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FLIGHT ACTIVITY OF THE BUTTERFLY , *Lampides boeticus* L. IN RESPONSE TO STICKY COLOR TRAP AND MALE COURTSHIP PHEROMONE EXTRACTS.

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ABSTRACT

Yellow and white sticky traps significantly attracted more *Lampides boeticus* (L.) adults (males and females) than any of the others tested colors (in the following orders, red , blue and green).

On the other hand, catches in the color sticky trap significantly influence by the trap design where the influence of color is less in Delta traps. However, most insect were caught by the vertical plate traps.

The male courtship pheromone of long tailed blue butterfly, *L. boeticus* females was extracted by immersing the abdomen of virgin female in five different solvents (Hexane, diethyl ether, chloroform. ethanol and acetone) .Bioassay in the field was carried out by using the vertical plate yellow sticky traps baited with pheromone extraction in the different solvent. Diethyl ether showed to be the best solvent for pheromone extraction. The residual effectiveness of pheromone extracts was lost after two days.

INTRODUCTION

There are approximately 14500 species of butterflies worldwide, (Morrone, 2002). The long-tailed blue butterfly, *Lampides boeticus* (L.) is an important pest of cowpea as well as several legumance plants (Jagginavar *et al*., 1990, Shantibala *et al*., 2004 and Mandal, 2005) in many area of the world. Hostplants of *L. boeticus* belonging to three families (Leguminoare, Cruiferae and Polygonaceae). It cause a severe economic decrease both in the quality and the yield (Sharma *et al*., 1998).

In moths, sex pheromones are released by females and male mate location is largely governed by chemical cues. By contrast, mate location in butterflies is largely mediated by visual cues, and several studies have demonstrated color-based mate choice (Sweeney *et al*., 2003; Robertson and Monteiro, 2005). There is accumulating evidence that these visual stimuli are accompanied by chemical signals that are important at close range (Wiklund, 2003; Costanzo and Monteiro, 2007)Male butterflies of many species emit scents. Usually the scents are produced in scent glands , which can be aggregated into so-called sex brands on the dorsal or the ventral part of male wings as in many pierids and nymphalids (Pliske et. al., 1976). Males of the queen butterfly *Danaus gilippus* Berenice, deprived of the two extrusible brushlike "hairpencils" at the rear of their abdomen, are capable of courting females but incapable of seducing them (Plisk and Eisner, 1969).

The use of pheromone traps is an effective method for butterflies (Otto and Pietsch, 2001 and Pernek et al 2003). The study of the behavior of response of insects to scents from either their own species (courtship pheromone) is one of the most recent and most active field of entomological research . Literature data concerning flight activity of *L. boeticus* is scarce. This study is aimed to present new data on the behavior of response of *L. boeticus* to color traps and male pheromone extracts as well as trap height and trap designs. Additionally, it evaluates the best solvent for courtship pheromone extraction.

MATERIALS AND METHODS

To determine color perference and trap design by *Lampides boeticus* L. adults different color traps (yellow, white, blue, green and red) as well as trap *design* (Vertical plate trap and Delta trap) were randomly hanged on wooden stands in cowpea filed at the Experimental farm of Faculty of Agriculture Mansoura university on July 2006. Each color and design had ten replicates. All traps were coated with Tangle-foot as a sticky materials. Trapped insects were counted after 24 hrs. In addition to estimate the efficiency of trap height catch of *L. boeticus.* Three height levels (0..50, 0.75 and 1.00 m) above the ground at which the traps is exposed were investigated. Each height had ten yellow vertical plate traps, the number captured butterflies were recorded after 24 hours.

To have a newly emerged adult males of *L. boeticus* for courtship pheromone extraction the larvae were collected from an untreated field in the Experimental farm of Faculty of Agriculture, Mansoura univ. ,Mansoura, Egypt. The collected larvae were reared on the natural host plant (*Vigna unguiculata* L.) and when the adult butterflies emerged they were sexed and kept at 4 C°under laboratory conditions. The courtship pheromone of *L. boeticus* males was extracted by immersing the hole body of males (5 ♂ in / 5 ml solvent) for 24 hr in five different solvents (Hexane, diethyl ether, chloroform, ethanol and acetone). All extracts were stored at 4 C° .

Extracts were bioassayed under field conditions, by using yellow vertical sticky traps continuing a piece of cotton. A set of traps were baited with five male equivalents of male extract as well a set of traps with pure solvent (control).All traps were placed at random on 1/3 fidan of cowpea plantation at high of 75 Cm. Each treatment had ten replicates.

