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Ability of amitraz to maintain the predator *Exochomus quadripustulatus* L. (Col., Coccinellidae) in an integrated management of *Eupulvinaria hydrangeae* (Steinw.) (Hom., Coccidae)

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Abstract

To investigate the possibility of using amitraz in an integrated control programme of *Eupulvinaria hydrangeae,* the selectivity of the insecticide to *Exochomus quadripustulatus* was studied in the laboratory and the effects of amitraz spraying on the predator populations were evaluated under natural conditions. Laboratory experiments included three complementary methods. The first involved topical application of the active ingredient (amitraz). The second method investigated the effects of the commercial formulation MITAC®, emulsifiable concentrate (EC) at 190 g/l amitraz, on ladybeetles dipped in the insecticide mixture. The third method tested the effects of the same commercial product when ladybeetles were fed with scale insects insecticide treated under field conditions. Amitraz or its MITAC® formulation applied in concentrations of up to 0.1 % equivalent active ingredient did not affect mortality or fecundity of *E. quadripustulatus.* However, when treatment was particularly severe as when adults were dipped in a MITAC® solution, a reversible tetanization was observed. Assuming that toxicity will also be low under field conditions, a preliminary field experiment was designed to investigate how *E. quadripustulatus* reacts to a partial MITAC® treatment of the vegetation. It was found that spraying induced a decrease in the number of *E. quadripustulatus* although there was no way of distinguishing between mortality and dispersal. Anyway the decrease of the predator is at worst in the same order of magnitude as for its prey: *E. hydrangeae.* The results of these laboratory and field experiments indicate that MITAC® could be an useful component in an integrated pest management scheme of *E. hydrangeae.*

1 Introduction

Since the early eighties, the soft scale *Eupulvinaria hydrangeae* Steinw. has caused serious damage to many urban ornamental plant species in Belgium (Merlin et al. 1988). Its biology and its entomophagous complex have been documented by Canard (1965) and by Merlin and Pasteels (1990). Previous studies (Tondeur et al. 1990a and b, 1991) have shown that amitraz (MITAC® formulated as an emulsifiable concentrate (EC) at 190 g/l) provides a successful chemical control when sprayed at the end of winter or in early spring. These experiments have led to the use of MITAC® being recommended in the control of soft scales in Belgium (registration n° 7389/B of January 31, 1991).

It was interesting to complete these results by an impact study on natural enemies of *E. hydrangeae,* particulary on the coccinellid, *E. quadripustulatus.* Among the relatively poor entomophagous complex of *E. hydrangeae,* this coccinellid is a major predator which therefore justifies its protection when pest management is carried out (Merlin et al. 1990).

It is well known that among the families of major predators of Homoptera, Coccinellidae show a very widespread tolerance to insecticides (Bellow and Morse 1988; Croft and Brown 1975; Hodek 1970 and Horn and Wadleigh 1988). Amitraz, which shows a high degree of safety to many beneficial insects in field conditions, is currently used in Integrated Pest Management (IPM) (Anonymous 1982a, b). Its harmlessness towards coccinellids has been demonstrated several time (ACTA 1989; ANONYMOUS 1982b; LAGOUARDE and BATALLA 1989; MORSE et al. 1987 and WEIGHTON et al. 1973).

To date, several methodologies to estimate selective toxicity of insecticides towards natural enemies have been well documented. As pointed out by BELLOWS et al. (1986), HORN and WADLEIGH (1988) and ROSENHEIM et al. (1989), it is important to take into account possible sublethal effects (e.g. behaviour-modifying effects, longevity, impacts on fecundity or on egg-hatching).

In this study, investigations into lethal and some sublethal effects of amitraz on *E. quadripustulatus* were carried out. In a first step, amitraz selectivity was studied in laboratory conditions according to the classical procedure (topical application) and according to two original methods using the commercial formulation (either dipping the ladybeetles in the insecticide mixture or feeding them with scale insects sprayed in field conditions).

The second step was a preliminary appraisal of the use of MITAC® in field conditions. An experiment was designed in order to observe, in the case of a weak toxicity of MITAC® on *E. quadripustulatus,* how spraying could modify the distribution of coccinellids and could possibly induce an aggregation on untreated vegetation in response to food decreases on the treated parts.

TONDEUR et al. (1991) recommended that MITAC® should be sprayed at the end of winter or in early spring to control *E. hydrangeae.* At this time, *E. quadripustulatus* is at the adult stage and ready to oviposit. For this reason, experiments was performed on this stage.

