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Correlation between *Plodia interpunctella* hübner (Lepidoptera, Pyralidae) males captured with a wing trap and the real density of moth's population

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Abstract

Laboratory trials have been carried out in a Peet & Grady chamber of 30 m^3 to evaluate the efficiency of wing pheromone traps in the presence of a known number of *Plodia interpunctella* males. Wing trap is considered the most effective for the monitoring of Indian Meal Moth. Ten, twenty-five, fifty, seventy-five and one-hundred unmated males - in absence of females - have been released in the chamber and the number of individuals captured by the trap, placed in the centre of the room at 2 m of height, was observed after day one, two, three and four. The wing trap has been activated with a lure impregnated with 0.2 mg of (Z,E)-9,12-tetra-decadenylacetate (TDA). Four replications were carried out for each male's density. The data have been analized with ANOVA and Duncan's *post hoc* test; the number of captures was expressed in terms of percentage on the total of released males. In all tests, the highest number of captures was on the first day. The catch percentage was high in the presence of a low population density while in the presence of a high moth's density the percentage decreased. In particular, from ten to fifty males/ 30m^3 the trap efficacy significantly decreased, while when the population density was fifty males/ 30m^3 or more the percentage of captured males was not significantly different.

Key words: Indian Meal Moth, pheromone trap, trap efficiency, monitoring.

Introduction

Moth traps are used to detect the presence of pests by season and location within a facility, to monitor apparent changes in the size of pest population over time, and to target focal points of infestation or entry (Burkholder, 1990). However, the information obtained have somewhat limited meaning because little is known about the efficiency of the traps. The effectiveness of the pheromone in attracting male moths may be influenced by many factors, as trap design and colour, location in the warehouse, ability to retain the insects after the capture, type of storage facility, food inside the facility, environmental temperature, type of lure, competition between the trap and free-living females, etc. (Howell, 1974; Levinson and Hoppe, 1983; Trematerra et al., 1994; Wright and Cogan, 1995). Mullen et al. (1998) retailed that several methods have been proposed to interpret trap catch data, but they require extensive statistical and computer analyses (Hagstrum et al., 1990; Wileyto et al., 1994) which may not be practical for field situations. In any case, early detection of infestations and an estimate of insect population is essential when developing a sampling programme for insect management; it would be useful to establish a relation between the number

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of insects per unit of volume of air and number of insect per unit of commodities (Subramanyam and Hagstrum, 1995). The practical possibility for obtaining information about the size of pests populations is offered by interpretation of monitoring data taking into account that captures are influenced by many factors.

In this study, the efficiency of a wing trap was evaluated in laboratory conditions, with a known number of virgin males of *Plodia interpunctella* Hübner. The wing trap was chosen because it is considered the most efficient trap to catch Indian Meal Moth. In particular, Mullen et al. (1998) tested the wing trap simultaneously with four other traps of different design, while Savoldelli (2004) compared it with delta, strip and funnel trap, in presence of a known number of males: the result indicated that the wing trap was the most effective design; in 48 hr it captured more than 50 % of males that were present in 30 m^3.

Materials and methods

The strain of *Plodia interpunctella* used in the tests was obtained from the Institute of Agricultural Entomology, University of Milan. It was reared, for several years, in a climatic room at 27 ± 1 °C, 70 ± 5 % r.h. and light/dark 16:8 h, on an artificial diet composed of bran, corn meal, wheat meal, glycerine, wheat germ, honey and yeast (Locatelli and Limonta, 2004).

It was possible to separate the larvae for obtaining virgin adult males, because the full-grown larvae of *P. interpunctella* have been distinguished in male and female, thanks to the presence of a pale brown spot on male's IX abdominal segment, while females have no spots or other distinctive characters.

The wing trap used in the tests is made of an adhesive base and a lid: length 240 mm, width 225 mm, height 110 mm, material: plastic (cod. 04009-04010, Gea Italy).

The tests have been made in a Peet & Grady chamber of 30 m^3, at a temperature of 25 °C, r.h. 50 % and natural light, from May to September 2002 and 2003, with a known number of unmated males of *P. interpunctella*. The wing trap was placed in the centre of the room, at 2 m of height, activated with a caoutchouc lure impregnated with 0.2 mg of (Z,E)-9,12-tetradecadenylacetate (TDA) (average daily release 30 mg/day). According to Levinson and Hoppe (1983), males used in the tests were 2-3-day-olds; they were released in the chamber in the afternoon.

The efficiency of wing trap was tested in presence of ten, twenty-five, fifty, seventy-five and one-hundred unmated males, in absence of females. Four replications have been made for each density of population. A new wing trap was used for each repetition while the lure was changed after the fourth repetition.

The number of individuals captured by the trap was observed day one, two, three and four after the release of the unmated males in the chamber. The number of captures was expressed in terms of percentage on the total of released males. The data have been elaborated with ANOVA and Duncan's *post hoc* test (P = 0.05) (SPSS for Windows 13.5).