RESULTS

1- Flight activity of *L. boeticus* in response to sticky color and trap designs.

The yellow and white vertical plate traps collected significantly more individuals of *L. boeticus (males and females)* than any of the other tested colors (Table 1) with an average 4.2± 1.8 and 3.4± 1.3 individuals / trap / day, respectively. The red traps collected more individuals (1.6 + 0.8) than blue (0.9 + 0.6) or green (0.0+ 0.0) color.

On the other hand, the influence of color is less with delta trap design, where only one individuals was caught by using delta traps. So, color presumably have the greatest effect by using vertical plate traps (Table 1).

Table (1): Average number of attracted insects / trap/day to different color and design traps.

Trap color	Trap design	
	Vertical plate trap	Delta trap
Yellow	4.2±1.8 a	0.2±0.4 b
White	3.4±1.3 a	0.0±0.0 b
Blue	0.9±0.6 b	0.0±0.0 b
Green	0.0±0.0 b	0.0±0.0 b
Red	1.6±0.8 b	0.0±0.0 b

From the above results it is clear that catches in the sticky trap significantly influenced by the trap design. Similar conclusion was obtained by (Southwood, 1978). He also, demonstrated that paper plates for sticky traps may be exposed either vertically or horizontally, the exposure will affect the catch. Fixed vertical plate traps will sample a different proportion of the passing air depending upon the wind direction.

2 – *L. boeticus* activity in response to trap height.

The obtained data are summarized and illustrated in Fig. (1) with significantly differences . The trap catch at 0.75 m height lured higher number of the butterfly than those fixed at 0.5 and 1m above the ground.

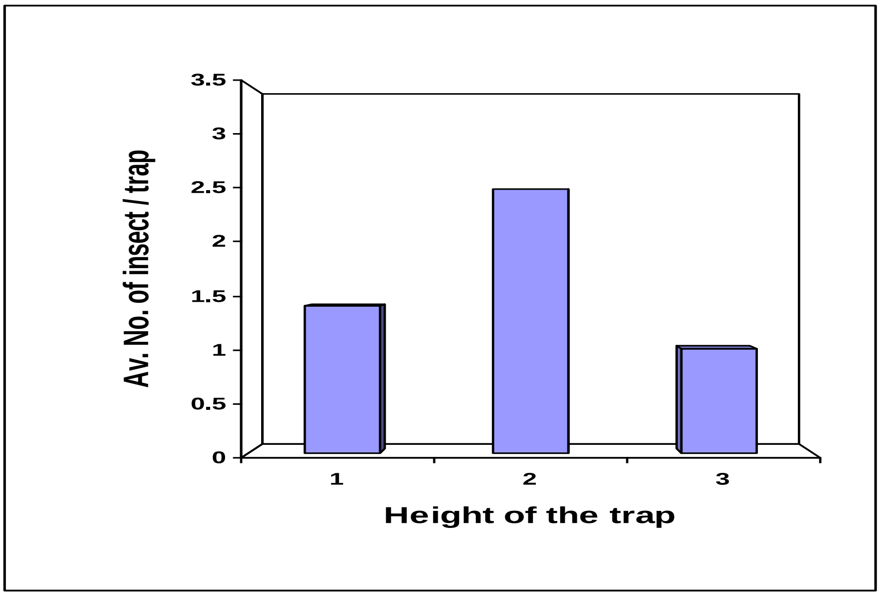

Fig. (1): Average number of *L. boeticus* adults / trap hunged on different height (0.50, 075 and 1.0 m) in cowpea field (L.S.D. (P = 5%)= 0.43 ,).

2- Female activity in response to courtship pheromone.

The results of the yellow sticky traps baited with pheromone extractions by using different solvents are presented in (Table 2).

The pheromone traps catches indicated that traps baited with diethyl ether, ethanol or chloroform extracts lured considerable number of *L. boeticus* females after 24 hrs.

After 48 hrs of bioassay the pheromone trap catches (Table 2) showed that diethyl ether and acetone traps lured significantly higher numbers of females than the other tested solvents. As shown in (Table 2) the residual effectiveness of all tested extracts was lost after the third day. So, diethyl ether approved to be the best solvent for courtship pheromone extraction.

Table (2): Average number of butterfly females / trap attracted to sex pheromone extracted in different solvents and untreated trap (bioassay every 24 h for three successive days) without renewal of the extract.