2 Material and methods

2.1 Rearing of *E. quadripustulatus*

The coccinellids were reared using the method described by KATSOYANNOS (1976). The adults used in the first laboratory experiment were produced in a rearing room at Gembloux University. Those used in the other experiments were produced in a separate rearing room at Brussels University. At the end of the reproductive diapause, adults were stored at 3 ± 1 °C until the start of the experiment. Storage duration was 25, 17 and 35 days respectively for the first laboratory experiment, the field experiment and the second laboratory experiment.

2.2 Laboratory experiments

2.2.1 First experiment

The topical application was performed with 1 µl of a 0.1 % technical amitraz solution in acetone (SCHERING n° B221) applied to the adult sterna. The effects of this application were compared to adults treated with acetone in the same way and to one untreated control. Twenty replicates were made.

Mortality and fecundity were recorded at 3–5 days interval during 2 months (from 11. 4. to 11. 6. 91). At every recording time, the eggs were collected and kept together by treatment in Petri dishes. An appraisal of egg-fertility was made by counting the larvae hatched for the same 3–5 days interval.

The adults were kept in pairs in Petri dishes 14 cm in diameter under a 16L:8D (Light:Dark) photoperiod and 22 ± 1 °C. They were fed with *E. hydrangeae* nymphs, adults or ovisacs infesting maple twigs (*Acer pseudoplatanus*). Twigs were replaced at each recording time.

In order to have complementary data on total fecundity, pairs treated with amitraz and those from the untreated control were transferred to 9 cm diameter Petri dishes and observed until total oviposition was completed (13. 8. 91). Once a week, the number of eggs laid was recorded and food was renewed.

2.2.2 Second experiment

Two treatments using the commercial formulation of amitraz, MITAC® formulated as an emulsifiable concentrate at 190 g a.i. (active ingredient) per liter, were compared. Each of them involved two concentrations of MITAC®: 2 and 5 ml of commercial product per liter of water.

The first treatment was a 5 sec immersion of the ladybeetles in either mixture. Control insects were dipped in water.

The second treatment consisted in treating the food supply: MITAC® *was applied in the field on* well infested maples twigs when the experiment started (30. 5. 91). During the two first weeks, the adults were fed with scale insects infesting these sprayed twigs. Control adults were fed with untreated twigs.

The adults treated with the higher concentration were observed only for mortality. Mortality and fecundity of the control adults and of those treated with the lower concentration were recorded once a week when food was renewed. The experiment continued until egg-laying ceased. Egg-fertility was appraised once a week in the same way as in the first experiment.

Fifteen replicates were made with pairs of adults kept in Petri dishes of 9 cm diameter under a 16L:8D photoperiod and at 22 ± 1 °C.

2.3 Field experiment

The experiment was carried out in a private park in the suburbs of Brussels. An homogeneous plantation of 450 young *Acer pseudoplatanus,* infested by *E. hydrangeae* was first pollarded at 3–4 m high to allow observation of *E. quadripustulatus* on the whole tree material.

The belt-shaped experimental area is mapped in the fig. 1. The experimental area was divided in three plots of 150 trees, named A, B and C, sprayed at different intensities. To appraise the possible ability of *E. quadripustulatus* to modify its distribution according to the severity of the insecticide treatment (e.g.: aggregation on areas free from spraying), two different proportions of unsprayed trees were kept in two plots randomly chosen. Therefore, spraying was carried out on 75 % of trees randomly chosen on plot A and on 50 % of trees on plot B. This experimental spraying induced an unavoidable disturbance because trees were bent in order to be completely sprayed. On the other hand, polythene sheets were used to protect the surrounding trees which were not sprayed. The last plot was unsprayed (plot C). About 200 m away, fifty maples were chosen as a control.

Material and spraying methods were the same as described in Tondeur et al. (1990a). MITAC®, formulated in an emulsifiable concentrate (190 g a.i./l), was applied *at 2 ml/liter as recommended in* Tondeur et al. (1991). Insecticide spraying was carried out during a warm and sunny day (15. 4. 91), and there was no rainfall during the following two days.

