

## Combined use of insect pathogenic fungi and nematodes against the onion thrips, *Thrips tabaci*, in the field

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**Abstract:** In the year 2003, field trials against *Thrips tabaci*, an important pest insect in onion, leek and chives, were conducted at four different sites with commercially available products based on insect pathogenic fungi and nematodes. The trials were performed according to the EPPO guideline PP 1/85(3) for the efficacy evaluation of insecticides “Thrips on Outdoor Crops”. As a chemical standard Perfekthion® was used in onion. In leek, Spruzit® and Neudosan® were applied alternately. The biocontrol products used were Mycotal® (*Lecanicillium muscarium*, former *Verticillium lecanii*, Koppert NL), PreFeRal® (*Paecilomyces fumosoroseus*, Biobest BE), Naturalis L® (*Beauveria bassiana*, Intrachem IT), Nemaplus® (*Steinernema feltiae*, E-Nema DE) and NemaGreen® (*Heterorhabditis bacteriophora*, E-Nema DE). They were applied either alone or in a mixture using common spray equipment. A wetting agent was added. The nematodes were applied at a rate of  $1 \times 10^6$  infective juveniles/m<sup>2</sup>. The dosage of the fungi was 1 kg (1.5 l in the case of Naturalis L®)/ha. The treatments started mid June and were repeated up to six times in weekly intervals. Throughout the summer, *T. tabaci* was recorded only in medium numbers (mean of 30 specimen/plant max.) at all four sites. In two trials (onion, Mainz; chives, Horkheim), no differences between treatments and the untreated control could be detected. In the third trial (onion, Schifferstadt), a significant reduction was recorded for the treatment ‘PreFeRal+Nemaplus’, both in the number of thrips/plant (2 compared to 6 in the control, respectively) and the frequency of infestation (38% compared to 93% in the control, respectively), one week after the final application (three times in total). Also in the fourth trial (leek, Bonn), the number of thrips/plant was lowest for the treatments ‘fungus+nematode’ (4 compared to 7 in the control, respectively; fungus here: Mycotal®) one week after the final application (six times in total). In this trial, yield was measured additionally, and it turned out, that the weight/plant registered for the treatments ‘Nemaplus’ and ‘Mycotal+Nemaplus’ was 20% higher than in the control (425 and 412 g/plant compared to 345 g respectively). These trials show that the use of insect pathogenic fungi and nematodes in the field is possible, confirming results of others collected in Great Britain and The Netherlands. In view of the extreme weather conditions in summer 2003 in Germany, and in comparison to the effect of the chemical standards, the results gained with the biocontrol agents are regarded as very promising. However, more experiments are necessary.

**Keywords:** *Thrips tabaci*, insect pathogenic fungi, *Beauveria bassiana*, *Lecanicillium muscarium*, *Paecilomyces fumosoroseus*, insect pathogenic nematodes, *Heterorhabditis bacteriophora*, *Steinernema feltiae*, biocontrol, field testing

### Introduction

Thrips can cause serious damage to many different crops. Especially the onion thrips, *Thrips tabaci*, is an ubiquitous pest insect. Due to their hidden mode of life, thrips are difficult to control. In particular, organic growers have no effective and economic control measure available against thrips.

The present study was conducted within the frame of the “Bundesprogramm Ökologischer Landbau“, a German research programme designed for support of organic agriculture. The intention was to develop a sustainable control method against both the air- and the soilborne life stages by combining insect pathogenic fungi with nematodes. After

laboratory and greenhouse testing, field experiments were performed in 2003. The results are reported here.

## Material and methods

In summer 2003, field trials were conducted in different crops and at four different sites: Bonn – leek (variety ‚Helios‘), Mainz and Schifferstadt – onion (variety ‚Bristol‘), Horkheim – chives, in co-operation with plant protection services and research institutions. As far as possible, all trials were performed according to the EPPO Guideline for the efficacy evaluation of insecticides PP 1/85(3) “Thrips on outdoor crops“. Briefly: Plot size at least 20 m<sup>2</sup>; four replicates per treatment; untreated control and a chemical reference product included; assessments by counting the number of living thrips either at five random groups of four successive plants per plot (leek) or on the plants of 5 x 0.5 m row lengths per plot (onion, chives). Perfekthion<sup>®</sup> served as chemical reference in the onions, whereas in the leek experiment, Spruzit<sup>®</sup> and Neudosan<sup>®</sup> were applied in alternation. As biological treatments the following products were used: Mycotal<sup>®</sup> (*Lecanicillium muscarium*, formerly: *Verticillium lecanii*, Koppert NL), PreFeRal<sup>®</sup> (*Paecilomyces fumosoroseus*, Biobest BE), Naturalis L<sup>®</sup> (*Beauveria bassiana*, Intrachem IT), Nemaplus<sup>®</sup> (*Steinernema feltiae*, E-Nema DE) and NemaGreen<sup>®</sup> (*Heterorhabditis bacteriophora*, E-Nema DE). They were applied either singly or in a mixture by means of standard application equipment (motorized sprayer, nozzle type e.g. Teejet 8003 VK, 2-3 bar), addition of a wetting agent (either Addit<sup>®</sup> or ProFital<sup>®</sup> fluid) and – for the nematodes only – removal of all filters. The application rate was 1x10<sup>6</sup> infective juveniles/m<sup>2</sup> for the nematodes, and 1 kg (respectively 1.5 l for Naturalis L<sup>®</sup>)/ha for the fungi. All treatments were applied with 1000 l of water/ha. Starting from mid/end of June, the plants were treated in weekly intervals up to six times. In addition, at the field site in Schifferstadt a fungicide commonly used in practice was applied against downy mildew, but with a distance of three days to the biological treatments.

