

EFFECTS OF „NEEM AZAL“ ON VITALITY AND FERTILITY OF *MELOLONTHA HIPPOCASTANI*

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1. Abstract

During the flight period of *Melolontha hippocastani* F. in 1994 it was tested in field and in combined field and laboratory studies whether Neem Azal agents could reduce the damages of this species. In comparison with this experiments with chemical insecticides („Rubitox“, active substance: phosalone; „Decis“, active substance: deltamethrine), biological insecticides (*Beauveria brongniartii*, blastospore suspension of the insect-pathogenous fungi; „ENVI-Repel“, extracts from garlic plants), and mechanical methods (soil treatment with a rotary hoe) took place.

Under field conditions Neem agents had no immediate lethal effect on the beetles but resulted in changes of behaviour: defoliation decreased, the intake of food was subsided completely after two to three days, the flight activity and the egg production was almost perfectly reduced and the beetles did not look for any protection against rainy weather. Beetles forced to feeding on neem treated leaves had no egg production under laboratory as under controlled field conditions. The „ENVI-Repel“ agent did not show any repellent or disturbing effect. There were also no effects of *Beauveria brongniartii* because of the lost of spores ability to germinate. „Rubitox“ and „Decis“ showed an immediate lethal effect within 3 - 4 hours which continued about 10 days. Thereby defoliation was reduced successfully.

Negative side effects on other arthropode species were only recognised the day after the treatment with „Decis“. One week and four weeks after the application of the insecticides there were no significant differences on other species between treated and untreated areas.

2. Introduction

In the Hessian Rhein-Main-Plain there is a natural occurrence of *Melolontha hippocastani* F. (NIKLAS, 1974). Flight strains with a four year developing cycle are in the hessian forest districts of Lampertheim, Bensheim and Darmstadt (DUBBEL, 1991).

During the last outbreak in the years 1949 to 1956 there was a heavy use of chemical insecticides. The following 30 years there was no damage caused by the cockchafer or its larvae. 1986 damage of 20 to 30 ha young stands was recognized. Up to 1990 the infestation area increased to about 200 ha. In both years chemical control was prohibited, so the infestation area in 1994 was about 10.000 to 15.000 ha. Under normal conditions the defoliation caused by the adult beetles every four years is not dangerous for the existence of the stands and the loss of biomass production is tolerated by forestry. Compared with that the damage of the roots during the development of the larvae is much more dangerous for the existence of the young stands. But under the special conditions of the Rhein-Main-Plain (population and industry centre, air pollution, lowering of the ground water level, overlapping of social and protection functions of the forest) both, damage of the roots and defoliation can lead to death of the stressed stands on great areas. Therefore control of *Melolontha hippocastani* must be directed at prevention of larvae feeding and defoliation.

At this time in forestry only the mechanical soil treatment with a rotary hoe is to be used for a few years before and after planting. Other methods either are too expensive or ineffective (collecting of the beetles), not developed far enough for use in practice (biological methods),

or there are no licensed pesticides for use in forests. In addition there are many problems because of ecological disadvantages following an pesticide application. In field and in combined field and laboratory experiments it should be tested whether several control methods could reduce the damage caused by *Melolontha hippocastani* combined with a well tolerance towards the environment.

3. Methods

The following control methods were tested:

- a) insecticides on the basis of natural substances:
 - „Neem Azal“ agents (= seed extracts from the neem tree, *Azadirachta indica*)
 - „ENVI-Repel“ (= extracts from garlic plants)
- b) biological insecticides:
 - *Beauveria brongniartii* (= blastospore suspension of the insect-pathogenous fungi)
- c) chemical insecticides:
 - „Rubitox“ (active substance: phosalone)
 - „Decis“ (active substance: deltamethrine)
- d) mechanical methods:
 - soil treatment with a rotary hoe

The experiment areas were located in the forest districts of Bensheim and Lampertheim in the Hessian Rhein-Main-Plain. They are characterized by an altitude of 90 - 100 m above zero, a mean temperature of 9,5° C and an average rainfall of 650 mm p. a.. The soil is a sandy deposition from Rhein and Neckar with low or middle nutrient and water contents.

