Regulation of *Cydia pomonella* by *Steinernema feltiae* in Northern Germany

B. Benduhn[1], P. Heyne[2], and P. Maxin[3]

Abstract

*A trial to reduce the population of codling moth (*Cydia pomonella L*) with endomopathogenic nematodes was initiated in Northern Germany. In the autumns of 2007 and 2008* Holsteiner Cox *orchards were treated with different concentrations (7.5 x 10^8; 1.5 x 10^9) of Steinernema feltiae at the time of leaf fall. The effect was assessed as the degree of fruit infestation during the following summer and at harvest. In both 2008 and 2009 an efficacy of about 55% relative to untreated control plots was determined.*

Keywords: Codling moth, *Cydia pomonella*, entomopathogenic nematodes, *Steinernema feltiae*

Introduction

Although codling moth (CM), *Cydia pomonella* L, usually produces only one generation in Northern Germany, its importance has risen during the past 20 years [TRAPMAN *et al.*, 2008]. In some commercial orchards, fruit infestations of up to 30% have been recorded [PALM *et al.*, 2007]. For an effective codling moth management all available tools should be used. Different trials in recent years have indicated that the use of entomopathogenic nematodes (EPN) can be a module in a combined control strategy [CURTO *et al.*, 2008]. It is important to use ideal weather conditions for effective pest mangement using EPN [KIENZLE *et al.*, 2008].

Material and Methods

The trial takes place at an 18-year-old apple orchard near Oldenburg/Holstein in Northern Germany, close to the Baltic Sea coast. The geographical position causes a humid climate with moderate temperatures in autumn suitable for applying EPN. The complete trial orchard is about 15 ha in size and planted primarily with the cultivar 'Holsteiner Cox'. The trial blocks measured about 2 ha in 2007 and 1.25 ha in 2008. No other apple orchards were located in the vicinity, thereby excluding any interference by immigrating CM adults.

EPN applications were carried out in the mornings of 12 Dec. 2007 and 7 Nov. 2008 at temperatures of 13 and 9-10°C, respectively. On both occasions there was light drizzle. Details of the weather conditions were recorded during and after treatment using a *Metos Compact* weather station. In order to avoid injuries to the nematodes, these were applied at reduced pressures of 8 bar (2007) and 6 bar (2008) using a grey LU 120-06 nozzle. In both years, two different concentrations of 7.5 x 10^8 and 1.5 x 10^9 *Steinernema feltiae* EPN were applied, each in 1.750 l water ha^{-1}.

[1] B. Benduhn, Öko-Obstbau-Norddeutschland, Obstbau- Versuchs- Beratungszentrum, Moorende 53, 21635 Jork, Germany. E-mail: bastian.benduhn@lwk-niedersachsen.de
[2] P. Heyne, Öko-Obstbau-Norddeutschland, Obstbau- Versuchs- Beratungszentrum, Moorende 53, 21635 Jork, Germany. E-mail: peter.heyne@lwk-niedersachsen.de
[3] P. Maxin, Det Jordbrugsvidenskabelige Fakultet, Aarhus Universitet, Kirstinebjergvej 10, 5792 Årslev, Denmark. E-mail: Peter.Maxin@agrsci.dk

Results

The effect of EPN treatment on CM infestation was assessed by counting infected fruits at two times during the following year. In Aug. 2008 and 2009, 5.000 apples (50 trees x 100 fruits) were scored for both treatment blocks and the untreated control. The results are shown in Table 1.

Table 1: Results of infestation ratings in August (% fruits damaged by CM)

Date of rating	7.5 x 10^8 EPN/ha	1,5 x 10^9 EPN/ha	Untreated control
28 Aug. 2008	4.3%	4.4%	10.4%
12 Aug. 2009	9.3%	6.9%	14.7%

At harvest time, 10 trees of both treatments and the control block were harvested completely. These trees lay on diagonal lines through the trial blocks. Windfall fruits were included in the analysis. In both years the higher EPN application resulted in a higher degree of efficacy which was about 55%. The results are shown in Figures 1 and 2.