Results and discussion

Results show that in presence of a low density of population the wing trap is very effective in capturing males, but in presence of a high moth's density the efficiency decreases. In particular from ten to fifty males/30 m^3 the trap efficacy significantly decreases, while when the population density is fifty males/30 m^3 or more the main percentage of captured males is not significantly different (Table 1). These results confirm previous observation made by other Authors. Howell (1974) observed that sex attractant traps for codling moth, *Cydia pomonella* (L.), are most effective at very low levels and their use to estimate the size of populations is not realistic because the traps do not response when populations are large and unknown. Levinson and Buchelos (1981) observed an increase of trap efficiency, related to a relatively low population density of *Cadra cautella* (Walker), monitored for two years in a flour mill. Also Trematerra (1997) referred that pheromone traps for stored product insects are generally effective when pests numbers are very low.

If we consider one-hundred the total number of caught males for each trap, it is possible to calculate the daily percentage of captures. The data indicate that the percentage of trapped males was high in the first 24 h, while in the following days it decreased (Figure 1). More than 70 % of captured males were caught on the first day, probably because virgin 2-3-day-old males, that were sexually mature, were used. However, it is to be considered that in presence of females, the competition between wild virgin females and pheromone traps can reduce trap efficiency, so additional data are required to analyzed the interaction between females (virgin and mated) and pheromone traps.

Data obtained from trap catch can be used to estimate pests populations but it is very difficult or impossible to establish the real size of

Table 1. Cumulative percentages of captured males of *P. interpunctella*, in presence of different population's density in 30 m^3. Means followed by the same letter, on the same column, are not significantly different (Duncan's test; P = 0.05).

N. males/30 m^3	% captured males ± SD 1 d	2 d	3 d	4 d
10	77.5 ± 17.08 c	90.0 ± 8.2 c	90.0 ± 8.2 c	92.5 ± 9.6 c
25	61.0 ± 8.2 bc	69.0 ± 6.8 b	69.0 ± 6.8 b	72.0 ± 5.6 b
50	46.5 ± 12.4 ab	55.5 ± 10.6 ab	57.0 ± 8.9 a	59.5 ± 7.7 a
75	42.7 ± 8.4 a	55.7 ± 10.0 ab	56.7 ± 9.0 a	61.0 ± 8.1 ab
100	45.2 ± 5.5 ab	50.2 ± 6.6 a	52.2 ± 4.4 a	55.0 ± 6.1 a

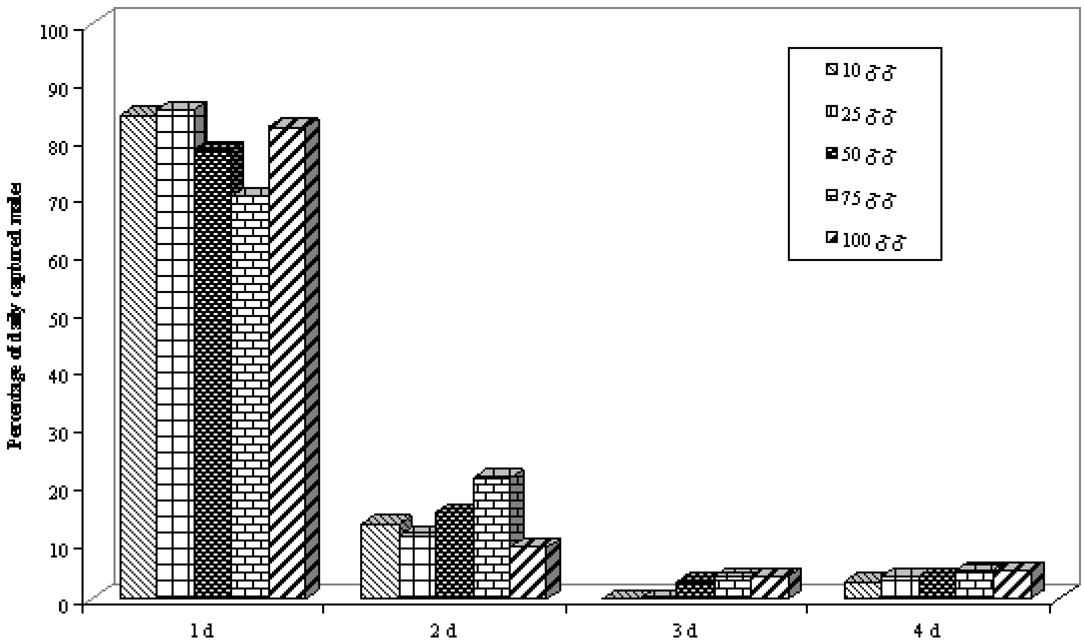

Figure 1. Mean daily percentage of captured males, in presence of different population's density of *P. interpunctella*, in 30 m^3.

populations only with monitoring data. It is known that pheromone trapping is an indirect measure of population levels because it captures insects that have dispersed from their natal habitat patches (Campbell et al., 2002). Arbogast and Mankin (1999) said that the value of traps in monitoring pest population is diminished by our limited ability to relate trap catch to population density, or some action to be taken. In any case, for pest management decision the monitoring with pheromone traps is particularly useful when population density is low because it enables us to locate infestations and take corrective action while the infestations are still small and before they spread to other commodities.

In summary, Pheromone-baited traps are an important part of our defenses against stored-product insect. Although this technique has been in use for many years, the relationship between trap catch and insect population level needs more researches.

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