

ON THE INFLUENCE OF NEEM PREPARATIONS ON SOME AGRICULTURAL AND FOREST PESTS

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Abstract

The influence of NeemAzal-T/S (NAZ) 1.0% or 0.5% water emulsions on some pests of vegetables was investigated in field conditions. NeemAzal-T/S water emulsions revealed potential repellent and/or deterrent or toxic properties for Mamestra brassicae, Pieris brassicae, Plutella xylostella, Brevicoryne brassicae and Aphis fabae but did not affect Phyllotreta spp. NeemAzal-T 2%, 10% and 20% water emulsions were tested in forest conditions against the large pine weevil - Hylobius abietis. In forest conditions the treatment of spruce seedlings with 20% water emulsion of the NeemAzal-T preparation significantly decreased weevil damage during the first vegetation period after planting.

Introduction

In the last decades plant extracts with insecticidal properties have evoked a substantial scientific and practical interest as a natural means of insect and mite pest control in sustainable agriculture. A botanical pesticide represents a mixture of different compounds with possibly different activities. The neem tree (*Azadirachta indica* A. Juss) produces several terpenoid compounds with insect antifeedant and growth-regulating properties, showing only low toxicity towards mammals and vertebrates in general.

Neem oil contains azadirachtin as the major component which was first isolated by Butterworth and Morgan (1968). It has been tested as a phytochemical pesticide in many crops and its use has been published in many reviews (Schmutterer, 1984; Schmutterer et al., 1981; Jacobson, 1987; Parmar, 1987).

We tested the formulation NeemAzal-T/S (Trifolio-M GmbH), which is based on an extract of neem seed kernels, with an Azadirachtin A content of 1% and plant oils (51%), against some agricultural pests and NeemAzal-T (Azadirachtin A content of 5%) against the large pine weevil – a dangerous forest pest in Estonia. The aim was to elucidate the diversity of biological effects evoked by this product on a number of harmful insects of field crops and forest, because there are many problems such as ecological disadvantages resulting from pesticide applications in forests as well as in fields.

The main task was the preliminary evaluation of the practical use of NeemAzal-T/S and NeemAzal-T in Estonia against certain pest insects.

Material and methods

The trials with cabbage (*Brassica oleracea*) pest insects were established on a cabbage field with the cultivar "Podarok". The spraying tests were carried out with three replications, each with seven cabbage plants. The spray volume was in accordance with the plant size. After the weekly counting of individuals on plants, the insects were removed and then the plants were sprayed with NeemAzal-T/S 1% water emulsion.

We mixed NeemAzal-T/S with water and tested concentrations of 0.5 to 1.0%. The field crops were sprayed once per week, while the number of insect individuals was counted and removed before each application.

For the small scale field trials with *Vicia fabae*, four neighbouring rows of beans were used. For each two rows of beans we performed one spraying with NeemAzal-T/S 0.5% water emulsion.

Large pine weevil – *Hylobius abietis* - concentrate on fresh clear cut areas where they are looking for maturation feeding on the cambial layers of young conifer tree stems. Heavy conifer seedling mortality is common, particularly where seedlings have been planted on recently clear-cut areas. NeemAzal-T 2%, 10% and 20% water emulsions were tested in forest conditions against weevils. In field conditions differently treated three years Norway spruce seedlings were planted in randomised blocks (40) in a fresh clear cut area and the damage rate of weevils was established in weekly intervals during the vegetation period.

Results and discussion

Pest insects on cabbage

We tested the effects of NeemAzal-T/S on six species of pest insects on cabbage (*Brassica oleracea*) plants. To the cabbage moth *Mamestra brassicae* NeemAzal-T/S revealed potent repellent and/or deterrent properties. On the treated plants no egg clusters and caterpillars were found, contrary to the control or untreated plants, where in early summer numerous caterpillars (up to 30 per plant) damaged the plants (Fig. 2).

Similar results were obtained in tests with the Large White (*Pieris brassicae*). The females of *P. brassicae* revealed an evident trend to avoid the cabbage plants sprayed with NeemAzal-T/S (Fig 1). By our visual observations the adults of *P. brassicae* did not contact treated cabbage plants, seemingly avoiding these plants. This observation is a reason to assume that the repellent (without contact) and not deterrent (on contact) properties of NeemAzal-T/S affected the females of *P. brassicae*. Moreover, the caterpillars from neighbouring untreated plants did not wander on the treated plants.

