MONITORING POPULATIONS OF THE WEBBING CLOTHES MOTH, *TINEOLA BISSELLIELLA,* USING PHEROMONE LURES

P. D. COX, D. B. PINNIGER & D. MUELLER[1]
CSL, London Road, Slough SL3 7HJ, UK and
[1]Insects Limited, 10540 Jessup Blvd, Indianapolis, IN 46280-1451 USA

Abstract—Webbing clothes moth, *Tineola bisselliella,* is a world-wide pest of clothing and textiles in domestic environments and also causes serious damage to textiles and ethnographic material in museum collections. Monitoring traps are an important component of pest control programmes but sticky traps without lures are not always very effective for the detection of moth adults. The female-produced pheromone was identified by Yamaoka in 1985 but it is only recently that the second component has been accurately identified, and a stable synthetic mixture of the two components is now available in a lure.

The paper describes the results of trials in the UK and USA where the performance of synthetic *Tineola bisselliella* pheromone lures has been evaluated in practical situations. Traps were successfully used to monior moth populations in museums and stores, and the results show that traps with the lures caught about 20 times the number of moths caught on similar but unbaited traps. The value of lure-based traps for the early detection of adult moths is discussed together with proposals for the use of pheromone traps in pest management programmes.

INTRODUCTION

The larvae of clothes moths have been causing problems for humans for thousands of years, feeding on and damaging clothes, furnishings and other items made from animal materials including fur, wool, feathers and hides. The main reason for their pest status rests in their unusual ability to digest keratin, a protein forming the principal constituent of these materials. Today the webbing clothes moth, *Tineola bisselliella (Hummell),* occurs in domestic premises, grain stores, museums and other buildings, as well as being frequently recorded in birds' nests. The webbing clothes moth is a world-wide pest of clothing and textiles in domestic environments and also causes serious damage to textiles and ethnographic material in museum collections (Pinniger, 1994). As well as biting holes in fabric and chewing through the warp threads of carpets so that the pile falls out, larvae cause further damage by producing large numbers of webbing tubes and sheets containing considerable quantities of faecal pellets which spoil the appearance of the object.

Following a continuing problem with heavy infestations of clothes moths at a large UK theatrical costume store, CSL was asked to visit the store and make recommendations for improving pest management strategies. As part of the improved strategy, clothes moth pheromone traps were installed to help identify the main areas of infestation within the store and to monitor the results of control measures. This paper presents the results of the monitoring programme in the UK during 1994, together with those from another trial in the USA during the same year.

METHODS AND MATERIAL

UK Trials

An initial inspection of the UK costume store revealed signs of active infestations of the *T. bisselliella* on all five floors of the 120,000 sq ft store, with moths flying and settling on items of clothing. Moth damage, particularly to wool felt, heavy wool clothes and furs, was widespread and pockets of infestation were found in many areas, with webbing, frass and larvae causing extensive damage to some items. One of the worst areas of active infestation appeared to be on the second floor in the section containing the mens' period costumes, and this was chosen as the area in which to place the pheromone traps.

Two sizes of sticky traps were used : a small trap with a 5x7 cm sticky base ('Trappit' trap from 'AgriSense') and a trap with a sticky surface area approximately 7 times larger and with a wider

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access opening ('No Survivor' trap from 'Insects Limited'). The smaller traps were placed on shelves containing piles of folded clothes while the larger traps were suspended from racks of costumes. The traps were placed in pairs, with unbaited control traps always placed within 1m of traps baited with pheromone. The pheromone was supplied by 'Insects Limited' in the form of 'Bullet Lures' which consisted of slow-release spheres in a plastic container with a permeable membrane. The lures should attract male clothes moths, and contain a pheromone with two components known as Koiganal I ((E)-2-octadecenal) and Koiganal II (E,Z)-2,13-octadecadienal) (Yamaoka *et al.*, 1985) (Fig. 1).

Prior to the field trials, the pheromone lure was tested in the laboratory, using a series of 3 flight chambers developed recently at CSL to study the flight activity of a small insects (Cox and Dolder, 1995). A 'Trappit' sticky trap containing a pheromone lure was suspended inside the top of each flight chamber and webbing clothes moths were released at the base of the chamber. After 18 hours under constant conditions of 25±1°C, 70±5% rh and continuous darkness, the number of moths caught in each trap was recorded. A UK laboratory strain of the moth, reared under constant conditions for many years, was used in the first test. Less than 5% of the moths released in the chambers were caught in the pheromone-baited traps. Similar results were obtained with a USA laboratory strain. It was decided to test the wild strain recently collected from the UK costume store and reared in the laboratory for only a few generations. This time, just over 25% of released moths were caught in the traps. These results highlight the importance of strain differences in insect behaviour, and of not relying on laboratory insect strains for this type of bioassay.

