THE PRELIMINARY RESULTS OF TRIALS CONDUCTED WITH NEEM AND COMBINATIONS OF NEEM AND *BACILLUS THURINGIENSIS* VAR. *KURSTAKI* IN GYPSY MOTH (*LYMANTRIA DISPAR* L.) CONTROL IN SLOVAKIA

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The gypsy moth, Lymantria dispar L. (Lep. Lymantriidae), is the most important defoliator of oak stands in Slovakia. If necessary, control is done by aerial applications of Bacillus thuringiensis var. kurstaki (Btk) and viruses preparations during outbreaks till now. However, when population density is very high (over 5 egg masses / tree) the larvae cause heavy defoliation in spite the fact, that treatment by (Btk) or viruses was done. From this reason alternative ecological possibility for control it is necessary to find. The effects of 2.0 (NAI2.0) and 4.0 (NAI4.0) l NeemAzal – T/S combined with 2.0 l Istroecol (rape oil formulation) per ha on larvae of gypsy moth in aerial application is shown. Larvae treated by 2.0 l showed 50.1 % mortality, larvae treated by 4.0 l showed 78.6% mortality. Average defoliation reached 3.85% in (NAI2.0) and only 3.15% in (NAI4.0) and was significantly lower as in control – 24.75 and 27.5 % (ANOVA, Scheffe test). Surface trials were carried out on another experiment. The effects of combination of NeemAzal and Btk products (A: Btk –0.02 l; B: NeemAzal –T/S –0.005 l + Btk -0.005 l; C: NeemAzal –T/S –0.01 l + Btk -0.01 l; and D: NeemAzal –T/S –0.02 l + Btk -0.01 l - each combination with 0.01 l of Istroecol diluted in 5 l of water) on gypsy moth larvae is shown. All used variants (A, B, C and D) reached 100.0% mortality (natural mortality was high as well –70%). Average defoliation reached 78.6% in A, 41.4% in B, 34.3% in C and 6.2% in D and was significantly lower that in control – 91.2 and 92.9% (ANOVA, Tukey HSD test). Defoliation in A was significantly higher as defoliation in B, C and D.

Key words: *NeemAzal products, Bacillus thuringiensis var.kurstaki, Lymantria dispar control*

Introduction

The gypsy moth, *Lymantria dispar* L. (Lep. Lymantriidae), is the most important defoliator of oak stands in Slovakia. The control is done by aerial applications of *Bacillus thuringiensis* var. *kurstaki* (*Btk*) and viruses preparations during outbreaks (every 6-10 years). When population density is very high (over 5 egg masses / tree) the larvae cause heavy defoliation in spite the fact, that treatment by (*Btk*) and viruses was done. Trials to control gypsy moth by application of NeemAzal products and combination of NeemAzal and *Btk* products in oak stands were conducted in spring 1998 to confirm, if NeemAzal preparations in combination with *Btk* could decrease or minimise defoliation (due to antifeedant effect).

The antifeedant activity of Neem is well known (Singh, 1993). However, different insect species showed varying degree of sensitivity to various extracts and pure compounds. For example cabbage leaves sprayed with 0.4% neem seed kernel suspension significantly reduced the damage by *Pieris brassicae* larvae. On the other hand, at 1 to 2% concentration, the Neem oil failed to give any significant protection to castor leaves against the hairy caterpillar, *Amsacta albistriga* (3 to 4% concentration protected castor leaves to the extend of 70.7 and 91.4% respectively).

Nicol and Schmutterer (1996) confirmed high mortality of gypsy moth larvae after treatment by NeemAzal-T (5% azadirachtin). In the treated stand the majority of the larvae died 3-4 weeks after application and hardly reached the second or the early third larval instar. The high reduction of production of faeces and gain in mass of untreated and treated larvae of gypsy moth was observed as well. Only 17 % of larvae had not died, however, the resulting adults were fertile. The feeding activity of gypsy moth larvae in the treated stands decreased rapidly (second antifeedant effect) (Nicol and Schmutterer, 1996).

During my experiments, I have tried to test the mixture of Neem product (low defoliation, but high expenses for treatment) and *Btk* product (low price, but sometimes high defoliation). My idea was to confirm if reduced amount of Neem preparation could be replaced partially by *Btk* and efficiency stay at the same (similar) level.