Four days before spraying, 560 adults of *E. quadripustulatus* were released on 28 trees evenly distributed in each experimental plot. Before the *E. quadripustulatus* release, the local population of this coccinellid on the site was evaluated by counting the adults on the entire surface of each of the 450 trees. In order to determine the effect of spraying on the coccinellid population including both indigenous and released adults, the same survey was carried out 15, 40, 55 and 146 days after release. The population density of *E. hydrangeae* was calculated on 10. 4. 91 on a sample of 50 twigs per plot on which the length was measured.

The efficiency of the insecticide was appraised one and an half months after spraying by counting the surviving scales on fifteen marked twigs evenly distributed in each treated plot. The measure of scale mortality was corrected according to natural mortality recorded in plot C.

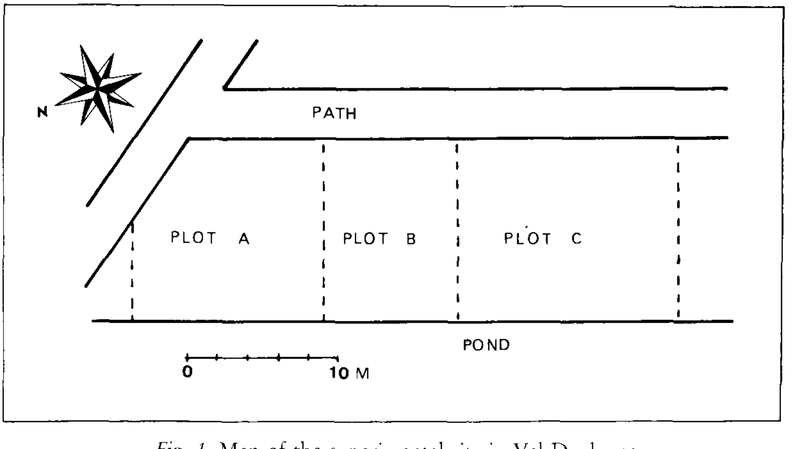

Fig. 1. Map of the experimental site in Val Duchesse

3 Results

3.1 Laboratory experiments

3.1.1 First experiment

Cumulative mortality is given in fig. 2A. No significant difference was recorded between control and technical amitraz. After 2 months the mortality ratio in relation to sex is 1 female per 3 males with no obvious influence of treatment.

Fecundity was analysed by two complementary statistical methods. On the one hand, analysis of variance does not record any significant difference between total egg-laying of the three treatments after 2 months: $F = 0.42$ with $p = 0.660$, $n = 20$. The same analysis on total egg-laying (table 1) of the 3 treatments followed until the end of the oviposition period does not show any significant difference either: $F = 0.71$ with $p = 0.404$, $n = 20$. On the other hand, egg-laying curves in the fig. 2B are compared by calculating the matrix of linear correlation coefficients for all treatment combinations (table 2). The coefficient values and their associated significance level indicate that the egg-laying follows the same pattern for all treatments even if the correlation between the egg-laying concerning the amitraz and the acetone treatments are not quite significantly related ($p = 0.11$). The coefficient value is so close to the others that it would not indicate any systematic difference in the egg-laying due to the treatment.

Table 1. **Comparison of cumulated egg-laying averages ($\overline{X}$) in the two laboratory experiments**

	First experiment		Second experiment			
	UNT	Amitraz	So	Co-So	Sp	Co-Sp
X	43.5	61.5	43.5	53.7	59.7	34.5
E.S.	14.0	16.3	8.2	8.8	12.6	8.2

1. In the first laboratory experiment (n = 20 pairs of adults): UNT = untreated control, Acetone = treatment of the adults with topical application of pure acetone, Amitraz = treatment of the adults with topical application of amitraz technical a.i. diluted at 0.1 %.
2. In the second laboratory experiment (n = 15 pairs of adults): So = treatment of the adults by dipping them in MITAC® at 2 ml/l, Co-So = control dipped in water, Sp = treatment of the adults by feeding them with infested MITAC® sprayed twigs at 2 ml/l, Co-Sp = control fed with infested unsprayed twigs.

Table 2. **Matrix of the linear correlation coefficients and their probability level between treatments for change in number of eggs laid over time in the first laboratory experiment**

	UNT	Acetone	Amitraz
UNT	1.00	0.66**	0.78**
Acetone[a]	0.66**	1.00	0.52ns
Amitraz	0.78**	0.52ns	1.00

First laboratory experiment (n = 20 pairs of adults): UNT = untreated control, Acetone = treatment of the adults with topical application of pure acetone, Amitraz = treatment of the adults with topical application of amitraz technical a.i. diluted at 0.1 %. ns: $p > 0.05$, * $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$.
[a] The period of acetone treatment was only two months.

