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A New Baiting Device to Capture and Monitor the Activity of the Oophagous Wasp *Trichogramma* in the Field

H. E. A. Sakr [*], S. A. Hassan [**] and C. P. W. Zebitz [***]

[*] Plant Protection Department, Fac. of Agric., Ain Shams University, Shoubra El-Kheima, Cairo, Egypt
[**] Institute for Biological Control, BBA, Heinrichstr. 243, D-64287 Darmstadt, Germany
[***] University of Hohenheim, Institute of Phytomedicine, D-70593 Stuttgart, Germany

ABSTRACT

A new baiting device to expose insect host eggs for parasitism by the oophagous wasp, *Trichogramma* spp. in the field without interference of predators was developed and tested. The device consisted of a flat piece of Plexiglas (1.5 x 1.5 x 0.5 cm) covered with nylon screen from both sides, forms a space to insert host eggs glued on a small cards of paper. Field evaluations showed that the numbers of undamaged replicates with the new baiting device were significantly higher compared to the conventional cardboard cards (5x10cm) with eggs glued. Parasitism rate with the new baiting device was not statistically different from the conventional ones. The new baiting device provided the host eggs with ample protection from predators in the field and at the same time did not significantly affect the number of eggs laid by the parasitoid.

Key Words: Baiting device, *Trichogramma*, parasitism, Field monitoring.

INTRODUCTION

One of the most important factors for the success of the use of *Trichogramma* in inundation programmes is the dispersal of the emerging parasitoids from the release point. Field studies investigating dispersal of *Trichogramma* from the release point have been conducted in field crops, orchards and forest environments (Schread, 1932; Kot, 1964; Stern *et al.*, 1965; Hendricks, 1967; Fye and Larsen, 1969; Allen and Gonzalez, 1974; Yu *et al.*, 1984; Keller *et al.*, 1985, Smith, 1988; Greatti and Zandigiacomo, 1995).

For inundative *Trichogramma* releases, it is crucial to know how far the *Trichogramma* still gives an acceptable level of parasitism from the release point. On the other hand, it is also important to know how many *Trichogramma* remains in the field, or orchard in which it was released. *Trichogramma* species are, in general, not specialised on one host and thus they cannot or do not synchronize their life cycles on a single host species. Host eggs are often not always available close to the point of emergence, therefore *Trichogramma* wasps disperse to reach other host-habitats.

Several authors employed sticky card traps (Hendricks, 1967; Kolmakova and Molchanova, 1981; van den Berg *et al.*, 1987; Romeis *et al.*, 1996, 1998), suction traps and sweep nets (Stern *et al.*, 1965) to monitor the activity of *Trichogramma* in the field. If *Trichogramma* is already present in the habitat, released *Trichogramma*, could be marked for example, with radioactivity or fluorescent powder (Stern *et al.*, 1965). Advantages of these type of traps is the clear record for the presence of *Trichogramma* and the possibility of studying both female and male dispersal behaviour, but usually only a very small part of the released *Trichogramma* is recaptured. Van den Berg *et al.* (1987) recaptured only 36 of 60,000 *Trichogrammatoidea cryptophlebiae* Nagaraja released, and Stern *et al.* (1965) recaptured also 147 of 1.5 million *Trichogramma semifumatum* released.

Indirect measurement of the dispersal, is based on estimating rate of parasitism, is possible both with naturally laid eggs (Hawlitzky *et al.*, 1984; Kanour and Burbutis, 1984; van Heiningen *et al.*, 1985) or with artificially placed eggs such as Angoumois grain moth *Sitotroga cerealella* (Oliver) and recollecting them several days later (Hase, 1925; Kot, 1964; Neuffer, 1987; Chernyshev *et al.*, 1988; Bigler *et al.*, 1990; Maini *et al.*, 1991; Sakr *et al.*, 2000, 2002). Another advantage of this method is that parasitism not only a result of dispersal, but also of host recognition, host acceptance and host suitability. Artificially placed eggs on cards might be hard to find for the wasps and thus underestimates dispersal (Chernyshev *et al.*, 1988). However, Maini *et al.* (1991) found no difference in parasitism by *T. maidis* (= *brassicae*) between natural and artificially applied egg masses in maize. Experience showed that these baiting-eggs are mostly attacked by insects in the field such as *Chrysoperla*, *Coccinella*, ants and many other generalist predators, making the evaluation of ecological and behavioural studies almost difficult. Thus, another method for monitoring of *Trichogramma* as well as for ecological studies in the field avoiding any disturbing effect as far as possible is needed.