## Results and conclusions

At all sites, only medium infestation rates were recorded throughout the summer (mean of 30 thrips/plant at maximum). In two trials (onion – Mainz; chives – Horkheim) no differences between the treatments and the untreated control could be detected at the end. In the onions, the frequency of infestation was 70-78% for all variants one week after the last treatment (five times in total), but the number of thrips was very low (2-3 insects/plant). Here, many natural enemies of thrips were observed (e.g. *Aiolothrips* spp., *Chrysoperla*-larvae) during the season. In the chives, a degree of weed covering of  $\geq 70\%$  at the date of the final assessment prevented an appropriate evaluation. In contrast, in a third trial (onion – Schifferstadt) a significant reduction of both, the number of thrips/plant and the frequency of infestation was achieved one week after the last treatment (3 times in total) for the variant ‘PreFeRal+Nemaplus’ (ca. 60% effect compared to ca. 20% for the chemical reference, Perfekthion<sup>®</sup>), respectively, see Figure 1). Also in the fourth trial (leek – Bonn), the lowest number of thrips/plant (4 compared to 7 in the control, respectively) was recorded within the ‘fungus+nematode’-variants (fungus here: Mycotal<sup>®</sup>) one week after the last treatment (6 times in total). No differences between variants were recognized for the frequency of infestation. In this trial, the yield was assessed additionally. Interestingly, the weight/plant was approx. 20% higher for the variants ‘Nemaplus<sup>®</sup>’ and ‘Mycotal<sup>®</sup>+Nemaplus<sup>®</sup>’ in comparison to the control (425, 412 and 345 g/plant, respectively).

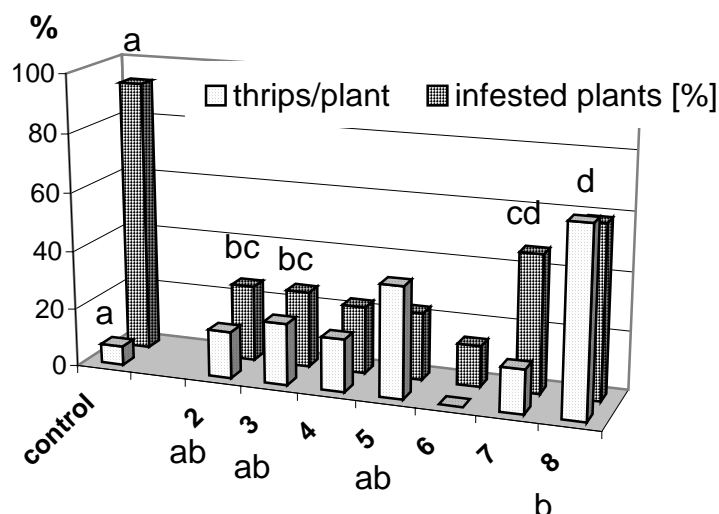


Figure 1. Effect [%] of treatments 2-8 in the field trial in Schifferstadt [Perfekthion<sup>®</sup> (2), PreFeRal<sup>®</sup> (3), NemaGreen<sup>®</sup> (4), NemaPlus<sup>®</sup> (5), Mycotal<sup>®</sup> (6), PreFeRal<sup>®</sup> + NemaGreen<sup>®</sup> (7), PreFeRal<sup>®</sup>+NemaPlus<sup>®</sup> (8), respectively] in comparison to the control (6.5 thrips/plant and 93 % frequency of infestation). Different letters indicate significant differences (Duncan,  $p \leq 0.05$ )

These trials confirm previous results from Great Britain and The Netherlands, which also showed that the use of insect pathogenic nematodes and fungi is not necessarily restricted to protected crops and greenhouses, but can be extended to the open field. In view of the extreme weather conditions in summer 2003 (very hot and dry) and in comparison to the effect of the chemical references, the results obtained with the biocontrol agents are encouraging. Unfortunately, the study was not prolonged.

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