The adults treated with amitraz laid many eggs at the end of their egg-laying period. No explanation can be given for this surprising record. Global egg-hatching rates are given in table 3. No obvious difference exists between treatments. However, these results are only indicative because cannibalism is probably highly promoted in our set up (no food was included in the boxes where the eggs were kept). Nevertheless, it appears that amitraz does not induce drastic egg sterility.

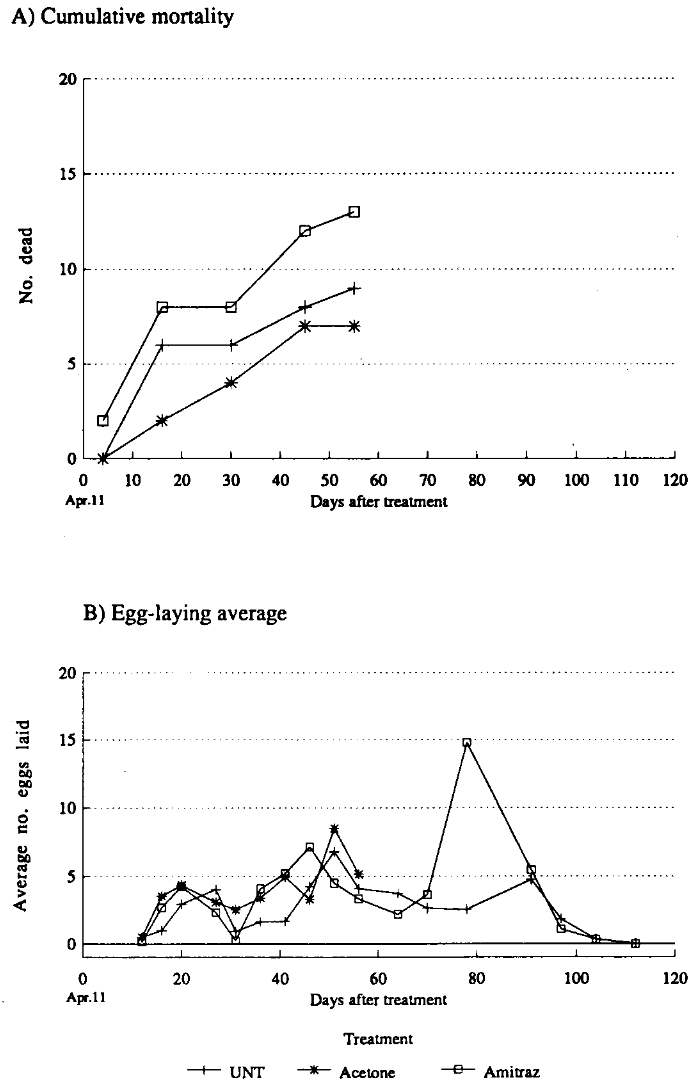

Fig. 2. Cumulative mortality and egg-laying average in the first laboratory experiment. Statistical analysis of data on the mortality at each date of observation: Chi^2: n.s.for p = 0.05

3.1.2 Second experiment

The ladybeetles dipped in MITAC® underwent a tetanization effect. The intensity of this shock appears to be enhanced with the concentration of the product but was reversible for all the insects after a few hours.

Mortality and egg-laying (fig. 3) were analysed as in the first experiment. Concerning mortality, no significant difference was found between treatments. At the end of the experiment the mortality ratio in relation to sex is 4 females per 1 male with no obvious influence of treatment. Concerning fecundity, the analysis of variance does not show any difference between total egg-laying (table 1) of the four treatments (F = 1.33 with p =

