PROJECT

Biological and chemical control of the vine weevil (Otiorhynchus sulcatus) (4102).

INTERNAL REPORT

TEST

Biological control of vine weevil larva (Otiorhynchus sulcatus) in pots in the glass-house - 1991

Boskoop 1991 (4102-07).

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SUMMARY

Biological control of vine weevil larva (Otiorhynchus sulcatus) in pots in the glass-house - 1991

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Internal report 4102-07

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Metarhizium anisopliae* (BI01020) gave good results this year for control in pots in the glass-house at both 16°C and 20°C. This investigation does not indicate host plant sensitivity when larvae are controlled with this fungus. Although there are slight indications in the trial results that something like this is possible. The spore density in the soil was high enough for good effectiveness, both at the beginning and at the end of the test.

The Heterorhabditis nematodes were generally speaking effective against the larvae. The assessment of Steinernema carpocapsae presents some difficulties, if we want to make a comparison with the Heterorhabditis nematodes. Because of supply problems (amongst other things), the first application of S. carpocapsae (Koppert) happened 19 days later than the other nematode treatments. The negative result for this nematode population at 16°C and 20°C is nevertheless not a good sign. At the moment a climate cell trial is being run to test whether differences in effectiveness exist between the nematode types/populations at lower temperatures. In the coming year experiments both outside and in the climate cell will be started to gain insight into the correct time of application of nematodes and the time which is necessary to arrive at a satisfactory effectiveness at a certain temperature.
temperatures.

The agents and treatments marked * are not admissible for the purpose mentioned in the tree-nursery.

PURPOSE

Determination of the effectiveness of biological control agents against the larva of the vine weevil in pots in the glass-house at two different temperatures. The effect of five populations of insect parasitic nematodes (Heterorhabditis sp. and Steinernema sp.) and the insect pathogenic fungus Metarhizium anisopliae* are compared with carbofuran, the only chemical control agent admissible in arboriculture. For M. anisopliae* it was also investigated whether a negative influence emanates from the host plant Thuja on the infection of larvae through the fungus and whether the type of soil exerts an influence on the infection process through this fungus.

The agents or treatments marked * are not admissible for the purpose mentioned in the tree-nursery.

EXPERIMENT DESIGN

Fifteen treatments were carried out at two different glass-house temperatures (16°C and 20°C) four times each with four test plants in parallel. All treatments with the exception of B, D, F and H have Thuja occidentalis 'Brabant' as test plant. B, D, F and H have Azalea mollis as test plant. These treatments with Azalea were only carried out at 16°C. The plants were inoculated once, with 40 eggs per plant. This happened on 29 July 1991.

The treatments given and doses are listed in table 1. On 27 May 1991 the plants were potted on into one litre pots with B42-soil (constituents: 60% peat moss fragments, 40% Finnish fen peat moss and 5% sharp sand or Gepac (soil without fen peat moss from Germany) and placed on mobile trolleys in glass-house 81 and 82 according to a random scheme (basic information 1). The soil of treatments E, F, G and H was mixed with BI01020 (1 gram per litre of soil) on 25 April and subsequently put away under cover in the warm without extra moistening until the potting date, 27 May. Between times the soil was shaken once more and mixed, to prevent oxygen deficiency. On 25 July and 19 November soil samples of treatments E, F, G and H were taken and sent to Bayer for determination of spore density in the soil.

Treatments J and K were carried out for the first time On 22 July 1991. These treatments were repeated on 6 September 1991. Treatments L and N were carried out for the first time on 26 September and M and P on 1 October 1991. Treatment O could not be applied at this point because of delayed supply and was therefore applied for the first time on 15 October. On 24 October 1991 treatments L, M, N, O and P were

applied for the second time. For the liquid agents and nematodes 25 ml injection liquid per plant was administered with a dispenser.

Table 1 - Treatments and dosages.

active substance#	trade name	dosage	% a.i.	number
A. untreated (Th+B42)	-	-	-	-
B. untreated (Az+B42)	-	-	-	-
C. untreated (Th+Gepac)	-	-	-	-
D. untreated (Az+Gepac)	-	-	-	-
E. M. anisopliae*(Th+B42)	BI01020	1 gram/1.	-	1x
F. M. anisopliae*(Az+B42)	BI01020	1 gram/l.	-	1x
G. M. anisopliae*(Th+Gepac)	BI01020	1 gram/l.	-	1x
H. M. anisopliae*(Az+Gepac)	BI01020	1 gram/l.	-	1x
J. carbofuran (Th+B42)	Curater liquid	37,5 l/ha	20	2x
K. carbofuran (Th+Gepac)	Curater liquid	37,5 l/ha	20	2x
L. Heterorhabditis megidis	Green Fly (HSH)	15.000/l	-	2x
M. Heterorhabditis megidis	Westerman (HF85)	15.000/l	-	2x
N. Heterorhabditis megidis	Westerman (HF85)	15.000/l	-	2x
O. Steinernema carpocapsae	Koppert	15.000/l	-	2x

L up to and including P = Thuja as experimental plant and B42 soil; %a.i. = percentage active substance; number = number of repeated applications; Th=Thuja; Az=Azalea; B42= type of soil; Gepac= type of soil.

