

PROJECT

Biological and chemical control of black vine
weevil (*Otiorhynchus sulcatus*)
(4102)

INTERNAL REPORT

EXPERIMENTS

Control of larvae of black vine weevil in climate
chambers - 1995
Boskoop 1995 (4102-38)

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SAMENVATTING

Bestrijding van de larven van de gegroefde lapsnuitkever in klimaatcellen

Boskoop 1995

Intern verslag(en) 4102-38

Auteur

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Bij een bodemtemperatuur van gemiddeld 12,5 °C is het insectenparastaire aaltje in het produkt Larvanem effectiever dan het aaltje in het produkt Nemapack (oude naam Nemasys H).

Enkele aaltjes selecties van het IPO zijn even effectief als Larvanem bij 12.5 °C bodemtemperatuur.

Uit zowel de klimaatcelproef, potproef buiten als de veldproef van 1995 blijkt dat in het veld Larvanem en Nemapack even goed werken. Bij toepassing in potten is Larvanem duidelijk beter dan Nemapack. De selecties van het IPO werken goed in de potten maar niet of slechts matig in de vollegrond. De onderlinge verschillen tussen de selecties van het IPO zijn alleen terug te vinden in de veldproef.

De met * gecodeerde middelen zijn niet toegelaten in de boomkwekerij voor dit doel.

SUMMARY

Control of larvae of black vine weevil in climate chambers.

Boskoop 1995

Internal report experiment(s) 4102-38

Author

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Of the tested commercial available nematode strains Larvanem (*Heterorhabditis* sp.(NWE)(NI-H-F85)) was more effective than Nemapack (*Heterorhabditis* sp.(NWE) (UK-H-211)) at the average temperature of 12.5 °C in pots.

The selections of *Heterorhabditis* sp. (NI-H-E87.3) are equally effective in this trial at 12.5 °C and showing the same efficacy as Larvanem.

Considering the results of the three trials performed in 1995 it can be concluded that:

- Nemapack (UK-H-211) has a higher temperature limit for efficacy than Larvanem (NI-H-F85) and the IPO selections (NI-H-E87.3). This temperature limit is higher than 12.5 °C. for Nemapack.
- In pots the efficacy of Larvanem and the IPO selections is higher than of Nemapack.
- In the field Larvanem, Nemapack and the B5 selection of NI-H-E87.3 are equally well performing. The selections m and F2 of NI-H-E87.3 are not effective in the field.

The with * coded means or treatments are not registered in nursery stock for the purpose used in this research.

MATERIAL AND METHODS

There are 6 treatments in 4 blocks with 8 plants per block. The plants were inoculated once with 20 eggs per plant. Normally we inoculate twice a year with eggs but egg production was too low in July/August to inoculate a second time. The plants were inoculated on 7 August 1995. As a test plant we used *Waldsteinia ternata*. The plants were potted in spring in one litre pots and placed in open boxes on the container field. The treatments were separated by non-treated plants. The border plants of the experiment were surrounded by non-treated plants to exclude the influence of heating the pot soil by direct sunlight on the side of the pots. The substrate used in the pots consisted of 55% pellets, 40% sphagnum-moss peat and 5% aeolian sand. The temperature of the soil in the pots was measured every 60 minutes with a Rologg NT1 temperature datalogger (see appendix). On 25 September 1995 the plants were placed in a climate chamber at 20 °C. On 26 October 1995 at 9.00 hour the temperature of the climate chamber was set to 12 °C. At 12.30 hour a Rologg NT1 temperature datalogger was placed in the soil of a border plant in the climate chamber. The temperature of the soil was measured every 60 minutes (see appendix) until the end of the trial.

The treatments with nematodes (2,3,4,5 and 6) were performed on 26 October 1995 at 13.30 hour. The nematodes were applied in 25 ml water per pot.