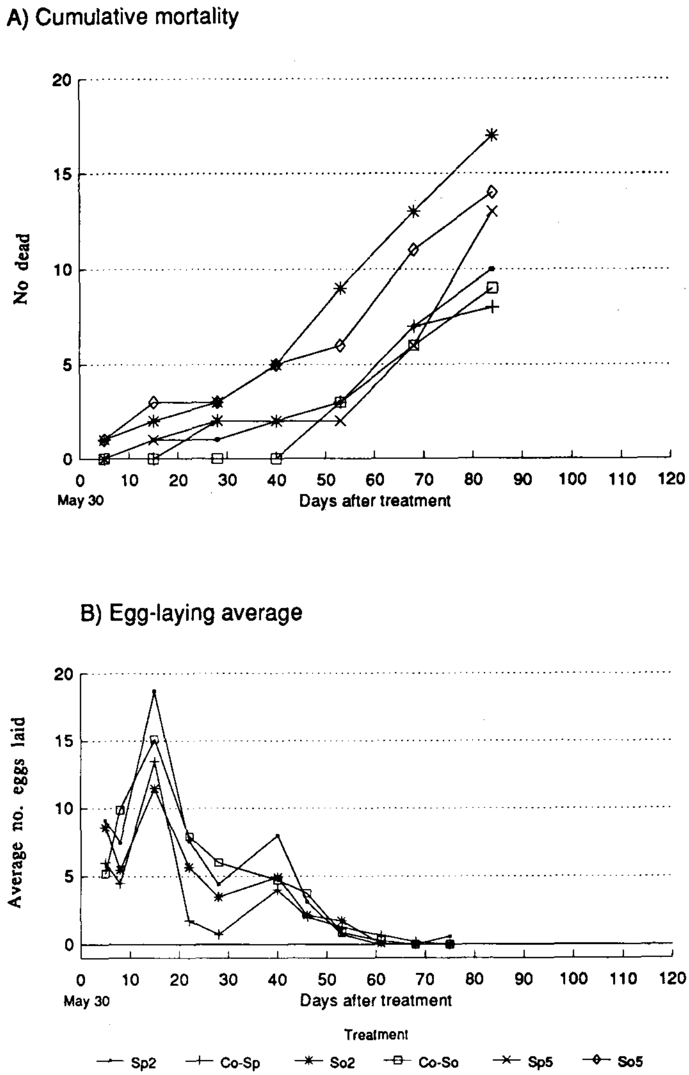

Fig. 3. Cumulative mortality and egg-laying average in the second laboratory experiment. Statistical analysis of data on the mortality at each date of observation: Chi^2: n.s.for p = 0.05

0.275, n = 15). The matrix of linear correlation coefficients between all treatments shows that all the egg-laying curves have the same pattern (table 4).

Global egg-hatching rates (table 3), as for the first experiment, do not show any drastic egg sterility due to the MITAC® treatment.

3.2 Field experiment

The initial density of *E. hydrangeae* per twig cm on 10. 4. 91 was ($\overline{X}$ ± E.S., n = 50) 6.0 ± 0.5 on plot A, 5.8 ± 0.6 on plot B, 6.3 ± 0.7 on plot C and 7.8 ± 0.6 on the control plot.

At the end of May, the efficiency of MITAC® calculated on the entire treated twigs sample, corrected by the natural mortality recorded on plot C, is 75 % on plot A and 90 %

Table 3. **Global percentage of egg-hatching in each treatment of the two laboratory experiments**

	Percentage of egg-hatching			
First experiment	UNT		Acetone	Amitraz
	28.2		35.7	28.8
Second experiment	So	Co-So	Sp	Co-Sp
	29.2	32.8	34.0	34.8

1. In the first laboratory experiment (n = 20 pairs of adults): UNT = untreated control, Acetone = treatment of the adults with topical application of pure acetone, Amitraz = treatment of the adults with topical application of amitraz technical a.i. diluted at 0.1 %.
2. In the second laboratory experiment (n = 15 pairs of adults): So = treatment of the adults by dipping them in MITAC® at 2 ml/l, Co-So = control dipped in water, Sp = treatment of the adults by feeding them with infested MITAC® sprayed twigs at 2 ml/l, Co-Sp = control fed with infested unsprayed twigs.

Table 4. **Matrix of the linear correlation coefficients and their probability level between treatments for change in number of eggs laid over time in the second laboratory experiment**

	So	Co-So	Sp	Co-Sp
So	1.00	0.89***	0.97***	0.90***
Co-So	0.89***	1.00	0.93***	0.83***
Sp	0.97***	0.93***	1.00	0.94***
Co-Sp	0.90***	0.83***	0.94***	1.00

Second laboratory experiment (n = 15 pairs of adults).
So = treatment of the adults by dipping them in MITAC® at 2 ml/l, Co-So = control dipped in water, Sp = treatment of the adults by feeding them with infested MITAC® sprayed twigs at 2 ml/l, Co-Sp = control fed with infested unsprayed twigs.
*** $p \leq 0.001$.

