Insect Pathogens and Insect Parasitic Nematodes
IOBC wprs Bulletin 26 (1), 2003
pp. 245-248

Persistence of the biological effect of codling moth granulovirus in the orchard – a preliminary field trial

Jutta Kienzle[1], Christof Schulz[1], Claus P.W. Zebitz[1], Juerg Huber[2]
[1] *University of Hohenheim, Institute of Phytomedicine, 70593 Stuttgart, Germany*
[2] *Institute for Biological Control, BBA, Heinrichstr. 243, 64287 Darmstadt, Germany*

Abstract: In a field trial, the persistence of the biological effect of codling moth granulovirus (CpGV) was investigated. With one treatment on May 23, with full concentration of CpGV (MADEX 3, 100 ml/ha), a considerable reduction of CM population was achieved over the whole vegetation period. This may indicate that over a considerable period of time after a single treatment, a biological effect of CpGV sufficient for an increased mortality of the larvae was present in the orchard. However, the onset of mortality was not fast enough to protect the fruit from damage.

Further research must be done to gain more experience about this effect. For intelligent IPM strategies a long term effect in population control of codling moth could be very important.

Key words: Codling moth, Codling moth granulovirus, persistence

Introduction

The use of codling moth granulovirus (CpGV) in IPM strategies as a tool for codling moth (CM) control is increasing in Southern Germany. Main interest is directed towards the efficacy of the virus in CM population control – which on a long term also means damage control.

In this context, the question of the persistence of the biological effect of CpGV in the orchard was raised. In the past, the effect of CpGV was assessed as reduction of damage, i.e. mortality of larvae before they could damage the fruit to a degree that its market quality was downgraded. For our purpose, the interest was directed towards control of CM population, i.e. the mortality of the larva also at later larval stages.

Since observations in the field seemed to indicate a rather persistent effect of CpGV applications in population control, a preliminary field trial was realized in 2000.

Material and methods

The experimental orchard of 0,4 ha was located at the research station of the University of Hohenheim. The variety Elstar on M9 was planted in 1986, the trees were vigorous. The orchard was divided into two equal parts with an untreated buffer zone of 20 m. One part was treated with CpGV in full concentration (MADEX 3, Andermatt Biocontrol, 100 ml/ha) on May, 23, 2000. The second part served as untreated control. After this, the whole orchard remained without any insecticide treatment until the end of the season.

Fruit damage was assessed several times during the year (1000 fruits per plot). Since the trees were also provided with trap bands for the assessment of the survival of the larvae, the fruits remained on the trees and were not opened. Thus, only deep entries and superficial stings could be distinguished. At harvest, 2000 fruits per plot were checked. They were split open to identify „stopped damage“ even if the entry was deeper. „Stopped damage“ means, that the entry did not reach the seed cavity, i.e. the larva did not complete its development in the fruit.

Corrugated cardboard belts were applied around the trunks of the trees and assessed at regular intervals (100-50 trees per plot). Thus, the effect of the single treatment on the diapausing larvae could be observed from interval to interval. The belts were applied at the end of June and checked on July 26, August 3, August 23 and September 9.

The probable hatching period of the larvae found in the belts in each interval was calculated using sum of degree-days >8,1 °C (Welte, personal communication). For completion of larval and pupal development 100 degree days each were assumed.

Results

In 2000, at Hohenheim, the CM flight started during the first decade of May. Nevertheless, first injured fruits could not be found until the last days of June, i.e. four weeks after the treatment. On 5th of July there was a slight difference in injured fruits between the treated and the untreated part (Table 1). In the treated part, there were also some „stings" on the fruits. At harvest, fruit damage was even slightly higher in the treated part (29,5 %) than in the untreated control (28,4 %). The number of fruits with „stopped damage", however, was higher in the treated part than in the untreated part.

Table 1: Fruit damage in % in early summer and at harvest in the treated and untreated plot.

Early summer				
Date	Plot	Superficial stings	Deep entries	Total damage
5.7.00	Treated	0.3	0.4	0.7
	Untreated	0	0.9	0.9
21.7.00	Treated	0	1.3	1.3
	Untreated	0	1.3	1.3
Harvest				
Date	Plot	"stopped" damage	Complete damage	Total damage
7.9.00	Treated	17.4	12.1	29.5
	Untreated	12.8	15.6	28.4

At each sampling date of the corrugated card board belts a distinct reduction of the number of larvae in the CpGV treated plot could be observed (Fig. 1). The efficacy of this single CpGV treatment in population control at the different assessment dates is shown in Table 2.