Source of attractions	Av. No. of male / trap / day		
	1st day	2nd day	3rd day
Ethanol	4.0±1.58	2.8± 1.1	2.0±1.5
Diethyl ether	5.4±167	4.0± 1.58	1.6±0.5
Hexane	2.2±0.65	1.0± 1.0	1.4±0.5
Acetone	2.8± 1.79	2.2±1.30	1.0±0.7
Chloroform	3.0±1.88	1.2±0.45	1.4±1.1
Distilled water(control)	1.2±0.5	0.6±0.5	0.8±0.8
L.S.D (P= 5%)	1.43	0.89	0.94

DISCUSSION

It is not certain why so many insects exhibit this strong response to yellow, Bernays and Chapman (1994) mentioned that yellow is a component of foliage color and is possibly involved in plant finding by the butterflies. The Japanese yellow swallowtail butterfly *Papilio xuthus* uses color vision when searching for food. It has at least five types of spectral receptors (UV, violet, blue, green, red)., suggesting that they have color constancy. In nature, these butterflies feed on nectar provided by flowers of various colors not only in direct sunlight but also in shaded places and on cloudy days. In the present study, the attractiveness of red color to the long-tailed blue butterfly was higher in comparison with blue and green colors. According to Bernays and Chapman (1994) many butterflies and moths are able to distinguish red as color. This is due to the presence of a visual pigment with maximum absorption of light with wave lengths around 600 mm. Shape may interact with color, as has been demonstrated in the apple maggot fly, *Rhajolites pomonella* . The flies are attracted to yellow rectangles but not to red, black or white rectangles (Bernays and Chapman,1994).

Adult of *L. boeticus* exhibited the lowest response to green color in comparison with the others tested colors. Butterflies (*Goneopteryx cleopartra* and *Eurema lisa*) tend to avoid the color green in their feeding behavior, but are during egg laying. The green photoreceptors are instead detection of movement.

A response to color may be coupled with a chemical cue. For example the cabbage butterfly, *Pieris rapae* will not oviposit on any substrate in the absence of glucosinlate such as sinirgin. It sinirgin is added to the substrate the insects will oviposit on blue, green or white paper, but few eggs are laid on red or black.

From the obtained results, it could be concluded that catches in the sticky yellow trap significantly influenced by trap height. According to Southwood (1978) the height above the ground at which trap is exposed will influence the catch. As the aerial density of the most insect decreases with height, in general the higher the trap the smaller the catch.

Courtship pheromone extracts of *L. boeticus* males in different solvents were tested. Diethyl ether approved to be the most effective solvent that showed good attractiveness under field conditions. According to Golub and Weatherston (1984), diethyl ether is one of the common solvents used for sex pheromone extraction of several lepidopterous species. Also, courtship pheromone of *P. napi* was extracted by using diethyl ether at 20 C^{o}.

In the present investigation *L. boeticus* females exhibited positive response to male pheromone extraction. Males of the green-veined butterfly, *Pieris napi*, are known to release citral (mixture of general and neral, 1:1) when interacting with conspecific females. Citral is a singal from the male directed to the female during courtship, and that it functions as a male sex pheromone (Johan *et al.,* 2007).

Further studies are still needed on the sexual behavior of butterflies and the application of courtship pheromone in combination with efficient trapping system for the management of long –tailed blue butterfly.

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نشاط طيران أبو دقيق البقوليات بالنسبة للمصائد اللاصقة الملونة ومستخلص فرمون الذكور.

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تم في هذا البحث دراسة نشاط طيران أبو دقيق البقوليات بالنسبة لألوان المصائد اللاصقة و شكل المصيدة هذا بالإضافة لاختبار كفاءة بعض المذيبات العضوية في استخلاص الفرمون الجنسي لذكور الحشرة.

و قد أوضحت الدراسة ما يلي :-

١- أن حشرة أبو دقيق البقوليات قد أبدت استجابة معنوية اتجاه اللون الأصفر يليه اللون الأبيض، بينما لم تبدي الحشرة أي استجابة تجاه اللون الأخضر.

٢- كان لتصميم المصيدة تأثير مباشر و واضح على جذب حشرة أبو دقيق البقوليات حيث أوضحت النتائج انجذاب أعداد عالية نسبيا تجاه المصائد vertical plate traps بالمقارنة بمصائد الـ Delta traps .

٣-أوضحت الدراسة أن مذيب الداي ايثايل أثير أفضل المذيبات المستخدمة في استخلاص الفورمون الجنسي من ذكور أبو دقيق البقوليات بالمقارنة بالمذيبات الأخري (إيثانول – كلورفورم – اسيتون – هكسان) و قد فقد مستخلص الفرمون جاذبيته بعد ٤٨ ساعة تحت الظروف الحقلية.