

# EXPERIMENTS WITH AZADIRACHTIN TO REDUCE THE COMMON COCKCHAFFER (*MELOLONTHA MELOLONTHA* L.) AND SOME LEAF-EATING INSECTS FROM THE ORDER LEPIDOPTERA

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## Abstract

The effect of Azadirachtin (as 10 g/l EC NeemAzaal-T/S, Trifolio M-GMBH) on the production of eggs by common cockchafer (*Melolontha melolontha* L.) females and on the mortality of the nun moth (*Lymantria monacha* L.), pine (spinner) moth (*Dendrolimus pini* L.) and pine looper (*Bupalus piniarius* L.) larvae under laboratory conditions was studied. 80 - 90% of the common cockchafer females fed during 14 days with oak (*Quercus robur* L.) leaves treated with Azadirachtin at a concentration of 0.03% were not able to produce eggs. Feeding inhibition and decreased vitality were also observed.

The preliminary studies showed that the concentration of Azadirachtin giving minimum 90% mortality of above mentioned species of Lepidoptera larvae can be established on the level of 0.025%.

The experiments will be continued in order to obtain more detail information on the effect of Azadirachtin on Lepidoptera larvae.

## 1. Introduction

Introduction of insecticides characterised by novel modes of action and by good environmental properties to forest protection is desirable. The products from the neem tree (*Azadirachta indica* A. Juss) have a number of properties useful for insect control (repellency, feeding and oviposition deterrence, insect growth regulator) and are considered as safe for the environment (low mammalian toxicity, low persistence) (Koul et al. 1990; Schmutterer 1990). The products from the neem tree are also characterised by low toxicity against nonphytophagous insect species, including natural enemies of pest insects (Hoelmer et al. 1990; Stark 1992, McCloskey et al. 1993).

The laboratory and field trials conducted so far on the use of insecticides based on Azadirachtin in forest protection were very promising (Schnetter et al. 1996; Rohde 1996). Although the high costs of neem products actually limits their use in a large scale, it seems that further experiments are required to determine for example the lowest effective dose for the particular species controlled.

The aim of this study was to evaluate the effect of Azadirachtin on egg production by common cockchafer females and on the mortality of the nun moth (*Lymantria monacha* L.), the pine moth (*Dendrolimus pini* L.) and the pine looper (*Bupalus piniarius* L.) larvae.

## **2. Materials**

### **1. Botanical insecticide**

NeemAzal-T/S as EC formulation containing 1% of Azadirachtin A, kindly obtained from Trifolio-M GmbH (Lahnau, Germany) was applied in laboratory tests.

### **2. Insects**

The following insect species were used:

- common cockchafer (*Melolontha melolontha* L.) adult females and males collected in a short time after emergence from the soil – the insects originated from two forest districts: Olsztynek and Czarne Człuchowskie
- second/third instar larvae of the pine (spinner) moth (*Dendrolimus pini* L.),
- second instar larvae of the nun moth (*Lymantria monacha* L.),
- second instar larvae of the pine looper (*Bupalus piniarius* L.).

The larvae of the above Lepidoptera species were collected from pine forest stands of different forest districts or were reared in laboratory.

## **3. Methods**

### **1. Experiments with common cockchafer adults**

The common cockchafer adults, males and females, were fed with oak (*Quercus robur* L.) leaves, which were dipped for five seconds in NeemAzal-T/S water suspension at the Azadirachtin concentration of 0.03%. In the experiments we only used those females in which the production of eggs were not observed (i.e. their ovaries were empty).

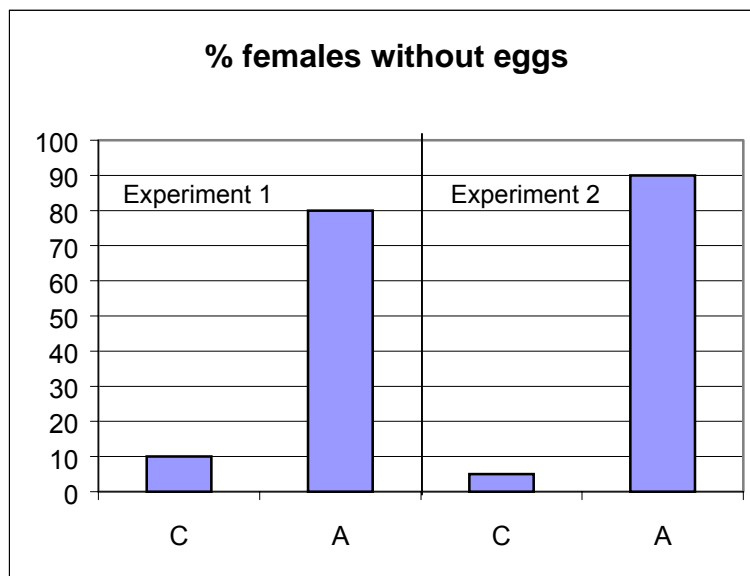
Twenty oak bunches (treated with Azadirachtin) with 5 males and 5 females on each placed in water were used in each of the two experiments. The same procedure was used for control treated with water. After 10 - 14 days, females were killed and the production of eggs in their ovaries were checked.