The flight period in spring 1994 started at 17.04. and continued to 08.06., strongly influenced by the weather conditions. At 08.05. female percentage reached 49,5% so that the application took place at 09./10.05.94 in young oak (*Quercus robur*) and red oak (*Quercus rubra*) stands in the infestation centre. With Neem a second application took place as planned two weeks later (May, 25th)

4. Results

4.1 Direct effects on the target organisms

On the „Neem“ treated areas no immediate lethal or repellent effects were seen. Instead of this changes of behaviour occurred: the beetles had a highly decreased activity, they did not fly any more and did not look for protection when the weather became cool and rainy.

Within 3-4 hours after application of „Rubitox“ the first cockchafers fell down from the trees and died a few hours later. Until the next morning about 50% of the beetles lay on the ground, some still living but with reduced activity. The next three days the rest of the beetles died. About one week after the application successful recolonization with cockchafers from untreated areas began.

The insecticide „Decis“ also showed immediate lethal contact effects. In addition to this a strong repellent effect was recognized. For about two weeks no cockchafers were seen on this area. Successful recolonization started about two and a half week after application.

On the areas treated with *Beauveria* respectively „ENVI-Repel“ whether immediate nor delayed direct effects on the cockchafers were recognized.

4.2 Loss of leaf mass

The loss of leaf mass was determined at three dates: one day before, four weeks after and twelve weeks after the application. The results are shown in figure 1.

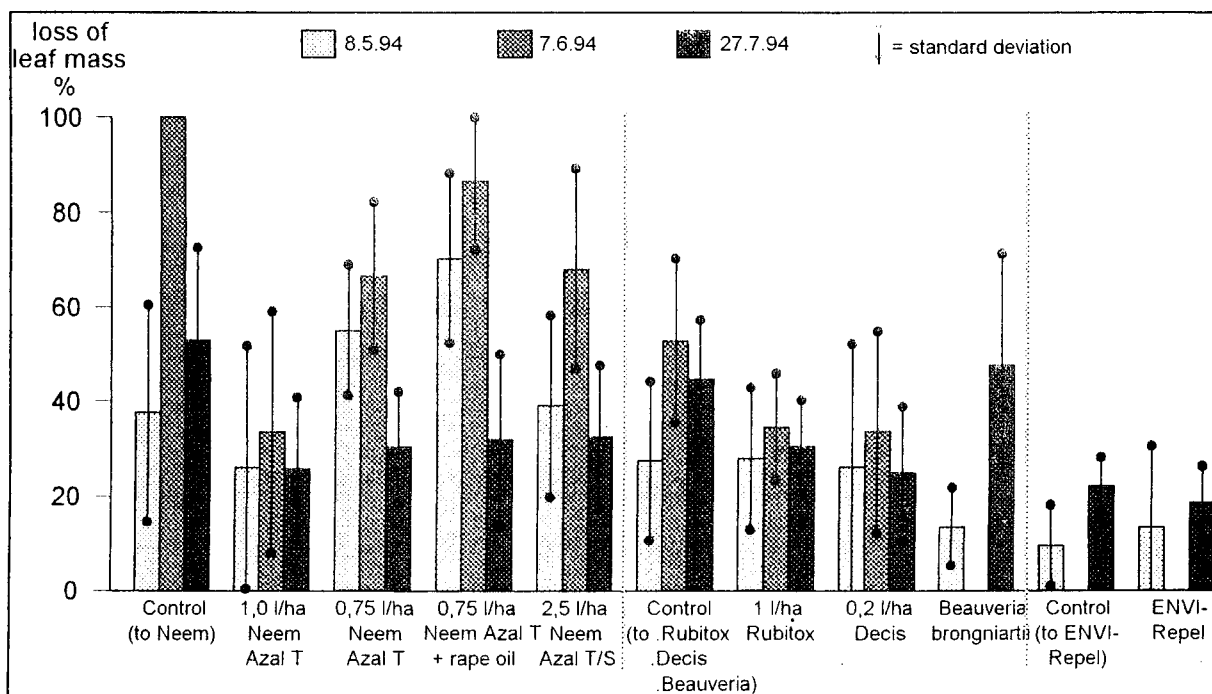


Fig. 1: Loss of leaf mass during the flight period of *Melolontha hippocastani* in spring 1994 (N = 20).

