Biological control of leafhopper *Jacobiasca lybica* (Bergevin & Zanon, 1922) (Hemiptera: Cicadellidae) by lacewing *Chrysoperla carnea* under laboratory conditions

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Résumé : **Introduction :** The cotton leafhoppers *Jacobiasca lybica* (Bergevin & Zanon, 1922), is a polyphagous species considered to be a major pest of grapevines in Europe, causing significant economic damage and considered in Morocco as a secondary pest of several crops including citrus fruits. Its control mainly based on chemical treatments, which remains necessary to explore more other techniques such as biological control. In this study, we evaluated the voracious appetite of different larva instars of the green lacewing *Chrysoperla carnea* (Stephens, 1836) (Neuroptera: Chrysopidae) on *J. lybica* under laboratory conditions. **Materials and methods :** The study was conducted in laboratory of INRA-Morocco (Qualipole of Berkane). The larvae and adults of leafhopper and lacewing were collected from a vineyard located in Berkane Province (Morocco) during autumn of 2021. Each lacewing instar (L1, L2 and L3) was put in a petri dish containing a humid filter paper and a freshly detached grapevine leaf, with 15 adults and 5 larvae of leafhoppers that was replicated nine times to assess the predatory potential, by counting the number of leafhopper consumed after 24 hours. **Resuts and discussion :** Our results indicated that the predation rate for L3 instar was 47,78 % which differs significantly from L2 instar 31,11%. No significant difference was revealed between L2 and L1 instars that had a predation rate of 21,66 %. The predation rates should be interpreted with caution as *C. carnea* was fed on *J. lybica* in our laboratory conditions and that do not reflect the real conditions in fields. Further studies should be done in fields as this predator was the most abundant natural enemies during the autumn period in Moroccan.
Mots clés : *Jacobiasca lybica*, biological control, *Chrysoperla carnea*, predation.

Introduction

The cotton leafhopper *Jacobiasca lybica* (Hemiptera: Cicadellidae) is considered a polyphagous species and a major grapevine pest in Europe and also as an emergent pest for citrus fruits in Morocco. The control of this pest is still poorly efficient, especially under Moroccan conditions with an absence of approved active ingredients on citrus fruits. Around the world, the chemical control is still the most common technique used to manage leafhopper populations. However, the extensive use of insecticides can lead to several issues. Our objective of this study is to evaluate the predatory performance of the green lacewing (*Chrysoperla carnea*) on *J. lybica* under the laboratory conditions.

Fig.1: Location of the collection area in Eastern Morocco. A zoom-in on the field of the collection

Materials et methods

Sampling area

The green lacewings and leafhoppers collections were done during Autumn 2021 in vineyard located in Couteaux de Saidia Domain in Berkane (Morocco) (Fig. 1). The vineyard (1,8 ha) was planted to 10-years old *Vitis vinifera* 'Carignan' cultivar. No pesticides were used in vineyards during the Autumn which coincides with late harvest time.

The green lacewing and leafhopper collection

The adults and larvae of the green leafhopper identified as *Jacobiasca lybica* (Bergevin & Zanon, 1922) (Hemiptera: Cicadellidae) (Khfif et al., 2022) (Fig. 2) and green lacewing identified as *Chrysoperla carnae* (Stephens, 1836) (Neuroptera: Chrysopidae) (according to the morphological aspects) were collected during the beginning of Autumn 2021 by a mouth aspirator. In field, the lacewing larvae were collected individually in empty 2 mL Eppendrof tubes to avoid a cannibalism.

Fig. 3: Lacewing adult with its three larval instars (L1, L2 and L3) (from left to right), Scale bars: 1 cm.

Fig. 2: Cotton leafhopper adult, *Jacobiasca lybica* : (A) male in dorsal view and (B) lateral view, Scale bars: 0.5 mm. (Khfif et al., 2022)

Predation test

The study was conducted in a climate-controlled room at 24 ± 1°C, with a 12-h photoperiod in a laboratory of entomology at (INRA – Qualipole of Berkane, Morocco). To evaluate the effectiveness of *C. carnea*, each lacewing instars (L1, L2 and L3) collected from fields was put in a petri dish (120 mm diameter) containing a humid filter paper and a single freshly cut grapevine leaf with 15 adults and 5 larvae of leafhoppers. Based on the length of lacewing larvae, it was ascertained as 1st, 2nd and 3rd instar lacewing (Fig. 3). All lacewing larvae were starved for 3 hours prior to the experiment to increase their motivation to search for leafhoppers. The number of leafhopper predated (mummies) by the lacewing was counted 24 hours after the beginning of the experiment, that was replicated 9 times (table 1).