### **2. Experiments with Lepidoptera larvae**

Aqueous suspensions at five different Azadirachtin concentrations (0.1; 0.05; 0.025; 0.01 and 0.005%) were prepared for tests of the insecticide. Bunches of Scots pine twigs were dipped for five seconds in each concentration and left to dry. Lepidoptera larvae were put on the treated bunches. The bunches with larvae were then placed in water. Three replicates of 15 larvae each were used for each concentration. The control bunches were treated with water. Percent mortalities were calculated 10 to 12 days after treatment. Immobile larvae which showed no response to a repeated tactile stimulus were evaluated as dead. At the same time, other observations concerning the abnormalities in development were noted.

## 4. Results and discussion

The effect of NeemAzal-T/S used at Azadirachtin concentration of 0.03% on the production of eggs by common cockchafer females fed during 14 days with treated oak leaves in comparison to controls is given in Fig. 1. The data showed that in first experiment with NeemAzal-T/S about 80% and in second one about 90% of females were not able to produce the eggs. In contrast, we observed in controls only about 10 and 5% of females which did not produce the eggs. It means that under laboratory conditions the period of time was too short for some females to finish oogenesis. However in experiments 1 and 2, 20 and 10% of females, respectively, fed with NeemAzal-T/S treated leaves were able to produce small number of eggs.

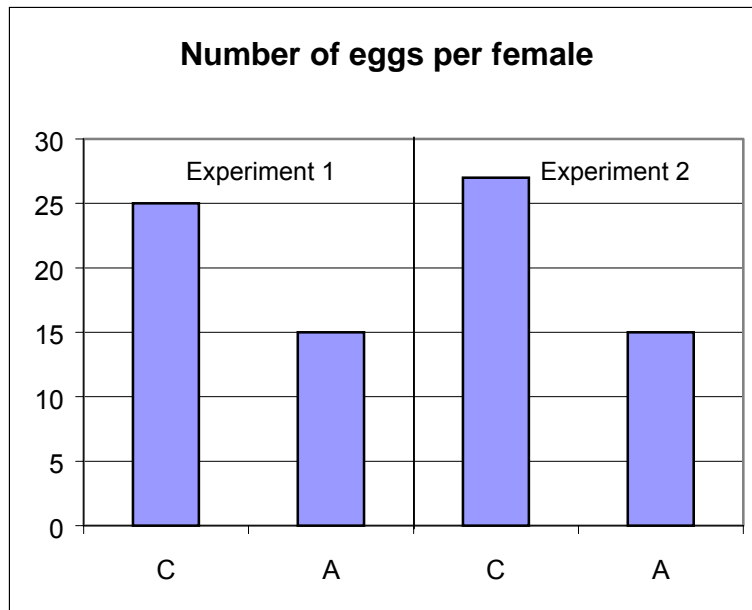


**Fig. 1.** Effect of Azadirachtin (A) on the production of eggs by common cockchafer females fed with oak leaves treated with Neem Azal T/S water solution at Azadirachtin concentration of 0.03% in comparison to controls (C).

Experiment 1 - females from Olsztynek forest district.

Experiment 2 - females from Czarne Człuchowskie forest district.

The mean number of eggs produced by one common cockchafer female in controls and in experiments taking into consideration only these females which produced the eggs is presented in Fig. 2. The mean numbers of eggs per one female in controls were 25 and 28, whereas the mean numbers of eggs per one female found in ovaries of insects fed with treated leaves were a half of those found in controls. The causes why some females fed with Azadirachtin treated leaves had eggs in their ovaries is unknown. It seems highly likely that those insects fed on untreated leaves of forest trees before they were collected. On the other hand it is known from literature (Dorn 1995, Crisofaro et al. 1996) that some number of eggs can be produced by females after consumption of Azadirachtin treated leaves.



**Fig. 2.** Mean number of eggs from one common cockchafer female in controls (C) and in combinations with Azadirachtin (A) taking into account only those females which were able to produce the eggs.

Experiment 1 - females from Olsztynek forest district.

Experiment 2 - females from Czarne Człuchowskie forest district.

It has been additionally observed that common cockchafer beetles, fed on oak leaves treated with Azadirachtin, reduced significantly the consumption of food (in comparison to control) and diminished their vitality. Results presented here confirm those obtained in Germany (Rohde 1996, Schnetter et al. 1996).

**Table 1:** The toxicity of NeemAzal-T/S against three species of Lepidoptera larvae

Instar and species of <i>Lepidoptera</i> larvae	Concentration of Azadirachtin giving minimum 90 % mortality after 10 days
second third instar larvae of the pine (spinner) moth ( <i>Dendrolimus pini</i> L.)	0.025%
second instar larvae of the nun moth ( <i>Lymantria monarcha</i> L.)	0.025%
second instar larvae of the pine looper ( <i>Bupalus piniarius</i> L.)	0.025%

In this preliminary experiment conducted under laboratory conditions, the concentrations of Azadirachtin giving minimum 90% mortality of larvae fed on treated foliage during 10 days was established (Table 1). All tested species of Lepidoptera larvae were susceptible to Azadirachtin. A minimum of 90% mortality of tested larvae was obtained at the concentration of Azadirachtin on the level of 0.025%. The larvae feeding on treated pine bunches reduced food intake and, at higher concentrations of Azadirachtin, died in a few days. It has been observed that larvae had difficulties with moulting and the successful moult was not seen.

The laboratory tests with Lepidoptera larvae will be repeated to obtain more detailed information on the activity of Azadirachtin based compounds. The experiments conducted in laboratory are very promising and can serve as a base for further investigation in the field in order to establish the dose for practical application of products containing Azadirachtin as active ingredient.

## Literature

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