Within one month there was 100% defoliation on the control area to the „Neem“ variants. On the other hand the „Neem“ treated areas showed a defoliation percentage from 35% to 85%. After finishing of the lammas shoots the defoliation percentage decreased to 53% on the control area and about 30% on the „Neem“ treated areas. On the „Rubitox“ and „Decis“ treated areas the loss of leaf mass only increased for a few percent and on the *Beauveria* and „ENVI-Repel“ areas there were no differences seen between treated and untreated areas.

4.3 Egg production and larvae development

In figure 2 the number of larvae found in one m² in August 1994 on each area is shown. On the „Neem“ treated areas larvae density was much higher than on the control area to this treatment. Only the area treated with a rotary hoe showed strongly reduced amounts. Opposite to that larvae density on the control area to the „Rubitox“, „Decis“ and *Beauveria* treatments was the highest of all experiments whereas the treated areas had reduced densities in the range of the „Neem“ variants.

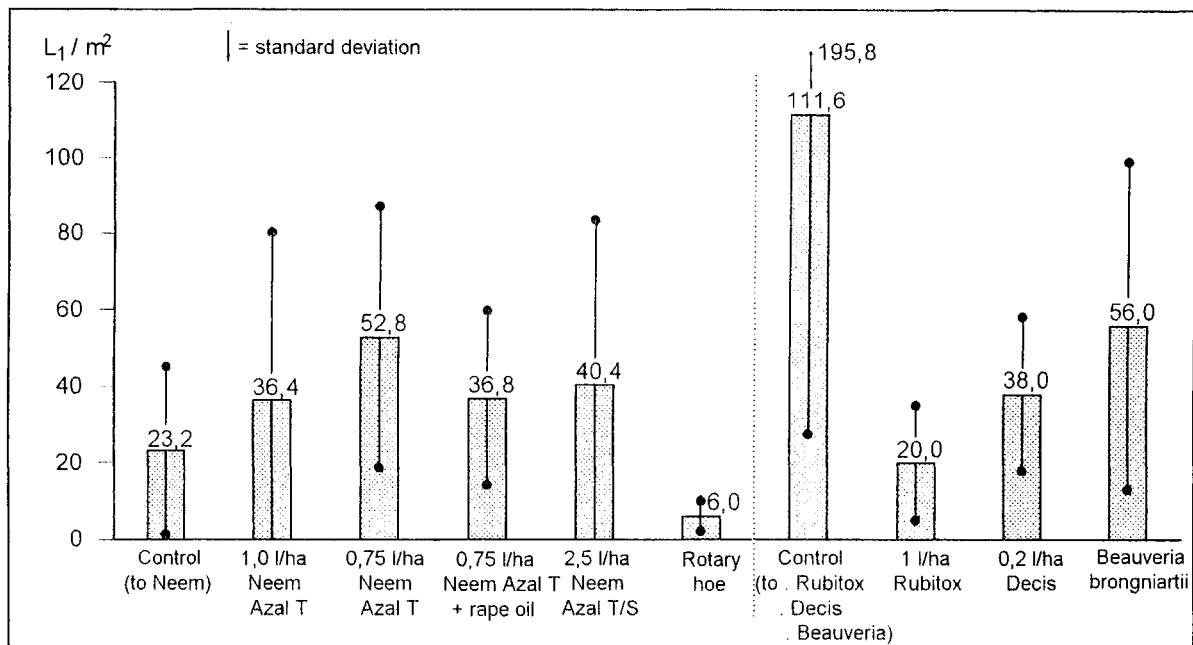


Fig. 2: Larvae density of *Melolontha hippocastani* in one m² in August 1994 (N = 10).