Statistical data analysis

We treated our data based on direct observations to distinguish the predated leafhoppers as a mummies under the binocular magnifier. Data analysis and plots were performed by R (version 4.1.2). Generalized linear models were fitted with the glm function of the Stats package (version 4.1.2), and package 'emmeans' (version 1.7.2) in R was used to test the significant differences in lacewing's larval instars using Tukey method.

Table 1: Experimental design summary

Lacewing instars	Number of leafhoppers		Replicates
L1	Adult	15	9
	Larvae	5	
L2	Adult	15	9
	Larvae	5	
L3	Adult	15	9
	Larvae	5	
Control	Adult	15	9
	Larvae	5	

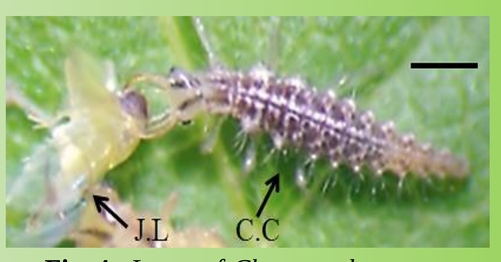

Fig. 4: Larva of *Chrysoperla carnea* (C.C) preying on *Jacobiasca lybica* (J.L) during the experiment, Scale bars: 1 mm.

Results

Our results indicate the voracity of different lacewing instars on leafhopper (Fig. 4). All three instars were active for the predation, and the predation rate was significantly different between *C. Carnea* instars (Chisq(1) = 14.3302, p-value= 0.0001). Predation rate for L3 (47,78 %) differs significantly from L2 instar with 31,11 % (p-value= 0.0032). No significant difference was revealed between L2 and L1 that had a predation rate of 21,66 % (p-value= 0.1002) (Fig. 5).

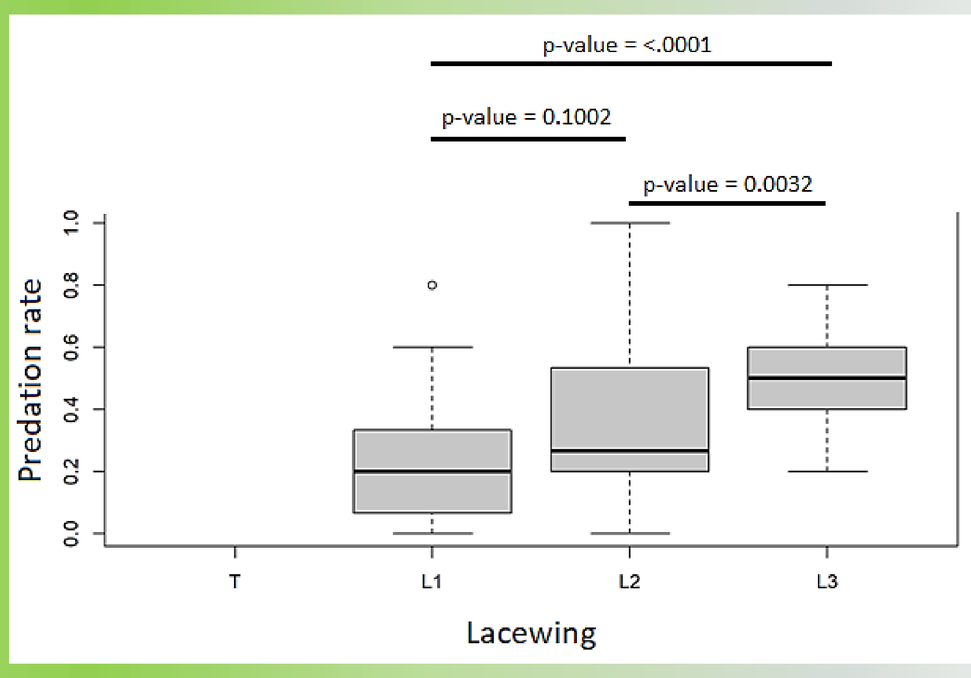

Fig. 5: Predation rate depending to lacewing instars (L1: 1st instar, L2: 2nd instar, L3: 3rd instar, T: control)

Conclusions

Our findings suggest that all three lacewing instars were active for leafhoppers predation. The voracity of predation increased from younger to older instars, however, these rates should be confirmed by further research in natural conditions. This biocontrol should be combined with other techniques as integrated management to control *J. lybica*.

Relevant references

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Acknowledgments

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