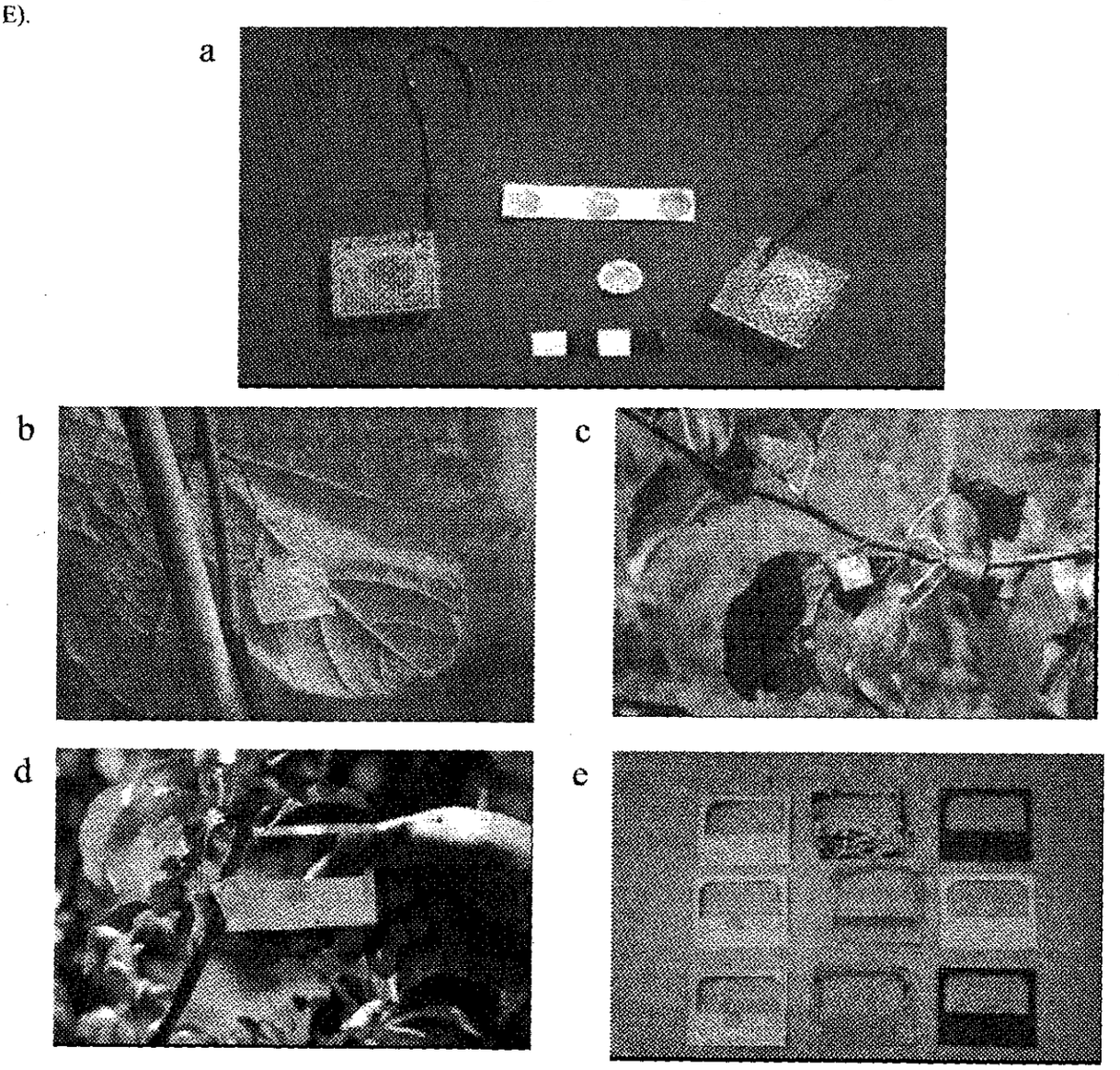
The present work is an attempt to modify the conventional method used for baiting *Trichogramma* adults in the field by exposing host eggs on cards with a new baiting device that provides protection from predators in the field.

