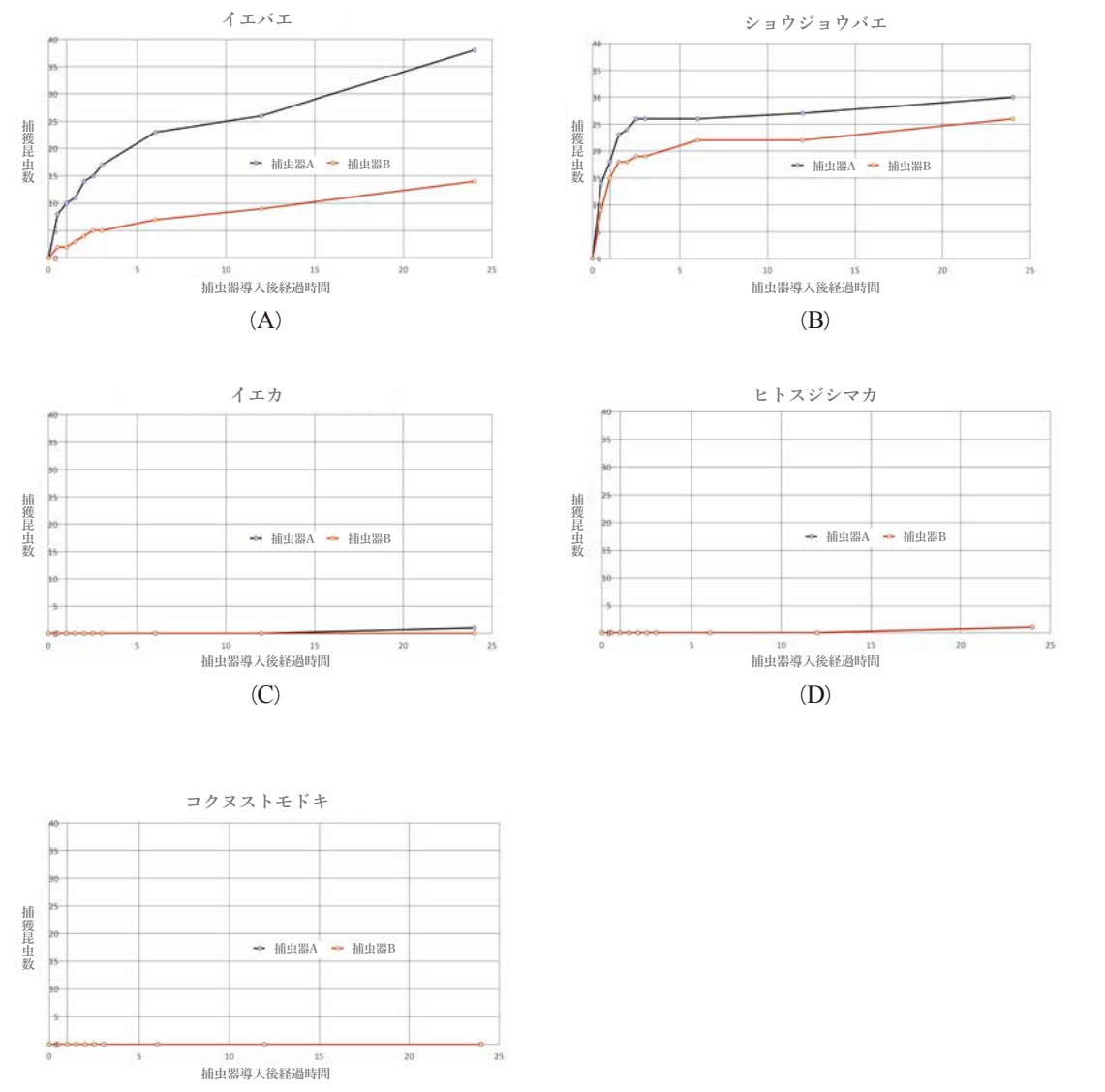
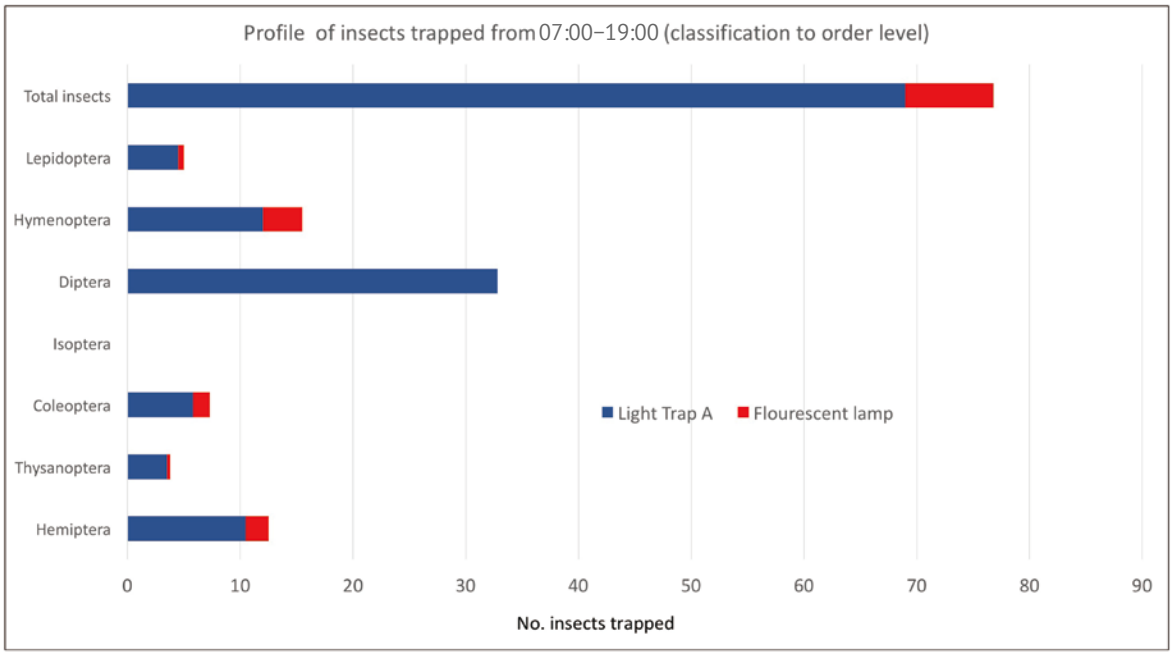
