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SELECTIVE ATTRACTIVITY OF ARTIFICIAL OVERWINTERING CHAMBERS FOR THE COMMON GREEN LACEWING SPECIES OF THE CHRYSOPERLA CARNEA (STEPHENS) COMPLEX IN WESTERN EUROPE (NEUROPTERA: CHRYSOPIDAE)

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The aim of this work is to test attractivity of different types of substrats in overwintering chambers for the common green lacewing species. Experiments were carried out in France near of Angers (48°28'N, 00°33'E) during winter 1999–2000. Sheets and rolls of corrugated cardboard, and staw were used as substrats.
Chambers were colonized by a large numbers of *Chrysoperla kolthoffi* (NAVÁS). The number of lacewings was two times greater in straw than in corrugated cardboard. The suitability of staw was confirmed.
Only 5 *Chrysoperla carnea* s. s. (STEPHENS) were collected, This species seemed to overwinter in more ventilated cavities than our confined boxes. Only one *Chrysoperla. lucasina* (LACROIX) was found.
Our device can already be used to improve the number of overwintering *Ch. kolthoffi* near the crops. In order to develop overwintering chambers as a proper tool for studing overwintering guild structures further experiments are needed with *Ch.carnea*, *Ch. lucasina* or other species.

Key words: lacewing, *Chrysoperla kolthoffi*, biological control, overwintering chamber

INTRODUCTION

The common green lacewing *Chrysoperla carnea* (STEPHENS) sensu lato is generally considered a major component of beneficial entomofauna in agroecosystems. Larva instars are oophagous or/and aphidophagous and can feed on numerous other arthropods.

As generalist predators they are mass reared and sold for releases in glasshouse or in field crops (PAULIAN 1999, MAISONNEUVE & MARREC 1999, RAT-MORRIS 1999).

IPM programmes develop strategies to improve the settlement of released species and to protect spontaneous beneficial populations. Flying movement of adult lacewings which could be compulsory and sometimes on a wide area may be an impediment for using those insects in IPM programmes.

In natural conditions, the developmental pattern of those insects is a facultative multivoltinism (CANARD 1998, CANARD & VOLKOVICH 2001). There is at

least two generations a year in western Europe (ŽELENY 1965). Short late-summer days induce ovarian diapause of adults which is completed at mid-winter whithout any particular stimulus. In autumn, after an intensive feeding period allowing the constitution of lipidic reserves (LEMESLE *et al.* 1998), diapausing adults start seeking for suitable overwintering sites (GEPP 1967)

Adults show a thermic quiescence resulting of low temperature during winter, the insects resume reproductive activity only in spring and simultaneously leave their wintering shelters. A few days later, females begin to lay eggs and offspring predaceous larvae will colonize all the outwood strata of vegetation.

To avoid excessive mortality and to further establish lacewings near the field, SENGONCA and FRINGS (1989) developed in Germany hibernating chambers packed with straw. The authors showed the efficiency of such a device to be colonized by a large number of lacewings and gave some advice: – (i) wooden (plywood) chambers are preferred to plastic ones – (ii) the orientation and the opening of the chamber must minimize inside air movements – (iii) green or red external color inducing fast warming up is more suitable than darker colours. MCEWEN (1998) showed that. (i) internal surface of the box is a key factor for the number of lacewing colonizing it (ii) and that caryophylene as possible attractant had no effect (MCEWEN *et al.* 1999). No work carried out in the field has given data concerning *Chrysoperla lucasina* (LACROIX) and *Chrysoperla kolthoffi* (NAVÁS) which are the two widely distributed species in western Europe (THIERRY *et al.* 1996). Morever both of these two species are reared and distributed by factories for releasing in IPM and organic farming (MAISONNEUVE, pers. com.). Nevertheless in nature the study of temporal changes in overwintering sites revealed marked differences between the species habits (THIERRY *et al.* 1994). In underwood biotopes, *Ch. carnea* s. s. has been found in dry leaves staying in the vegetation from about 20 cm to 3 m up or coexisting with *Ch. lucasina* in ivy tufts invading bushes, whereas *Ch. kolthoffi* is overwintering in unheated and dark parts of buildings.

The aim of this work is to test attractivity of different types of substrats in wintering chambers for the common green lacewing species.