MATERIALS AND METHODS

Description of the new baiting device

The device consists of a square piece of transparent Plexiglas (15 x 15 x 5 mm) with a circular opening in the centre (9 mm in diameter) closed from both sides with nylon screen (0.7 mesh). The screen allows adult *Trichogramma* to enter.

The nylon screen was glued on the Plexiglas, leaving one edge unglued to insert and handle an egg card when needed. The egg card with about 125 host eggs *S. cerealella* glued with Traganth® on a piece of paper (6 mm in diameter), was inserted in each baiting device. The devices were distributed in an apple orchard and fixed to the leaves and/ or the branches of the apple trees using pieces of wire (Figure 1 A, B, C, D and E).



Fig, (1): (a) The new baiting device and cards with *S. cerealella* eggs; (b) New baiting device fixed on the leaves; (c) Same hung on apple branches; (d) New and conventional devices with the eggs; (e) Conventional devices attacked by predators in the field.

Testing of the baiting device

Laboratory experiments

The suitability of the new baiting device was tested and compared with conventional cards under the laboratory condition. A wooden-frame cage (120 high, 48 wide and 60 cm long) was used. Three sides of the cage were made of muslin; the fourth side and the top were covered with plastic. Four vine plants (100 cm high) grown in pots were placed in each cage. Three cages for each treatment (new baiting device/ conventional card) were used. Release of *Trichogramma cacoeciae* (Marchal) was made in the experimental cages by placing a glass tube (7.5 × 1 cm) on the lower surface of the cage containing the wasp adults. For monitoring, ten fresh *S. cerealella* egg cards (each with ca. 125 eggs) were hung every two days on the leaves of the four vine plants.

The host egg cards were removed every two days after exposure to the *Trichogramma* adults and incubated at 25°C, 70–80 % RH and 16L: 8D hour's photoperiod until they turned black. Number of parasitized eggs at the new baiting device and at the conventional cards was counted.

Field experiments

The suitability of the new baiting device was compared with conventional cards by conducting field experiments in an apple orchard located at Schaafheim, Southern Hessia, Germany. Sixty new baiting devices and 60 conventional cards were hung on every third apple tree, also, on the hedges (every 5 metes) and changed every week from 2nd May to 27th June 2000. After collection, the units (both the devices and the cards) were incubated at 25 °C, 70-80 % R.H. and 16 L: 8D hours for about 5 days. The number of damaged units and the number of parasitized eggs were counted.

RESULTS AND DISCUSSION

Testing of the new baiting device

Laboratory experiments

The results showed that parasitism in the new baiting device was not statistically different from the conventional card, when *Trichogramma* adults were released on the caged potted vine plants (Table 1). Total parasitism were 116.9, 81.9, 77.0 and 47.5 in the new baiting device and 164.6, 94.2, 80.9 and 58.0 on conventional card, when 1600, 850, 450 and 250 adults for each cage were released, respectively. Highest parasitism occurred in the first day after release, in both types of experiments. Parasitism in the new baiting device was 18.7 % lower than in the conventional card. The new baiting device did not markedly deter or disturb the parasitoid egg laying.

Table (1): Comparison between the new baiting device and the conventional card using *Sitotroga cerealella* eggs when both were exposed to *Trichogramma cacoeciae* on vine plants potted in cages under laboratory conditions.