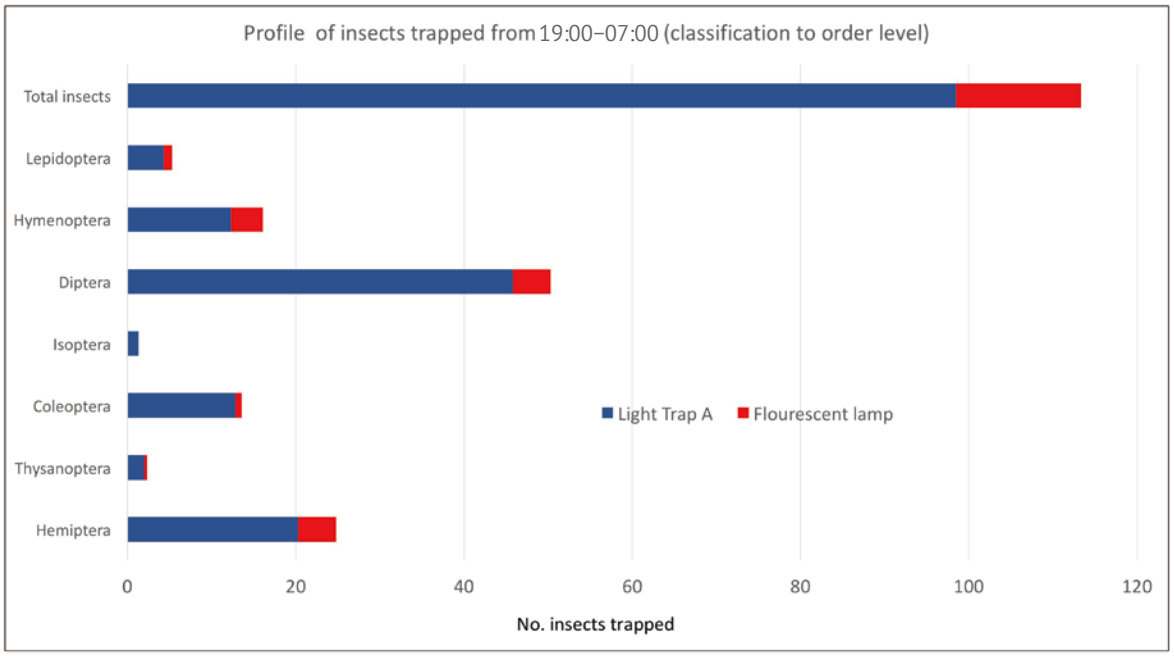