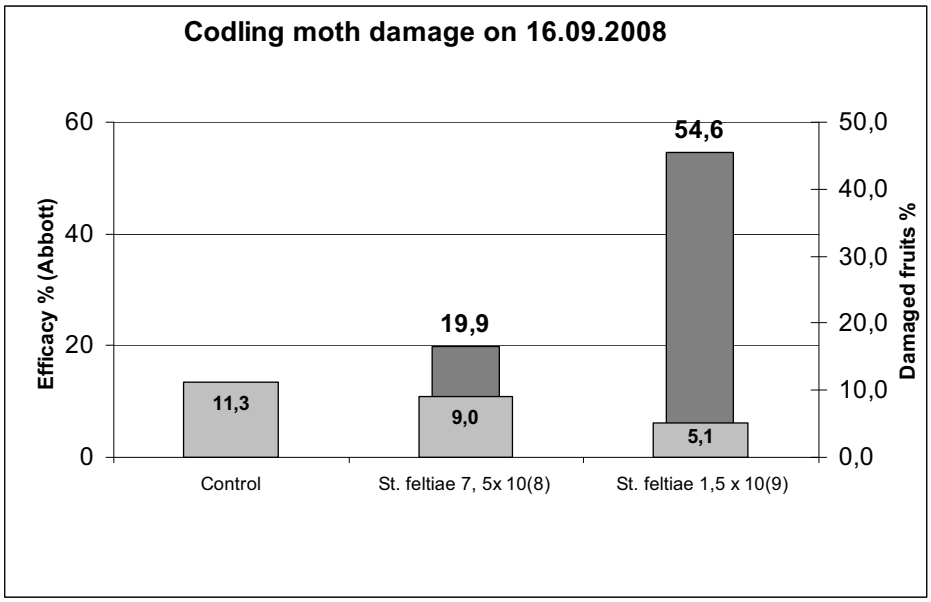

Figure 1: Codling moth damage on 16 Sept. 2008 at harvest, and degrees of efficacy of the two EPN concentrations.

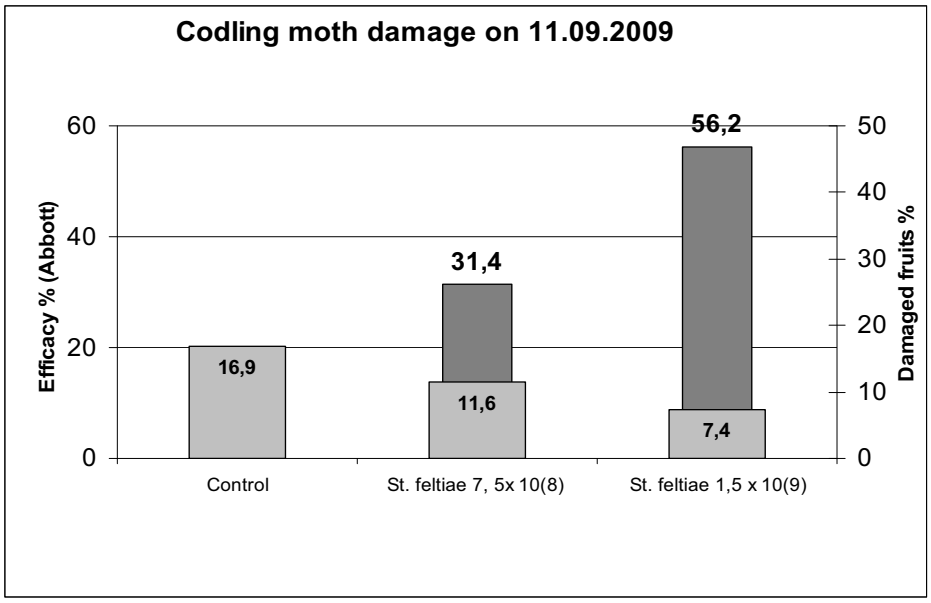

Figure 2: Codling moth damage on 11 Sept. 2009 at harvest, and degrees of efficacy of the two EPN concentrations.

Discussion

The results indicate a potential of EPN to reduce the CM population if a concentration of 1.5 x 10^9 nematodes is applied at a time of advantageous weather conditions. The water volume of 1750 l ha^{-1} was sufficient to achieve the observed reduction of CM infestation, making it practicable for farmers to use this method as part of an integrated CM control strategy.

However, more practical research work relating to the technical methods of applying the EPN is needed, e.g. using sensor technology to reduce the amount of wasted spray mixture. Further, the types of nozzles and pumps used in agricultural spraying equipment may not be well adapted to the application of living organisms because of high shear forces, necessitating further technical developments.

Acknowledgements

The authors thank the E-nema Company for supplying entomopathogenic nematodes, and the Domke family for permission to carry out the EPN trials on their orchard.

References

Curto, G., Reggiani, A., Vergnani, S., Caruso, S. & Ladurner, E., (2008). Effectiveness of entomopathogenic nematodes in the control of Cydia pomonella larvae in Northern Italy. *13th International Conference on Cultivation Technique and Phytopathological Problems in Organic Fruit-Growing:* 271-276

Kienzle, J., Zimmer, J., Volk, F., Zebitz, C.P.W., (2008). Experiences with entomopathogenic nematodes for the control of overwintering codling moth larvae in Germany. *13th Int. Conference on Cultivation Technique and Phytopathological Problems in Organic Fruit-Growing:* 277-283.

Palm, G., Vollmer, I., Kruse, P. (2007). Untersuchung der Apfelwicklerpopulation und Bekämpfung 2006 an der Niederelbe. *Mitt. des Obstbauversuchsringes des Alten Landes* **62**:111-115.

Trapman, M., Helsen, H. & Polfliet, M. (2008). Development of a dynamic population model as a decision support system for Codling Moth *(Cydia pomonella* L*)* management*. 13th International Conference on Cultivation Technique and Phytopathological Problems in Organic Fruit-Growing:* 247-251