MATERIALS AND METHODS

Construction of lacewing chambers took inspiration from the design outlined by SENGONCA and FRINGS (1987) (Fig. 1). It consists of a wooden box (50 cm × 30 cm × 30 cm (1)); untreated pine wood was used to avoid alteration of insect behaviour due to chemical protection. The box was closed by a fiber-board front side (2) which was drilled randomly by thirty five 15 mm diameter holes. This front side was designed to be easily removed to check the content of the chamber. Each chamber was divided vertically in three compartments (Fig. 2) the lower part leaving free as a crawl space (a). Partitioning was done with 20 mm wire netting (b)

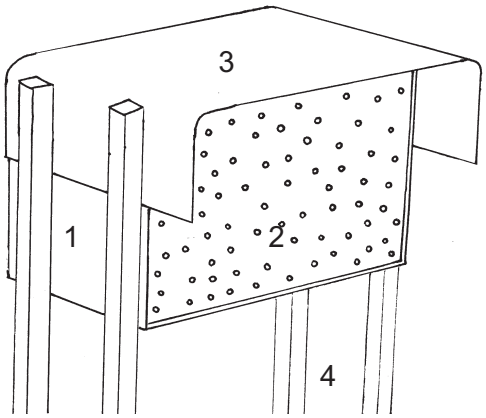

Fig. 1. General view of the overwintering chamber. (1) wooden box, (2) fiber-board front side, (3) plastic plate roof and (4) wooden pool

to allows easy insect movement from one compartment to an other. A green plastic plate was stapled as a roof (3) on top and lateral sides of the box with an eave to protect the front side from rain and wind. Each chamber was bolted to four wooden poles (4) 170 cm above ground level facing away from the dominant wind direction (western wind in our conditions) as proposed by MCEWEN (1998). Corrugated cardboard was used as a substrate for the lateral compartments : in one compartment sheets were piled up (c), a compact roll was inserted vertically in another compartment, while the middle compartment was tightly filled with straw.

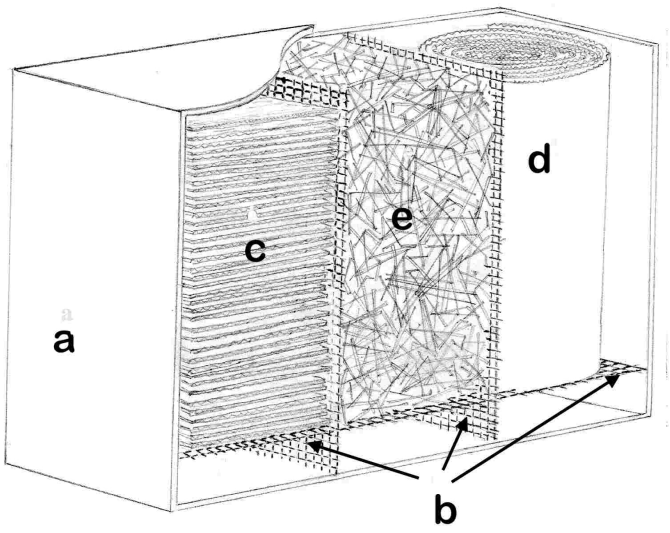

Fig. 2. Inside part of the overwintering chamber. (a) crawl space; (b) 20 mm wire netting; (c) sheets of corrugated cardboard, (d) roll of corrugated cardboard and (e) straw

Experiments were carried out in France in four stations whithin a 50–kilometer area in the Loire valley around Angers (48°28'N, 00°33'E) (Fig. 3). Two stations were located in sub-urban areas (1 and 2) and two others far away from the town in a farming zone: one in the south (3) and the last in the north (4). During the first week of November 1999 four chambers were placed in each station. As far as the station environment made it possible, the chambers were placed in four situations : (i) in a protected or field seed crop area, (ii) near a hedgerow, (iii) underwood, (iiii) near a expected overwintering site of *Ch. kolthoffi* (farmsheld and/or woodshed).

The boxes were removed during the first week of February. They were placed individually in plastic bags and quickely transferred in a cold room (4±1°C) to keep insects in thermic quiescence and inhibit their moving inside the chambers. The chambers were then checked in the laboratory and the lacewing location recorded as precisely as possible. The lacewings were then identified.