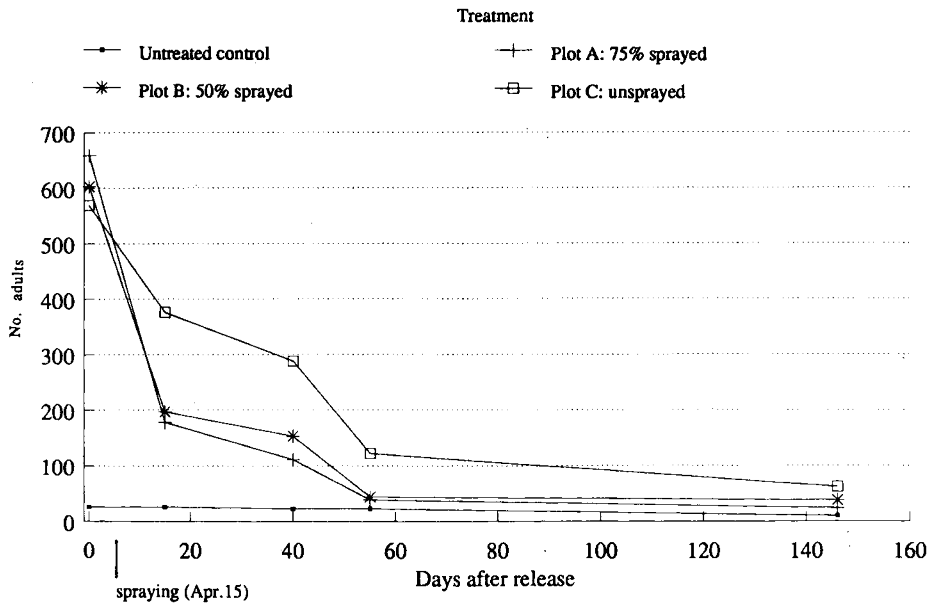

Fig. 4. Change over time of *E. quadripustulatus* in the field experiment. All plots include 150 trees excepted for the control plot: 50 trees

on plot B. Considering the 75 % and the 50 % of treated trees on plot A and plot B respectively, the estimated reduction of scale population compared to plot C is 56 % on the whole of plot A and 45 % on the whole of plot B.

Change over time in the *E. quadripustulatus* populations is given in fig. 4 for each treatment. The first adult count made before release shows a higher population in plot A followed by plot B and plot C. This suggests a gradient of population on the site which could be related to microclimatic conditions. The following measurements provide an appraisal of the combined effect of the coccinellid release and insecticide treatments.

On April 26, adults were more numerous on plot C than on plot B, the lowest population being on plot A. This distribution is inversely related to the severity of treatments which suggests that spraying depresses the *E. quadripustulatus* population. This assumption is reinforced by the fact that the distribution after treatment is opposite to the natural one which was recorded at the first count. In the course of the season, a population decrease due to mortality or dispersal is observed with no obvious effect of insecticide treatments.

In order to analyze the situation in more detail, the distribution of adults in relation to insecticide treatment of the trees is given in table 5.

Compared to unsprayed trees, an obvious decrease of *E. quadripustulatus* occurred on sprayed trees. On the other hand, the number of adults observed on the unsprayed trees in plots A and B is significantly lower than in plot C. This can be explained by a drift of the insecticide droplets onto the protected trees or by disturbance of trees during spraying. Therefore, there is no evidence of a coccinellid aggregation. Comparing the mean number of *E. quadripustulatus* on sprayed trees of plot A or B to that of trees on plot C (table 5), we estimate that about 20 % of coccinellids remained on sprayed trees. Considering the 25 and 10 % survival (see above) of *E. hydrangeae* on plots A and B respectively due to MITAC® spraying, the ratio of coccinellid/coccid seems at worst unchanged.

The linear correlation coefficients of the relationships between the adult numbers per tree at successive dates for each plot (table 6) provide some indications about the long term effect of the treatments. The significant difference between plots recorded April 26 and May 21 could mean either a difference in mortality rate between sprayed and unsprayed trees or an enhanced adult mobility in

Table 5. **Average number of coccinellids on sprayed (SP) or unsprayed (UNS) trees on which insects were released (20 adults/tree)**