Table 1 - Treatments pot experiment.

active ingredient	product name	company	dose	%ai [#]	number [@]
1. control	-	-	-	-	-
2. <i>H. sp.</i> (NWE)(UK-H-211)	Nemasys H	Brinkman	0.5 10 ⁶ /m ²	-	1x(38)
3. <i>H. sp.</i> (NI-H-F85)	Larvanem	Koppert	0.5 10 ⁶ /m ²	-	1x(38)
4. <i>H.sp.</i> (NI-H-E87.3)(m)	-	IPO-DLO	0.5 10 ⁶ /m ²	-	1x(38)
5. <i>H.sp.</i> (NI-H-E87.3)(B5)	-	IPO-DLO	0.5 10 ⁶ /m ²	-	1x(38)
6. <i>H.sp.</i> (NI-H-E87.3)(F2)	-	IPO-DLO	0.5 10 ⁶ /m ²	-	1x(38)

%ai = percentage active ingredient

@ number = number of sprayings. Between parentheses the week number of treatment

The trial ended on 29 november 1995. The soil in each pot was searched for the presence of larvae. Of each larva the size was noted (five instars (L1 to L5) of the larvae and one pupal stage) and whether they were parasitized by the insect-parasitic nematodes. The living larvae and dead larvae (not visually infected by nematodes) were washed and put into a petri dish for a few days to see if any of the living larvae were infected.

The total number of larvae found, the number of infected and not infected larvae and the number of L2, L3, L4 and L5 are noted in the database (see appendix) and used for statistic analysing. There were no pupae found. The data are analysed with ANOVA. The values are transformed to square root numbers before analysing.

RESULTS

The results are summarized in table 2. The number of larvae are an average of the 4 blocks and are shown in the table as number of larvae per plant. The results are statistically analysed with ANOVA. The results of this analysis are shown in table 2.

Table 2 - Mean number of larvae per plant (n) and percentage reduction compared to control (4102-38).

behandeling	n	total% [#]	L2% [#]	L3% [#]	L4% [#]	L5% [#]	par% [#]
1. control	15.2	0 a	0 a	0 a	0 a	0 a	0 a
2. <i>H. sp.</i> (NWE)(UK-H-211)	9.8	35.4 b	18.6 a	30.1 b	37.3 b	41.9 b	3.6 b
3. <i>H. sp.</i> (NWE)(NI-H-F85)	1.2	92.3 c	85.8 b	92.8 c	94.5 cd	92.0 c	2.5 b
3. <i>H. sp.</i> (NI-H-E87.3)(m)	2.2	85.7 c	61.1 b	88.6 c	85.7 c	89.4 c	14.8 c
4. <i>H. sp.</i> (NI-H-E87.3)(B5)	1.2	92.3 c	89.4 b	90.6 c	93.7 cd	93.0 c	2.8 b
5. <i>H. sp.</i> (NI-H-E87.3)(F2)	1.3	91.3 c	78.8 b	91.9 c	96.0 d	88.6 c	21.1 c

percentage reduction based on number of larvae. Par% = percentage parasitized larvae. Statistical results (letters behind figures) are based on square root transformation of number of larvae.

The population in the control consisted for 7.7% of L2-larvae, 26.6% of L3-larvae, 34.5% of L4-larvae and 31.1% of L5-larvae.

Figures in the same column followed by the same letter are not statistically significantly different, with a 95% confidence limit.

As the graphs in the appendix show the temperature in the soil is average 12.5 °C from the start of the inoculation until the end of the trial.

The tested strains *Heterorhabditis sp.*(NWE)(NI-H-F85) and *Heterorhabditis sp.*(NI-H-E87.3) were equally effective with approximately 90% control of the larvae. There was no difference between the three selections of NI-H-E87.3. *Heterorhabditis sp.*(NWE)(UK-H-211) was showing clearly lower control results than the other strains at this temperature (~ 35% control).

Table 3 - Percentage reduction compared to control of the tested nematode strains in three trials performed in 1995 (4102-38 (climate chamber; T = 12.5 °C), 4102-40 (pot trial outside), 4102-41 (field trial)).

treatment	climate chamber [#]	pots outside [#]	field [#]
1. <i>H. sp.</i> (NWE)(UK-H-211)	35.4 a	59.5 a	53.4 c
2. <i>H. sp.</i> (NWE)(NI-H-F85)	92.3 b	84.7 cd	54.6 c
3. <i>H. sp.</i> (NI-H-E87.3)(m)	85.7 b	88.4 d	10.5 ab
4. <i>H. sp.</i> (NI-H-E87.3)(B5)	92.3 b	80.5 bc	38.5 bc
5. <i>H. sp.</i> (NI-H-E87.3)(F2)	91.3 b	70.0 b	1.9 a

percentage reduction based on number of larvae. Statistical results (letters behind figures) are based on square root transformation of number of larvae.