Two and a half week after the application cockchafer from several treated and untreated areas were collected and brought into laboratory. Beetles coming from the „Neem“ and „Rubitox“ treated areas had strongly reduced egg production and larvae hatching whereas beetles from the „Decis“ area produced even more eggs and larvae than those from the untreated control area (table 1).

Variant	Ø number of clutches / 10 females	Ø number of eggs / 10 females	Ø number of eggs / clutch	Ø number of eggs / female	proportion of damaged eggs (%)	Ø number of larvae / 10 females	hatching - rate (%)
Control	5	149	29,8	14,9	0,7	79	53
Neem 1,0 l/ha	3	39	13,0	3,9	5,1	6	15
Neem+rape oil	2	22	11,0	2,2	27,3	7	32
Rubitox	3	47	15,7	4,7	6,4	19	40
Decis	7	157	22,4	15,7	0,0	88	56

Tab. 1: Egg production and larvae development of *Melolontha hippocastani* collected two and a half week after application from the experiment areas.

In another experiment the crowns of 6 trees on every area were wrapped into a net the day after the application. 50 female and 20 male cockchafers were set inside the net so that the beetles were forced to feeding on the treated leaf. Two weeks later the cockchafers were collected and brought into laboratory. Egg production and larvae development is shown in table 2.

Variant	Ø number of clutches /10 females	Ø number of eggs / 10 females	Ø number of eggs / clutch	Ø number of eggs / female	proportion of damaged eggs (%)	Ø number of larvae / 10 females	hatching - rate (%)
Control	7.0	155	22.1	15.5	1.9	90.7	58
Neem 1,0 l/ha	0	0	0	0	--	0	0
Neem 2,5 l/ha	0	0	0	0	--	0	0
<i>Beauveria</i>	8.3	190.7	22.9	19.1	7.9	80.3	42

Tab. 2: Egg production and larvae development of *Melolontha hippocastani* forced to feeding on different treated crowns under field conditions for two weeks.

Egg production and larvae development of the beetles coming from the „Neem“ treated areas was reduced to zero whereas the cockchafers coming from the *Beauveria* treated area produced more eggs than the control beetles. But in this case the proportion of damaged eggs was higher than in control so that the number of larvae decreased.

4.4 Side effects

Side effects on non target organisms were seen especially the day after the application on the „Rubitox“ and „Decis“ treated areas. Mainly great numbers of dead larvae of the gypsy moth (*Lymantria dispar*) and weevils (*Curculionidae*) as well as lower numbers of other butterfly larvae, beetles, flies and spiders were found on plastic canopies in the stands. Within one week dead fall decreased rapidly, only some dead larvae of the gypsy moth were found on the „Rubitox“, „Decis“ and „Neem“ treated areas.

In addition several flight traps and ground traps were brought out on treated and untreated areas to examine more side effects on non target arthropod organisms. The traps were emptied five times: one day before as well as one day, one week, one month, and one year after the application. In the first two cases the traps were active for 24 hours and in the next three cases they were active for 3 - 6 days. Negative side effects were only seen on the „Decis“ treated area one day after the application when the number of individuals, species and arthropod families was strongly reduced. On all other areas and all other dates the changes in composition of the arthropod fauna on treated areas were quite similar to those on the untreated control areas.

5. Discussion

The application of Neem products as well as several other insecticides was only partly successful under field conditions: the loss of leaf mass was reduced but larvae density did not decrease effectively. The reason for that was not an ineffectiveness of the means in principle

but the small experiment areas in comparison to the whole infestation area so that flights from untreated to treated areas were possible in a wide range.

The effectiveness of the several means - especially of „Neem“ - in principle was seen in the combined field and laboratory studies. Intake of leaf mass, egg production and larvae development were strongly reduced when the trees were treated with „Neem“. The „Neem“ preparates only act as a feeding poison and do not show any contact effects (SCHMUTTERER and KAETHNER, 1988; ROHDE and BRESSEM, 1995). So they are more selective than the other insecticides and would be preferred until other biological control methods with an even higher selectiveness would be developed for use in practice.

6. References

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