RESULTS AND DISCUSSIONS

Except one individual, no lacewing have been found in boxes in sub-urban areas; conversely 18 and 99 lacewings were found respectively in stations 3 and 4. Different hypothesis could be proposed to explain those results: – (i) guild density is lower in sub-urban areas which are more drastically perturbated by human activity than in farming areas and particularly in station 4 where IPM programmes have

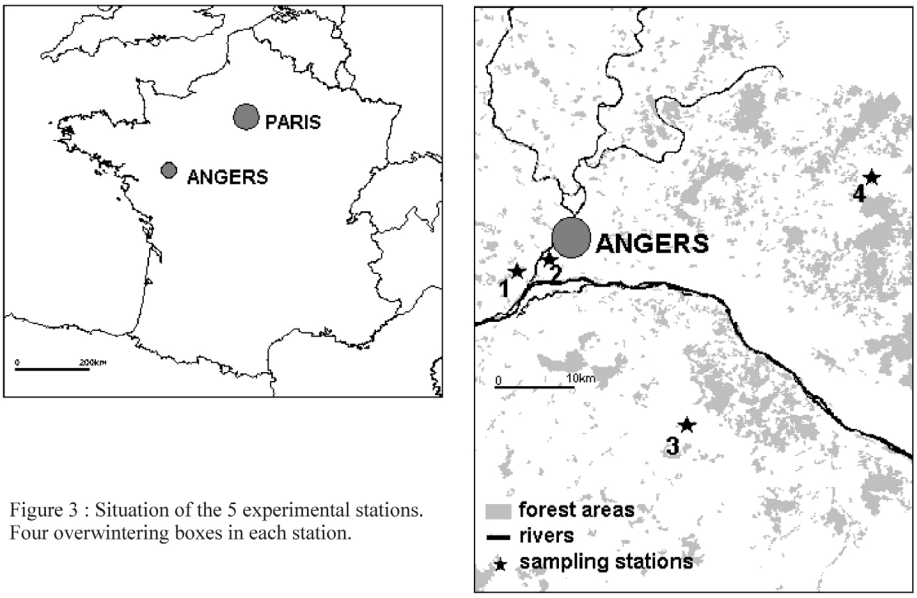

Figure 3 : Situation of the 5 experimental stations. Four overwintering boxes in each station.

Fig. 3. Situation of the four experimental stations

Table 1. Number of individuals of *Chrysoperla kolthoffi* collected in the chambers located in stations 3 and 4

Location in the station	cultivated field	hedgerow	underwood	farmshed / woodshed
Station 3	8	2	0	8
Station 4	19	30	17	27
Total	27	32	17	35

been perfomed for three years (GALEZ *et al*. 1998) – (ii) numerous unheated parts of building offer alternative overwintering sites more suitable than our chambers – (iii) the outline of buildings could disturb the lacewing in their orientation towards the chambers (MCEWEN 1998).

Chrysoperla kolthoffi was the main species collected (111 individuals). Even if the chamber construction and the substrates were more suitable for *Ch. kolthoffi* than for others species, we note the similarity between these results and our present knowledge of the distribution of this species, which is always dominant in the atlantic part of Europe (THIERRY *et al.* 1996). As reported by THIERRY (1991) concerning overwintering sites (unheated parts of building), females are slightly more numerous (55%).

The number of *Ch. kolthoffi* was quite equal in stacked sheet and rolled corrugated cardboard, but two times greater in straw. The suitability of this last substrate is confirmed. May be, as dry foliage used by SENGONCA and FRINGS (1989), cardboard did not provide enough space for adult *Ch. kolthoffi* to hide.

Most of the lacewings were found hidden inside straw or between the cardboard lying and not in the periphery. This observation is not consistent with SENGONCA and FRINGS (1989) who recorded 94% of lacewings aggregated in area at least 4 cm distant of the louvered front of chambers.

A total of 5 *Chrysoperla carnea* s. s. were collected, 4 were found ouside the boxes, between the green plastic plate and the upper side, only one was found in straw. *Ch. carnea* s. s. seemed to overwinter more in ventilated cavities than the confined, and always rather humid, atmosphere of our boxes. This preferendum could be related with our knowledge of the overwintering sites of this species in the field.

Table 2. Location of *Chrysoperla kolthoffi* within the chambers

Location within the chamber	straw	sheets of cardboard	rolled cardboard	periphery of substratum
Station 3	9	8		1
Station 4	47	22	19	5
Total	56	30	19	6

Only one *Ch. lucasina* was found in the chamber located in station 4 in straw substrate. This species is rare in Loire Valley although in station 4, it was been mass introduced during three years of IPM programmes. Obviously, this species is not attracted by our device. As for *Ch carnea* s. s., the chamber construction that we tested seemed to be unsuitable.

Our device can already be used to improve the number of overwintering *Ch. kolthoffi* near the crops. In order to develop overwintering chambers as a proper tool for studing overwintering guild structures further experiments are needed with *Ch.carnea, Ch. lucasina* or other species.

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