Date of survey	April 26			May 21			June 5		
Tree class	SP $\bar{X}$ ± ES (n)	UNS $\bar{X}$ ± ES (n)[a]	SP/UNS	SP $\bar{X}$ ± ES	UNS $\bar{X}$ ± ES	SP/UNS	SP $\bar{X}$ ± ES	UNS $\bar{X}$ ± ES	SP/UNS
Plot A	2.1 ± 0.6 (18)	6.0 ± 1.2 (10)a	0.35	0.9 ± 0.3	2.5 ± 1.0	0.36	0.4 ± 0.1	0.4 ± 0.3	1.00
Plot B	2.0 ± 0.7 (13)	6.1 ± 1.2 (15)a	0.33	1.3 ± 0.4	2.9 ± 0.8	0.44	0.4 ± 0.3	1.0 ± 0.5	0.40
Plot C	-	11.0 ± 0.9 (28)b	-	-	5.9 ± 0.9	-	-	1.4 ± 0.9	-

Field experiment: Plot A = release of 560 adults and spraying of 75 % trees with MITAC® at 2 ml/l, Plot B = release of 560 adults and spraying of 50 % trees with MITAC® at 2 ml/l, Plot C = release of 560 adults and no spraying.
ANOVA between sprayed and unsprayed trees (on April 26): $p \leq 0.001$. ANOVA between plots (on April 26): $p \leq 0.01$. [a] numbers followed by different letters are significantly different for $p = 0.05$ according to the Newman and Keuls test.

Table 6. **Linear correlation coefficients (R) between two dates of survey for coccinellids counted on each tree**

Dates of survey compared	R value in plot A	R value in plot B	R value in plot C	Signif. level (p)*
Apr. 26–May 21	0.47	0.56	0.73	0.01
May 21–June 05	0.17	0.39	0.33	ns

Field experiment: Plot A = release of 560 adults and spraying of 75 % trees with MITAC® at 2 ml/l, Plot B = release of 560 adults and spraying of 50 % trees with MITAC® at 2 ml/l, Plot C = release of 560 adults and no spraying.
* Statistical analysis: Chi^2.

plots where spraying was done. Considering that the counting of April 26 was carried out 11 days after spraying, it is to be expected that mortality, if any, is of little importance and that the difference observed is mainly explained by dispersal. For the later dates, no significant difference was recorded.

Table 7 gives the distribution of adults according to trees with or without coccinellid release. The higher means are always recorded on trees where release was done. Two months after release we found that there were still about two times more adults on trees with release which suggests a sedentary behaviour of *E. quadripustulatus.* Nevertheless, a slight homogeneization occurs in the course of the season as indicated by the increase in the ratio of adults found on trees without release and trees with release.

4 Discussion

Laboratory experiments show that amitraz or its MITAC® formulation applied at concentrations up to 0.1 % eq. a.i., which is higher than usually recommended, does not affect mortality and fecundity of *E. quadripustulatus.* However, when the treatment is particularly extreme as when adults are dipped in MITAC® solution, a reversible tetanization is observed. Egg-laying of *E. quadripustulatus* appears to have been very irregular in the course of the experiments. This is possibly due to the heterogeneity of *E. hydrangeae* life stages provided as food (e.g. presence of newly produced ovisacs increasing egg-laying).

In spite of the lack of replication (essentially due to the difficulty in finding a large place suitable for an experimental design invaded by *E. hydrangeae*) and the use of laboratory reared insects, the preliminary study of MITAC® effects in field conditions provides some findings within the framework of an integrated control strategy.

In the short term (between 15 and 26. 4.) the decrease of *E. quadripustulatus* population recorded 11 days after insecticide treatment on sprayed plots is due to either mortality or dispersal outside plots although there was no way of distinguishing between one or the other. In addition to a possible toxic effect of MITAC®, other effects of spraying are probably also involved. Tetanization observed in drastic laboratory conditions could dislodge the insects and could also be more dramatic in field conditions or increase dispersal. Also, a repulsive effect can not be excluded.

Moreover, at least a part of the general decrease of *E. quadripustulatus* adult population on plots sprayed could be due to disturbance by handling the trees during spraying. As the individual contribution of these effects is unknown, it is impossible to estimate the mortality actually due to MITAC®.

In the longer term when mortality induced by MITAC® can be excluded, some results (table 6) indicate that, in spite of a sedentary behaviour, spraying enhances coccinellid mobility inside plots probably related to a lack of food. Nevertheless, the ability of

E. quadripustulatus to aggregate on areas which escape the MITAC® spraying has not been demonstrated. Concerning the coccinellid/coccid ratio, our results do not permit an accurate analysis but suggest that the balance is maintained.