Figures in the same column followed by the same letter are not statistically significantly different, with a 95% confidence limit.

The percentage of parasitized larvae found does not represent the real total infection rate. The mortality rate between Larvanem and Nemapack is significantly different but the percentage of larvae found to be parasitized is equal for both strains. Comparing the mortality between Larvanem and the F2 selection of NI-H-E87.3 shows no difference but the infected larvae found suggests a higher infection rate for the F2 selection. What the percentage of parasitized larvae found probably suggests is a relative late and/or slow infection of larvae in the treatments with a high percentage parasitized found. This is actually an indication that these nematode selections are not as good as the ones with a low percentage and a high mortality rate. The importance of this suggestion does not seem important for the control result in the pot trial. But if we look at the results of the three trials (climate chamber, pots outside and field trial) summarized in table 3 than we can see that it could have had influence on the control results in the field trial. The selections m and F2 of NI-H-E87.3 show both a relative high rate of parasitized larvae found in the climate chamber and the lowest control rate in the field. The slower mobility or penetration of these nematodes in the field soil give other natural enemies better possibilities to prevent a good control of the larvae of the vine weevil. An other possibility is that these selections are not very active in searching their prey and this has mainly consequences for control when the distance between the nematodes applied and the larvae is relatively large, like in a field situation. The influence of temperature is not so likely since there is good control in the pot trial outside. Both trials in field and pot were performed under the same climatic conditions. The nematodes were applied at the same time in both trials and temperature in pot and field were only slightly different (see internal report 4102-40, 4102-41).

GENERAL CONCLUSIONS

Of the tested commercial available nematode strains Larvanem (*Heterorhabditis* sp.(NWE)(NI-H-F85)) was more effective than Nemapack (*Heterorhabditis* sp.(NWE) (UK-H-211)) at the average temperature of 12.5 °C in pots.

The selections of *Heterorhabditis* sp. (NI-H-E87.3) are equally effective in this trial at 12.5 °C and showing the same efficacy as Larvanem.

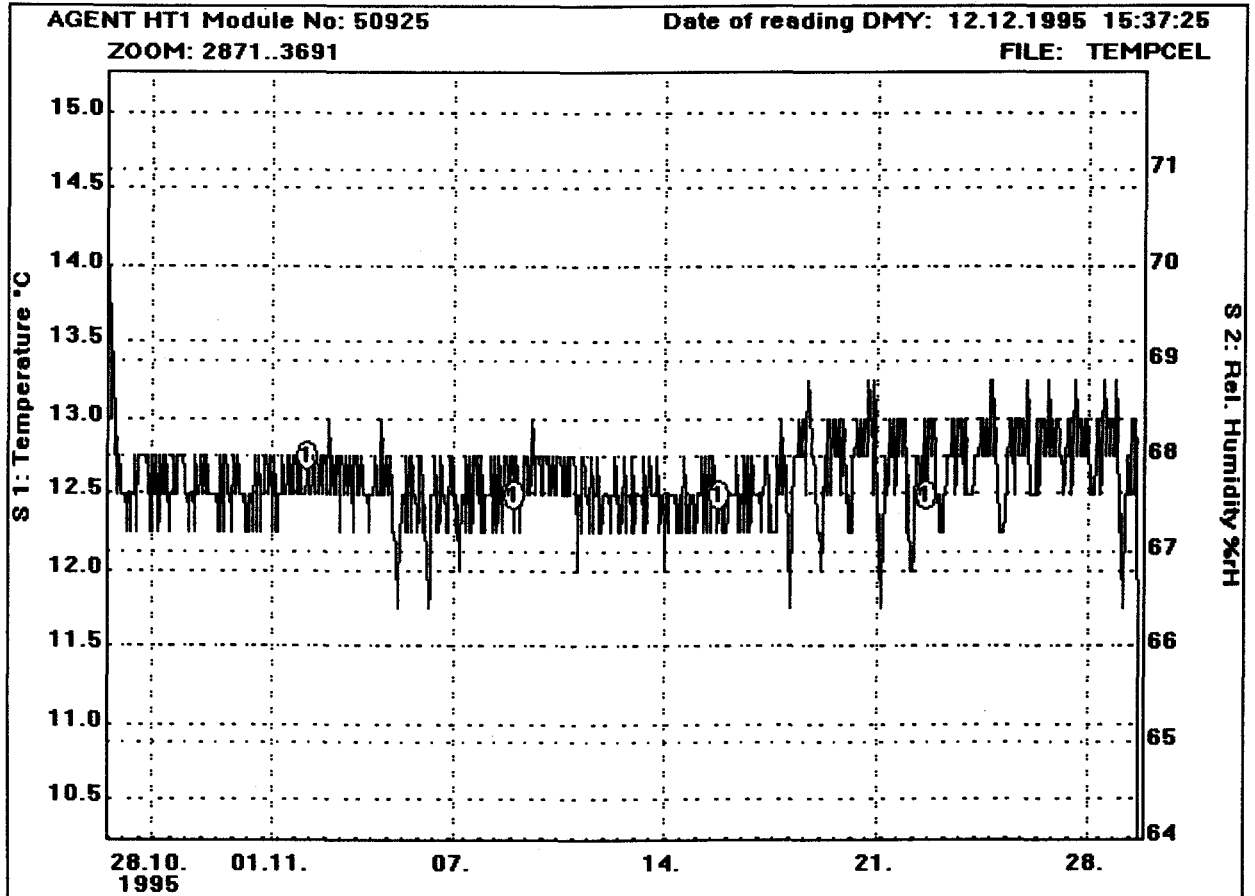
Considering the results of the three trials performed in 1995 it can be concluded that:

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APPENDIX

- Graphics of the soil temperature in pots in the climate cell
- Datafile with results

AGENT HT1: Module No: 50925
Programming info: soil temperature climate cell(4102) 1995
Evaluation info: soil temperature climate chamber 1995
soil temperature climate chamber 1995 (4102)



4102-38 CONTROL OF THE LARVAE OF THE BLACK VINE WEEVIL IN CLIMATE CHAMBER - 1995 (mean soil temperature 12.5°C, +/- 1)

beh = behandeling(treatment): 1 = untreated; 2 = UK-H-211(0.5); 3 = NL-H-F85(0.5); 4 = NL-H-E87.3(moederstam); 5 = NL-H-E87.3(B5); 6 = NL-H-E87.3(F2)

larv = total number of not infected larvae per pot

sta2 = 2nd instar larvae and smaller

sta3 = 3rd instar larvae

sta4 = 4th instar larvae

sta5 = 5th instar larvae

par = number of parasitized larvae per pot

blok	beh	larv	sta2	sta3	sta4	sta5	par
1	1	26	5	10	9	2	0
1	1	15	2	6	3	4	0
1	1	12	2	5	3	2	0
1	1	8	0	2	3	3	0
1	1	5	0	0	2	3	0
1	1	26	0	11	13	2	0
1	1	14	3	3	4	4	0
1	1	21	4	6	4	7	0
1	2	10	0	0	2	8	0
1	2	4	0	2	0	2	0
1	2	7	0	2	0	5	0
1	2	4	0	1	3	0	0
1	2	5	0	1	2	2	0
1	2	10	1	4	4	1	0
1	2	8	0	1	4	3	0
1	2	6	0	3	0	3	0
1	3	0	0	0	0	0	0
1	3	1	0	0	0	1	0
1	3	0	0	0	0	0	0
1	3	0	0	0	0	0	0
1	3	0	0	0	0	0	0
1	3	3	0	1	0	2	0
1	3	2	0	1	1	0	0
1	3	1	0	0	1	0	0
1	4	0	0	0	0	0	2
1	4	5	2	1	1	1	6
1	4	0	0	0	0	0	4
1	4	8	2	0	4	2	4
1	4	1	0	1	0	0	1
1	4	5	3	1	0	1	1
1	4	6	1	1	4	0	2
1	4	1	0	1	0	0	2
1	5	1	0	0	1	0	0
1	5	0	0	0	0	0	0
1	5	0	0	0	0	0	0
1	5	0	0	0	0	0	0
1	5	2	0	2	0	0	1