図3. 実験室内評価での捕虫器Aと捕虫器Bにおける飛翔昆虫の累積捕獲数（4回の反復実験に基づく）。
(A)イエバエ、(B)ショウジョウバエ、(C)イエカ、(D)ヒトスジシマカ、(E) コクヌストモドキ。

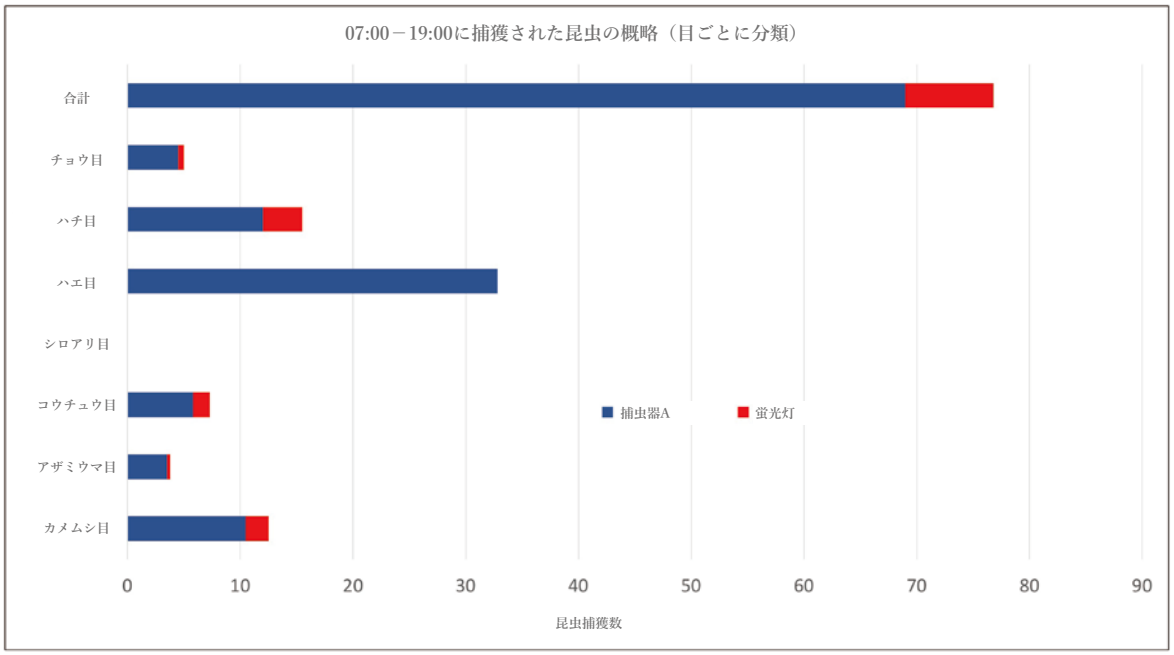


(A)

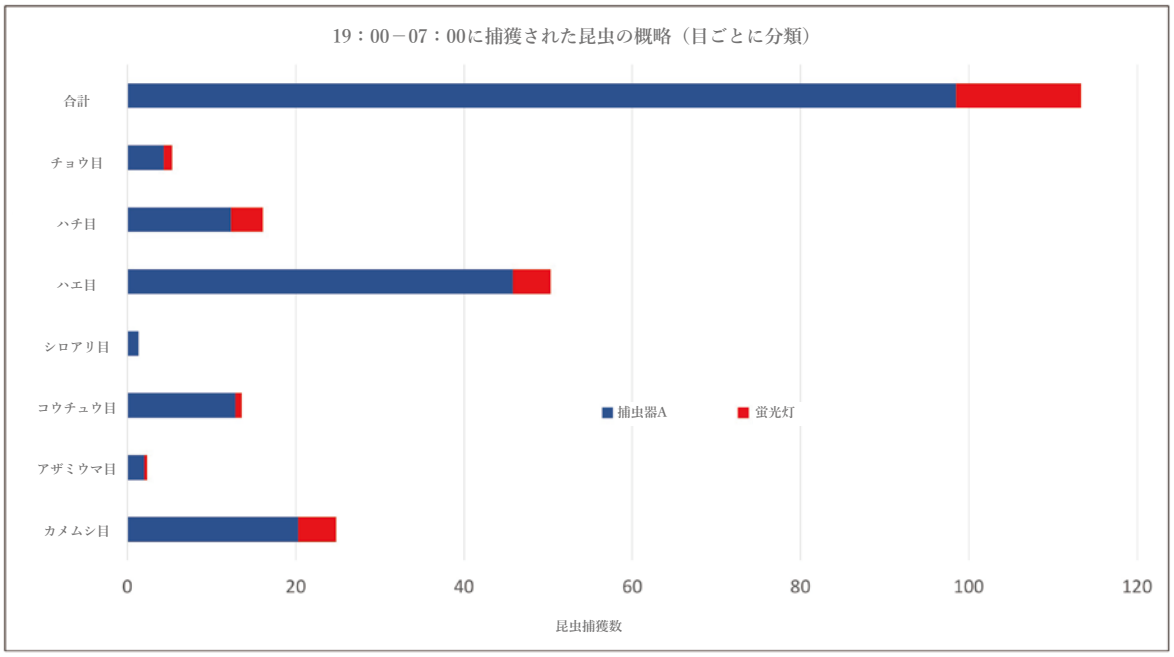


(B)

Figure 4: Comparison of the profile of flying insects (classification by order) attracted and trapped in Light trap A versus that in regular fluorescent lamp based on field evaluation during the day (07:00 –19:00) and night (19:00 –07:00).



(A)



(B)

図4. 日中（07:00－19:00）および夜間（19:00 – 07:00）のフィールド試験に基づいた、捕虫器Aと白色の蛍光灯に誘引され捕獲された飛翔昆虫（目ごとに分類）の概略比較。