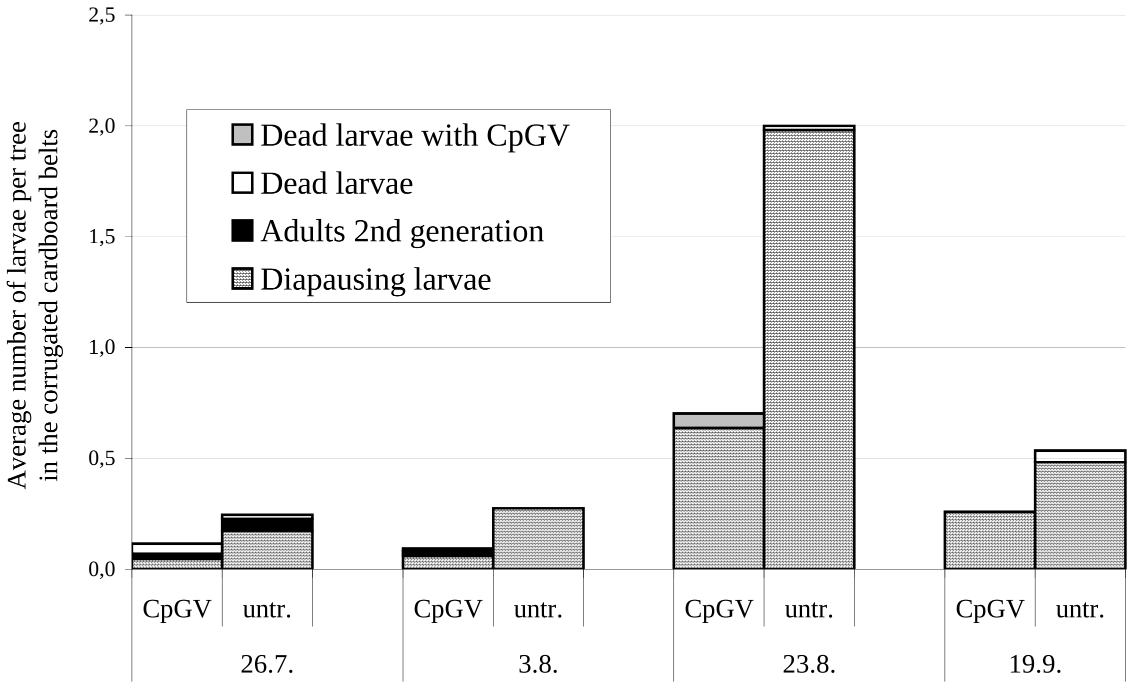

Fig. 1: Reduction of CM population in the treated and untreated plot: Number of larvae in the corrugated card board belts at the different assessment dates.

Table 2: Effect of CpGV on the diapausing larvae and probable hatching period (in days after treatment) of the corresponding larvae from the egg

Sampling date	Hatching period of the larvae (DAT)	Reduction of population in %
26.7.	38-48	64.2
3.8.	49-60	74.2
23.8.	61-83	67.8
23.9.	84-97	46.4

Discussion

The reduction of CM population over the whole season by a single treatment with CpGV in May suggests that over a considerable period of time after the treatment, a biological effect of CpGV sufficient for an increased mortality of the larvae was present in the orchard. Obviously, the larvae did not die fast enough to prevent fruit damage. Since the fruit damage in both plots was similar, it can be excluded that the reduced population in late summer is simply due to the effect of CpGV on the first generation, or to a difference in fruit attack. With regard to the small size of the plots, this was also not to be expected.

These first results can confirm the findings of Huber (1980) and of Glen & Payne (1984) that most of the CpGV applied with a treatment is inactivated rather quickly by UV-irradiation (half life about two days).

However, the inactivation curve is bi-shaped: a small part of the CpGV applied (about 1 %) persisted for a much longer time in the orchard. This corresponds to laboratory findings of Huber & Lüdcke (1996).

At first, these findings seemed to beof little interest, since high concentrations of CpGV are necessary for damage control. A normal synthetic product in such a low concentration would also be totally ineffective. However, for CpGV the low slope of the dose-effect-curve must be considered. Since with 1/10 of the normal concentration also rather good effects in damage control can be achieved, it seems realistic, that 1/100 of this concentration (1 % of the CpGV applied) could be enough to cause a considerable, but slow larval mortality – as observed in this experiment.

These one year results certainly must be followed by further experiments. However, if further research confirmes the trend shown in this first trial, this would be an important finding for the use of CpGV in intelligent CM control strategies. It would mean that a high concentration of CpGV, applied at the beginning of the hatching period of CM larvae, will conduct to an acceptable population control effect over the whole vegetation period or at least for the first generation. Thus, such an application could give a certain security to the grower for this period. If problems arise with insecticide resistance or imprecise timing of the treatments, there will be no outbreak of the CM population as consequence.

It is not known, as to what happens with the possible persisting fraction of CpGV, if several treatments are applied at rather short intervals. Glen & Payne (1984) supposed that the residuals of several treatments sum up. Further studies are necessary to examine these effects and their possibilities for use in intelligent IPM strategies.

Acknowledgements

We wish to thank the Volkswagen-Stiftung, Hannover, for funding of the project (II/74 037).

References

Glen, D.M. & Payne, C.C. 1984: Production and field evaluation of codling moth granulosis virus for control of *Cydia pomonella* in the United Kingdom. Ann. Appl. Biol. 104: 87-98.

Huber, J. 1980: Field persistence of the codling moth granulosis virus. IOBC wprs Bull. 3 (6): 58-59.

Huber, J. & Lüdcke, C. 1996: UV-Inactivation of baculoviruses: the bisegmented survival curve. IOBC wprs Bull. 19 (9): 253-256.