For the UK field trials, the traps were set up in the costume store at the end of June. Counts of trapped moths were made every few weeks until the middle of November when lower winter temperatures reduced moth activity. When sticky surfaces became covered with moths, the traps were replaced with new ones and the original pheromone lures were transferred to the new traps at the same time.

USA trials

Trials in the USA were carried out in the Field Museum of Natural History, using 'Bullet lures' in 'No Survivor' sticky traps. The level of infestation varied throughout the museum, with some areas being highly infested. Some individual objects were infested, including Indian head-dresses, animal

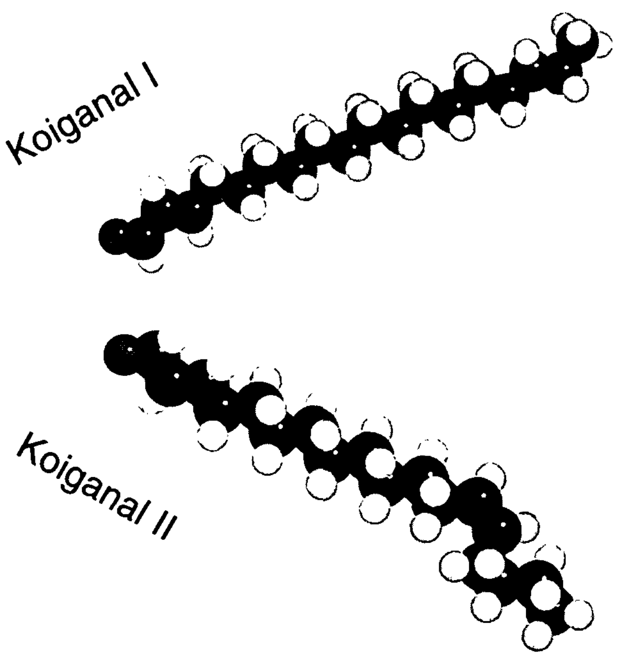

Figure 1. Molecular structure of the pheromone of *Tineola bisselliella.*

mounts and fish skeletons that had not been properly cleaned. Particularly bad infestations were found in closets containing piles of long forgotten woollens, and in the wool carpeting under items that had not been moved for a long time. Traps were placed in pairs in many locations throughout the museum, with an unbaited control trap close to each pheromone-baited trap. Also, a comparison was made between traps containing both pheromone components (Koiganal I and II) and traps containing only the main component (Koiganal I). Trapping commenced in March and continued until the end of September, and counts of trapped moths were made every week.

RESULTS

UK Trials

The total numbers of *T. bisselliella* adults caught, after two, five, eight, fifteen and twenty weeks' exposure, are summarised in Fig. 2. At every counting date considerably more moths were found in the pheromone-baited traps than in the unbaited controls. Numbers caught remained high until there was a reduction in November. This was probably due to a natural decline in moth activity as temperatures fell in the autumn; however, control strategies employed in the store during the summer may also have contributed to the decline in numbers. During the period July to November a total of 740 moths were caught on the pheromone-baited traps compared to only 38 on the unbaited controls. Although the larger 'No Survivor' traps on average caught more moths per trap than the smaller 'Trappit' traps, the comparatively small number of traps used and the variation between replicate trap catches rendered any comparison between trap designs inconclusive. Taking all the trap results together, those with pheromone lures caught a mean of 123 moths per trap compared to only 6 per unbaited control trap.