Number of released *Trichogramma*	Mean no. of parasitized eggs by *T. cacoeciae* per cage							
	New baiting device				Conventional cards			
	Day 1	Day 3	Day 5	Total	Day 1	Day 3	Day 5	Total
1600	72.0	31.4	13.5	116.9[a]	95.9	54.0	14.7	164.6[a]
850	64.1	12.6	5.1	81.9[b]	81.5	10.8	1.9	94.2[b]
450	68.8	6.6	1.6	77.0[c]	75.5	4.0	1.4	81.0[c]
250	45.1	2.7	0.0	47.5[d]	54.0	3.9	0.1	58.0[d]

Numbers followed by the same letter in each line are not statistically different at the $p < 0.05$ level, t-test, SAS Institute, 1996.

Field experiment

The mean number of parasitized eggs inside the new bating devices undamaged by predators was significantly higher compared to that in the conventional cards (Figure 2A). In the summer months, the mean number of undamaged parasitized eggs inside the new baiting devices was consistently significantly higher than that at the conventional card. From week 19 (9th May to 27th June 2000) onwards, the number of undamaged parasitized eggs inside the new baiting devices per week was 90, 85, 86.7, 85, 93.3 and 83.3 %

compared to 25, 16.7, 15.2, 0.0, 0.0 and 0.0 % at the conventional cards. Figure (2B) showed that egg parasitism rate was significantly higher using the new baiting devices compared to the conventional cards. Parasitism rate was higher in spring than in summer.

The results of the present study confirmed that if baiting units for *Trichogramma* adults including host eggs are placed in apple orchards without protection from predators, the eggs will be attacked by predators, especially in the warmer months of the year. The results of the field experiments comparing the new baiting devices with conventional cards showed that 85.5 % of the exposed new devices were undamaged by predators, compared to only 17.1 % of the conventional cards. The significant increase in the undamaged devices increases the chances of capturing egg parasitoids in the field, especially when the occurrence of the species is at low density. In 8.9 % of the eggs at the devices in the present work, field *Trichogramma* were captured compared to 1.4 % of the conventional cards.

The field data showed that parasitism rate was higher in spring than in summer. This can be partly due to the emergence of the overwintering *Trichogramma* generation in spring, but also to the massive increase of vegetation in summer and the wide searching surface for the adults to find host eggs. In summary, the new baiting device provided the host eggs with ample protection from predators and did not significantly affect the egg laying of the parasitoid under field conditions.