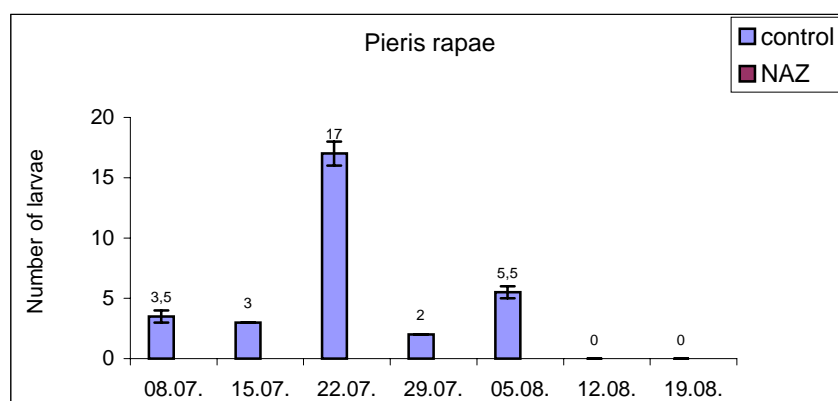


Fig 1: The number of larvae and egg clutches (per plant) on the weekly intervals treated with NeemAzal (NeemAzal-T/S) 1% water emulsion plants and untreated control cabbage plants.

No eggs and no caterpillars of the Small White, *Pieris rapae*, were detected on cabbage plants treated with NeemAzal-T/S (Fig 1) while the control plants were damaged by *P. rapae*.

Against the diamond-back moth, *Plutella xylostella* and the garden pebble moth, *Evergestis forficalis* NeemAzal-T/S also acted as a potent repellent and/or ovipositional deterrent. Throughout the season no eggs and no caterpillars of these species were found on cabbage plants sprayed with NeemAzal-T/S (Fig 2 and 3).

The cabbage aphid, *Brevicoryne brassicae* showed typical seasonal dynamics being most abundant in late summer (Fig. 2). Only a few colonies were on the treated plants in the early summer, but during the middle and late summer all aphid colonies disappeared.

Our results allow us to conclude that the spraying of cabbage plants with NeemAzal-T/S 1% water emulsion can avoid the damage of the six most harmful pest insects of cabbage plants. The main effects were due to the repellent and/or deterrent properties of NeemAzal-T/S. Lepidoptera are among the organisms most sensitive to neem extracts (Martinez and van Emden, 1999).

Bean aphids, *Aphis fabae*

We sprayed the bean *Vicia faba* with NeemAzal-T/S in early summer, at the time when the plants were infested by bean aphids. Three days after the treatments no living aphids were found. The bean plants were free from aphids during the course of two weeks after the spraying. During this time the control bean plants began to fade from damage. Only one month after the treatment the first winged aphids appeared.

It was evident that NeemAzal-T/S affected the bean aphids via direct toxicity and later repellent and deterrent modes of action. Aphids are very susceptible to the contact action of NeemAzal-T/S in the recommended concentrations (0.3-0.5% water emulsions) seemingly due to their thin cuticle.