Predatory impact was not perceptible because of a very weak larval population which developed on the experimental plots (equivalent to the control plot). The reasons for this are probably the unfavourable climatic conditions and a possibly poor ability of the laboratory reared adults to oviposit under field conditions.

The overall evaluation of laboratory and field results suggests that MITAC® would be an useful component in an I.P.M. of *E. hydrangeae*. Of course, we cannot conclude on the harmlessness of MITAC® on the remainder of the beneficial entomofauna. Indeed, the Hymenopterous parasitoïds seem to be less tolerant of amitraz than coccinellids (ACTA 1989). Thus, it is possible that *Metaphycus melanus* (Encyrtidae) and *Coccophagus lycimnia* (Aphelinidae) identified as the only parasitoïds of *E. hydrangeae* (MERLIN and PASTEELS, 1990) could be more affected by MITAC®.

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Zusammenfassung

Zur Selektivität des Insektizids Amitraz gegenüber dem Prädator Exochomus quadripustulatus L. (Col., Coccinellidae) im Rahmen von integrierten Bekämpfungsmaßnahmen gegen die Schildlaus Eupulvinaria hydrangeae (Steinw.) (Hom., Coccidae)

Es wurde die Selektivität des Insektizids Amitraz gegenüber dem Marienkäfer *Exochomus quadripustulatus* im Labor und Freiland untersucht. Den Laborexperimenten lagen drei komplementäre Methoden zugrunde: 1. Topikale Applikation von Amitraz; 2. Eintauchen der Käfer in eine Handelsformulierung MITAC® als Emulsion (190 g/l); 3. Fütterung der Käfer mit Schildläusen, die im Freiland mit Amitraz bekämpft worden waren. Amitraz oder seine Formulierung MITAC® zeigten in Konzentrationen bis zu 0,1 % (als Sprühmittel) keine Wirkung auf die Mortalität und Fruchtbarkeit von *E. quadripustulatus*. Selbst bei der stärkeren Anwendungsform des Tauchens wurde nur eine reversible Starre bei den Käfern beobachtet. In der Annahme, daß die Toxizität auch unter Freilandbedingungen gering ist, wurde eine vorläufige Freilanduntersuchung durchgeführt, um zu prüfen, wie *E. quadripustulatus* gegenüber der partiellen MITAC®-Kontamination der Vegetation reagiert. Es zeigte sich, daß das Sprühen zu einer Abnahme der Zahl der Käfer führte, allerdings gab es keine sichere Unterscheidungsmöglichkeit zwischen Mortalität und Abwanderung. Schlimmstenfalls lag die Abnahmequote bei den Käfern in der gleichen

Table 7. **Average number of coccinellids observed on trees on which insects were released (R) or not (WR) (only for the unsprayed trees)**

Date of survey	April 26			May 21			June 05		
Tree class	WR $\bar{X} \pm$ ES (n)	R $\bar{X} \pm$ ES (n)	WR/R	WR $\bar{X} \pm$ ES	R $\bar{X} \pm$ ES	WR/R	WR $\bar{X} \pm$ ES	R $\bar{X} \pm$ ES	WR/R
Plot A	1.0 ± 0.3 (27)	6.0 ± 1.2 (10)	0.17	0.6 ± 0.3	2.5 ± 1.0	0.24	0.3 ± 0.1	0.4 ± 0.3	0.75
Plot B	0.7 ± 0.2 (60)	6.1 ± 1.2 (15)	0.12	0.7 ± 0.2	2.9 ± 0.8	0.26	0.2 ± 0.1	1.0 ± 0.5	0.23
Plot C	0.6 ± 0.1 (122)	11.0 ± 0.9 (28)	0.05	1.0 ± 0.1	5.9 ± 0.9	0.17	0.7 ± 0.2	1.4 ± 0.9	0.51

Field experiment: Plot A = release of 560 adults and spraying of 75 % trees with MITAC® at 2 ml/l, Plot B = release of 560 adults and spraying of 50 % trees with MITAC® at 2 ml/l, Plot C = release of 560 adults and no spraying.

Größenordnung wie bei der Beute, *E. hydrangeae*. Aus den Ergebnissen dieser Labor- und Freilanduntersuchungen geht hervor, daß Amitraz bzw. MITAC® eine nützliche Komponente im Rahmen einer integrierten Bekämpfung der Schildlaus *E. hydrangeae* sein könnte.

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