OBSERVATIONS

The plants were harvested between 18 and 20 November. The soil of each test plant was examined for the presence of larvae of the vine weevil. For each test plant the number of larvae found was noted. The root system of the test plants was also evaluated for insect damage. This was done by giving an evaluation mark (scale 0 to 5), whereby 0 indicates an undamaged root collar and 5 an entirely ringed root collar as a result of insect damage. The observations can be found in basic information 2.

RESULTS AND DISCUSSION

Table 2 shows a summary of the results. The number of larvae is an average taken over 4 parallels and is represented as number of larvae per plant. The same applies for the evaluation mark for the root system. The results were processed statistically using ANOVA (see basic information 3). The result of this processing has been included in the table. For the analysis of the number of larvae it was necessary to apply a transformation to the values. In this case the square root of the values was chosen.

Table 2- Average number of larvae per plant and average evaluation mark for insect damage to the root collar per plant.

treatment#	larvae	16°C insect damage	stage	larvae	20°C insect damage	stage
A. untreated (Th+B42)	low → 2,4a	3,3 ab	4,5	0,9 a	1,3 ab	5,0
B. untreated (Az+B42)	1,8b	3,0 ab	2,4	-	-	-
C. untreated (Th+Gepac)	2,3 a	3,6 a	4,5	1,1 a	2,0 a	4,9
D. untreated (Az+Gepac)	1,9 b	3,8 a	2,4	-	-	-
E. M. anisopliae*(Th+B42)	0,2 cd	0,7 cd	4,8	0,0 b	0,3 cd	-
F. M. anisopliae*(Az+B42)	0,0 d	0,0 d	-	-	-	-
G. M. anisopliae*(Th+Gepac)	0,1 cd	0,2 d	5,0	0,0 b	0,1 cd	-
H. M. anisopliae*(Az+Gepac)	0,0 d	0,0 d	-	-	-	-
J. carbofuran (Th+B42)	0,0 d	0,0 d	-	0,0 b	0,0 d	-
K. carbofuran (Th+Gepac)	0,0 d	0,0 d	-	0,0 b	0,0 d	-
L. H. megidis (Nemasys)	0,4 c	0,6 cd	3,7	0,1 b	0,4 cd	4,0
M. H. megidis (Gr. Fly,HSH)	0,2 cd	0,4 d	4,4	0,0 b	0,1 cd	-
N. H. megidis (Westerman, HF85)	0,2 cd	0,7 cd	3,8	0,0 b	0,9 bc	-
O. S. carpocapsae (Koppert)	1,7 b	2,4 b	4,8	0,9 a	1,7 ab	4,8
P. H. bacteriophora (Bio-erre)	0,3 cd	1,5 c	4,8	0,0 b	0,4 cd	-

L to P = Thuja as test plant and B42 soil; Th= Thuja; Az= Azalea; B42= type of soil; Gepac= type of soil.

larvae=average number of larvae per plant; insect damage = insect damage to root collar (scale 0 to 5). The numbers in the table followed by the same character are not significantly different within a reliability of 95%; stage = average stage of the larvae (1 to 5).

The results of table 2 show the following:

1) Metarhizium anisopliae* (BI01020) (E,F,G and) had a good effect on the beetle larvae at both temperatures. A slight influence of the host plant on the control can be established, diagnosed at 16°C, but this effect is not significant.

2) All nematode populations except for S. Carposcapsae (O) have practically the same good effect as carbofuran against beetle larvae at both temperatures. S. carpocapsae (Koppert) (O) had no effect at all.

3) With Azalea as host plant the development of the larvae remains far behind in comparison with Thuja as host plant (see table 2).

PROVISIONAL CONCLUSION

Metarhizium anisopliae* (BI01020) gave good results this year for control in pots in the glass-house; this in contrast to the results of the previous year (see iv 48/91 (4007-26). Last year a clear temperature effect was still apparent - at 16°C there was no effect and at 20°C only a slight effect. Factors such as good incubation of the fungus grain and possible differences in quality of this product could be to blame here. Since in this experiment no reduction of the egg-inoculation of the beetle was carried out, as in the container experiment outside, the different results in the glass-house experiment by year may be partly connected with this. As mentioned in iv 39/91 (4007-24) a high natural mortality as a result of too many larvae and too little food can influence the experiment results considerably. This could be an important reason for the erratic, frequently bad results often occurring previously. This goes for both the chemical and the biological agents. From this investigation it is evident that no host plant sensitivity is observed in the control of the larvae with this fungus. Although it is true that the experimental results give slight indications that this may be the case. The spore density in the soil both at the start and at the end of the experiment was high enough to be able to be sufficiently effective. At the moment a few lab experiments are still running which should make it clear whether exudates from the roots influence the infection process of the larvae through this fungus directly or indirectly. Also we are examining what is the minimum operational temperature of M. anisopliae.

Generally speaking the heterohabditis nematodes have worked well against the larvae. The assessment of Steinernema carpocapsae presents a few problems if we try to make a comparison with the Heterorhabditis nematodes. Because of supply problems, amongst other things, the first application of S. carpocapsae (Koppert) happened 19 days later than the other nematode treatments. The negative result for this nematode population at both temperatures is nevertheless not a good sign. At the moment a climate cell experiment is still running in which the existence of differences in effectiveness between the nematode types/populations at lower temperatures is being tested. In the coming year both outside and climate cell experiments will be started to gain insight into the correct time of application of nematodes and the period which is necessary at a certain temperature to obtain a satisfactory effect.