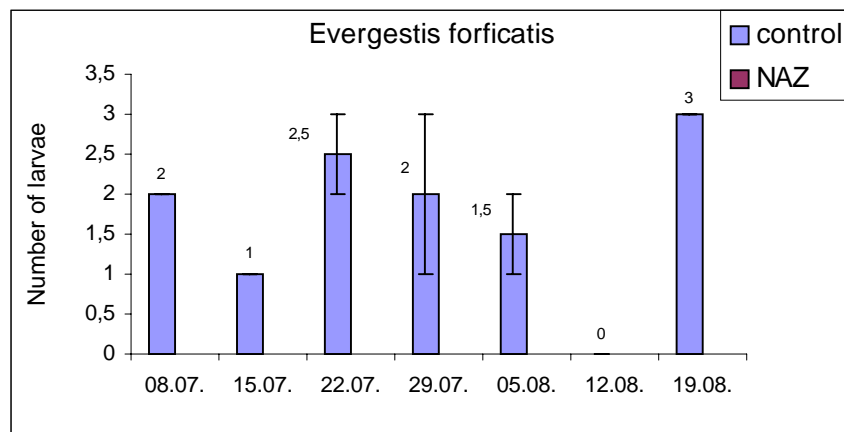
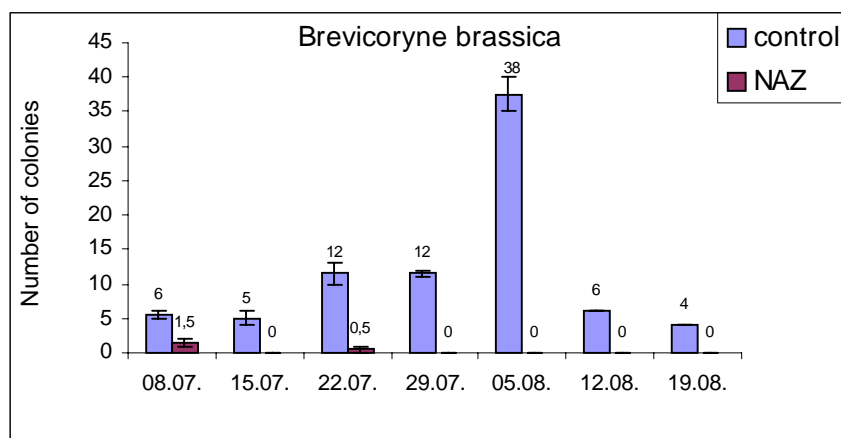
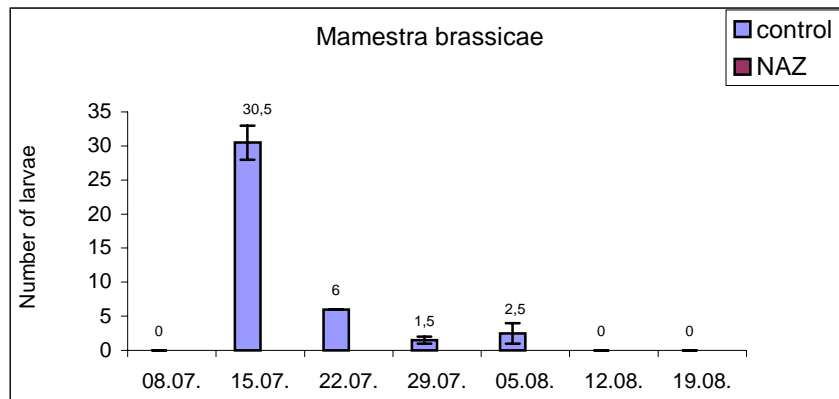


Fig 2: The number of larvae and colonies of insects per control cabbage plant and per plant treated with NeemAzal-T/S (NeemAzal-T/S) 1% water emulsion.

Our results are in accordance with some other data about the action of neem on *Vicia fabae*, showing that the contact toxicity must be supported by a long term efficacy to control this aphid (Schulz et al., 1996; Lowery et al., 1993)

In our opinion the property of direct toxicity of NeemAzal-T/S has often been underestimated. The physiological effects of azadirachtins obviously involve besides

morphogenetic (insect growth regulating) ones a direct neurotoxicity (see Mordue., 1997).