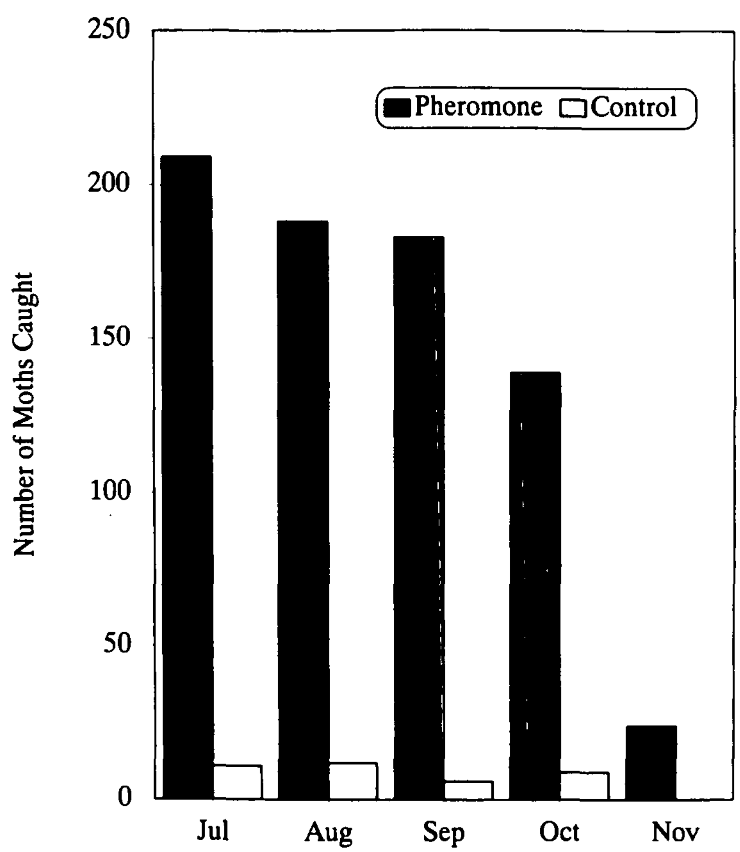

Figure 2. Comparison of trap catch showing the increase in catch on traps with lures.

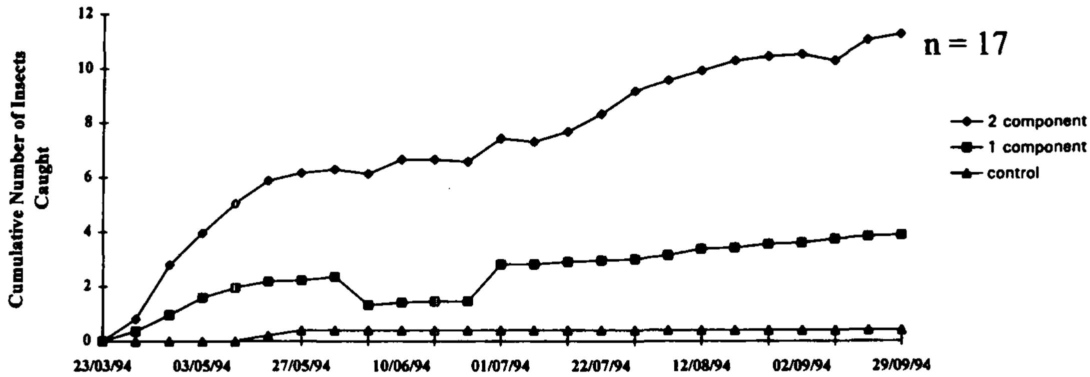

Figure 3. Comparison of *Tineola* pheromones over a six month period.

USA trials

The mean numbers of *T. bisselliella* caught per trap each week are summarised in Fig. 3. Throughout the entire trapping season, only 2 moths were caught on the unbaited traps, and nearly always more moths were caught on the two component baited traps than on the single component traps. Over the six month period a mean of about 0.4 moths were caught per week per two component trap compared to about 0.2 moths per week per single component trap.

DISCUSSION

In the UK trials, the presence of pheromone lures in the traps increased the catch of clothes moths by a factor of times 20 compared to unbaited control traps. The large number of moths caught at one trap position enabled pest control measures to be targeted in this area, thereby avoiding the unnecessary use of pesticides in other areas with consequent financial savings and a reduction in possible health risks to staff.

In the USA trials, the presence of the single and the two component lures in the traps increased the moth catch by factors of about 10 and 20 times, respectively, compared to the unbaited traps. The two component lure trap was twice as effective in catching moths as the single component lure trap. The trapping programme was effective in locating hidden infestations and in assessing the effectiveness of other pest control measures.

Trials in both countries have provided further evidence that using pheromone-baited traps is a valuable method of helping to identify centres of infestation within a large storage area as well as monitoring variations in infestation levels over time. Continued monitoring for several years will also help to evaluate the effectiveness of pest management strategies in use in stores and museums.

RECOMMENDATIONS

- If clothes moth infestation is suspected, in April place traps throughout the area to be monitored on a regular grid or plan.
- Monitor trap catch after two and four weeks.
- Increase trap numbers in areas of higher catch to pinpoint infestation.
- Continue to monitor traps and record catch at monthly intervals, and target inspection and control measures on infested areas.
- Replace lures annually and modify trap patterns as necessary in response to catch and control success.
- Use crawling insect traps to monitor for the presence of carpet beetles and other pest species.

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