2	6	1	1	0	0	0	2
2	6	0	0	0	0	0	2
2	6	0	0	0	0	0	1
2	6	1	0	1	0	0	4
2	6	0	0	0	0	0	1
2	6	0	0	0	0	0	2
2	6	0	0	0	0	0	1
2	6	0	0	0	0	0	1
3	1	*	*	*	*	*	*
3	1	2	0	1	1	0	0
3	1	15	0	5	8	2	0
3	1	17	0	4	8	5	0
3	1	15	0	3	4	8	0
3	1	7	2	3	2	0	0
3	1	10	1	2	1	6	0
3	1	16	3	6	5	2	0
3	2	21	2	3	8	8	1
3	2	6	1	4	1	0	0
3	2	13	0	5	8	0	3
3	2	9	5	2	1	1	0
3	2	2	0	2	0	0	0
3	2	14	1	5	5	3	0
3	2	21	1	12	4	4	0
3	2	5	1	1	2	1	0
3	3	2	1	0	0	0	1
3	3	4	2	1	1	0	0
3	3	0	0	0	0	0	0
3	3	1	0	0	0	1	0
3	3	2	0	1	1	0	1
3	3	5	0	1	2	2	2
3	3	0	0	0	0	0	2
3	3	1	0	1	0	0	1
3	4	3	1	0	1	1	3
3	4	2	0	0	1	1	0
3	4	5	0	1	1	3	0
3	4	0	0	0	0	0	1
3	4	2	0	0	1	1	0
3	4	0	0	0	0	0	3
3	4	0	0	0	0	0	3
3	4	2	0	1	0	1	2
3	5	0	0	0	0	0	0
3	5	1	0	0	0	1	0
3	5	0	0	0	0	0	0
3	5	0	0	0	0	0	0
3	5	0	0	0	0	0	0
3	5	2	1	0	0	1	2
3	5	0	0	0	0	0	0
3	5	2	0	0	0	2	2
3	6	0	0	0	0	0	0
3	6	0	0	0	0	0	0
3	6	3	0	0	1	2	1

3	6	8	4	2	0	2	5
3	6	0	0	0	0	0	3
3	6	0	0	0	0	0	0
3	6	2	1	0	1	0	12
3	6	0	0	0	0	0	5
:							
4	1	5	0	1	0	4	0
4	1	7	1	4	2	0	0
4	1	2	0	1	0	1	0
4	1	3	1	1	0	1	0
4	1	13	3	1	7	2	0
4	1	7	1	4	1	1	0
4	1	0	0	0	0	0	0
4	1	2	0	0	1	1	0
4	2	0	0	0	0	0	0
4	2	7	1	1	5	0	0
4	2	4	0	1	2	1	0
4	2	5	0	1	4	0	0
4	2	4	0	1	1	2	0
4	2	4	0	1	1	2	0
4	2	13	3	2	8	0	0
4	2	2	0	0	2	0	0
4	3	6	1	1	3	1	0
4	3	0	0	0	0	0	1
4	3	10	2	1	1	6	3
4	3	1	1	0	0	0	0
4	3	0	0	0	0	0	0
4	3	2	1	0	0	2	0
4	3	2	0	1	1	0	0
4	3	3	0	2	1	0	0
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4	4	2	0	0	2	0	2
4	4	1	0	0	0	1	1
4	4	1	0	0	0	1	0
4	4	2	1	1	0	0	4
4	5	1	0	0	0	1	1
4	5	0	0	0	0	0	0
4	5	0	0	0	0	0	1
4	5	0	0	0	0	0	0
4	5	0	0	0	0	0	2
4	5	6	0	0	4	2	1
4	5	0	0	0	0	0	5
4	5	2	0	0	0	2	6
4	6	2	0	0	0	0	1
4	6	2	0	0	0	2	6
4	6	0	0	0	0	0	3
4	6	1	0	1	0	0	9

12

4	6	1	0	1	0	0	11
4	6	3	1	0	0	2	2
4	6	3	0	0	1	2	0
4	6	*	*	*	*	*	*
:							