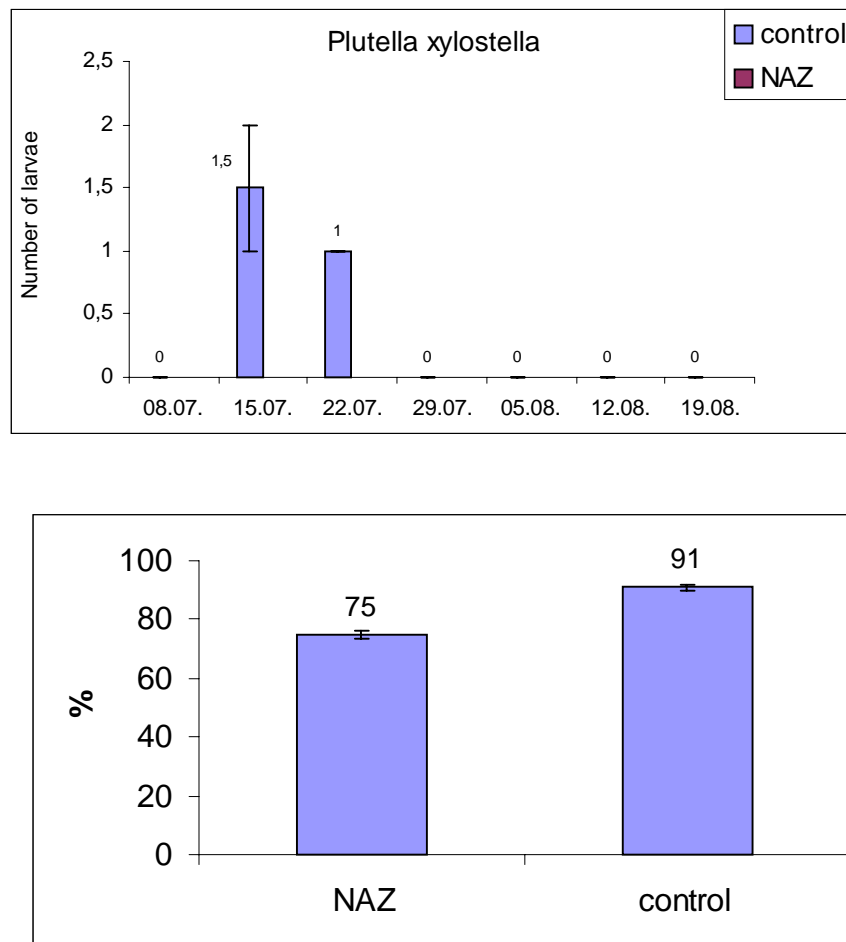


Fig 3: The percentage of damaged carrots by carrot flies in treated with NeemAzal-T/S (NeemAzal-T/S) 1% water emulsion and untreated control variants.

Flea beetles, Phyllotreta spp.

NeemAzal-T/S had no effect in our tests on the turnip flea beetles *Phyllotreta atra*, the large striped flea beetle *Ph. nemorum* and the flea beetle *Ph. vittata* in spite of weekly spraying of cabbage plants.

Carrot fly, Psila rosae

The results of spraying were estimated in autumn. Carrot flies - *Psila rosae*, seriously damaged the carrots. In the control carrot, larvae of *P. rosae* damaged 94%. In carrots, treated weekly with NeemAzal-T/S, the damage was reduced only by 20% (Fig. 3). Further studies are needed to explain these results.

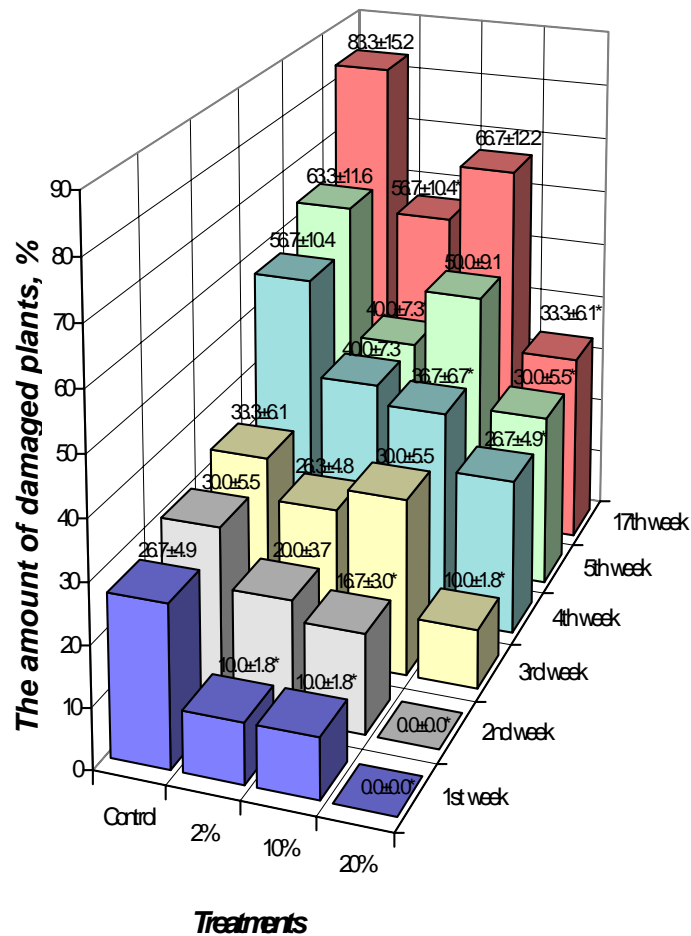


Fig 4: The percent (% ± standard deviation) of damaged 3-years old spruce seedlings treated with water emulsion of NeemAzal-T in concentration 2%, 10% and 20% and untreated seedlings by *Hylobius abietis* L. in fresh clear-cut area in 1. . . 5 and 17 weeks after planting.

* Significant differences between variants by Student t-test, $p < 0.05$

Large pine weevil, Hylobius abietis

NeemAzal-T 20% water emulsion affected the feeding behaviour of pine weevils in forest conditions significantly (Fig. 4). During the first two weeks weevils did not eat bark of seedlings treated with 20% emulsion. Significantly less weevils damaged these seedlings during the whole season. In the case of *H. abietis*, neem preparations seem to have an influence mainly via taste, as weevils were at first checking treated seedlings by touching them with their palpi and after that the untreated control seedlings were preferred for feeding. Only some phytotoxic influence of the 20% NeemAzal-T emulsion to the spruce seedlings was noticed. It is possible to conclude that NeemAzal-T in a 20% water emulsion was longer active against pine weevils than other still tested plant compounds (Luik, 1997).

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