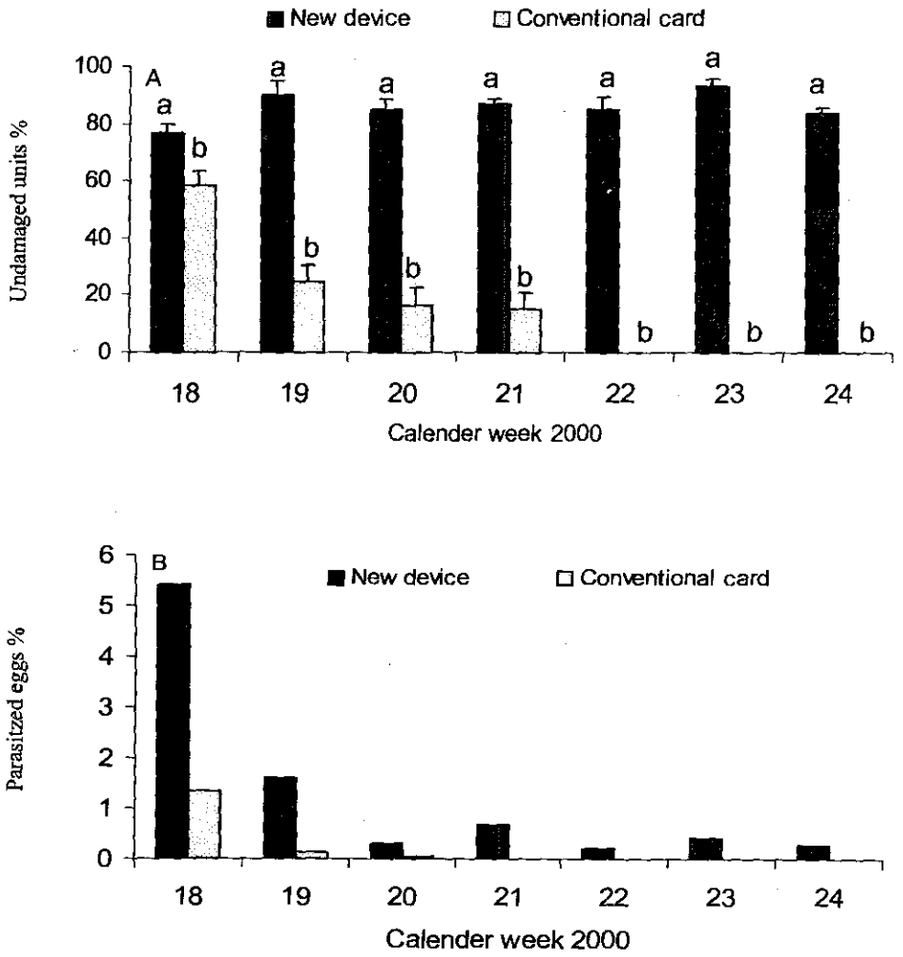


Figure (2): Comparison between the new baiting device and the conventional card using *Sitotroga cerealella* eggs as host in apple orchard, May-June 2000 (A) percentage of units undamaged by predators after one week of exposure. (B) Parasitism %.

The laboratory exposure tests showed that the device did not deter the adult *Trichogramma* from approaching the device or significantly affect the egg laying of the female parasitoid.

It can be concluded that the new baiting device can provide the host eggs with sufficient protection from predators without significantly affecting the egg laying behaviour of the parasitoid.

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تقنية جديدة لتسجيل نشاط طفيل التريكوجراما فى الحقل

حامد الدمرداش صقر[*] ، شريف على حسن[**] و Zebitz Claus[***]

[*] قسم وقاية النبات، كلية الزراعة، جامعة عين شمس، شبرا، القاهرة، مصر.
[**] Institute for Biological Control, BBA, Germany
[***] University of Hohenheim, Institute of Phytomedicine, Germany

إن التقنية المعتادة لتسجيل نشاط طفيل الترايكوجراما فى الحقل تتلخص فى تفريد بيض العائل قبل بيض حشرة فراشة الحبوب *Sitotroga cerealla* ثم إعادة جمعه مرة أخرى بعد عدة أيام. وقد لوحظ أن بيض العائل المعرض بهذا الأسلوب يهاجم بالعديد من المفترسات الحشرية مما يؤدى إلى خطأ فى تقويم كفاءة ونشاط وسلوك الطفيل. فى هذه الدراسة ولحماية بيض العائل من المفترسات المختلفة وتفادى خطأ التقويم – أمكن تصميم وحدة صغيرة على هيئة قفص من قطعة صغيرة من البلاستك المقوى (Plexiglass) أبعادها (١،٥ x ١،٥ x ٠،٠٥سم) وبها ثقب فى المنتصف قطره ٩ ملى ويغطى بقطعة من الشاش المقوى بنفس أبعاد البلاستك من الناحيتين مع ترك مسافة تسمح لإدخال كروت الورق التى تحمل بيض العائل. تم وضع ١٠ من هذه الأقفاص الصغيرة المشار إليها فى وحدة كبيرة (قفص كبير) أبعاده (١٠٠x٦٠x٤٥سم) به شجرة تفاح صغيرة وكرر العمل ثلاث مرات. أظهرت النتائج المعملية لأختبار هذه الوحدات أن القفص الصغير لايعيق الطفيل من الوصول لبيض العائل. أشارت النتائج ان التطفل على البيض بإستخدام هذه التقنية الجديدة أقل بنسبة ١٨،٧% عن أستخدام الكروت التقليدية ولكن هذا الفارق غير معنوى. بينما تشير النتائج الحقلية أن عدد الوحدات (الكروت) التى تم حمايتها من الإفتراس بهذه الطريقة معنوى جداً مقارنة بالطريقة التقليدية. من ذلك ينتج أن هذه التقنية الجديدة تقدم حماية لبيض العائل من المفترسات فى الحقل وفى نفس الوقت لاتؤثر فى عملية التطفل.