Material and methods

Trials focused on control of gypsy moth by application of NeemAzal products and combination of NeemAzal and *Btk* products in oak stands were conducted in May 1998. I wanted to confirm, if combinations of NeemAzal and *Btk* preparations could decrease or minimise defoliation. The effects of 2.0 (NAI2.0) and 4.0 (NAI4.0) l NeemAzal – T/S combined with 2.0 l Istroecol (rape oil formulation) on larvae of gypsy moth was studied in the first study. Applications were carried out by aeroplane with the ingredients diluted in 100 l water / ha. Artificially reared gypsy moth larvae were exposed into cloth bags after treatment on treated and control plots (10 branches each variant, 2 repetitions). They were taken into lab after 3 weeks together with sample branches. Surface trials were carried out on another experiment at the beginning of June 1998. The effects of combination of NeemAzal and *Btk* products (A: *Btk* –0.02 l; B: NeemAzal –T/S –0.005 l + *Btk* -0.005 l; C: NeemAzal –T/S –0.01 l + *Btk* -0.01 l; and D: NeemAzal –T/S –0.02 l + *Btk* -0.01 l - each combination with 0.01 l of Istroecol diluted in 5 l of water) on gypsy moth larvae was studied. Again gypsy moth larvae were exposed on sprayed trees into cloth bags on treated and control plots and taken into lab after 3 weeks together with branches. Mortality on treated and control plots was evaluated by Abbott formula. Defoliation was evaluated on the basis of 20 leaves, which were taken from each sample branch (10 branches each variant, 2 repetitions). Analysis of variance was used for comparison of differences in average defoliation (Tukey HSD Test and Scheffe Test).

Results and discussion

Aerial applications

Larvae treated by NAI2.0 showed 50.1 % mortality, larvae treated by NAI4.0 showed 78.6% mortality 3 weeks after treatment. Average defoliation reached 3.85% in (NAI2.0) and only 3.15% in (NAI4.0) and was significantly lower as in control – 24.75 and 27.5 % (ANOVA, Scheffe, test) (Table 1). Differences between defoliation caused in NAI2.0 treatment and NAI4.0 treatment were low and not statistically significant. Low defoliation in control it is caused by high natural mortality of reared larvae (egg masses for caterpillars rearing were collected in outbreak conditions).

Table 1 Differences in defoliation - aerial application [Scheffe test; (P <0.01), n=20, MAIN EFFECT: Treatment]

Treatment	Neem 1	Neem 2	Control 2	Control 1
Average def.	3.850	3.150	27.500	24.750
Neem 1	•	0.998010	0.000000**	0.000003**
Neem2		•	0.000000**	0.000001**
Control2			•	0.898061

Surface treatments

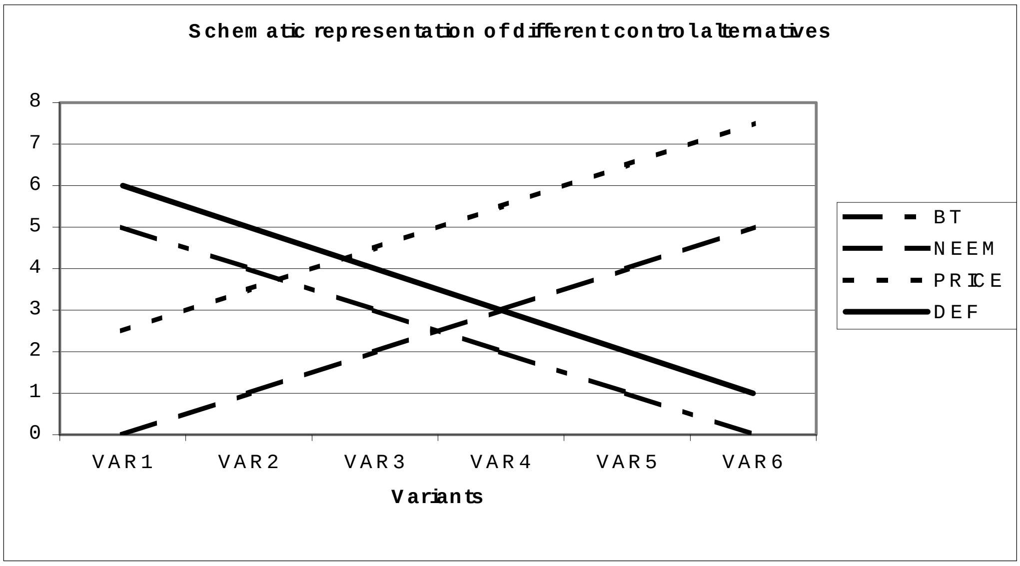
All used variants (A, B, C and D) reached 100.0% mortality after 3 weeks. Natural mortality was extremely high as well –70%. There were 2 reasons – 1^{st} (egg masses for caterpillars rearing were collected in outbreak conditions) and 2^{nd} experiments were leaded at the beginning of June, when leaves are not optimal for young gypsy moth larvae feeding. Average defoliation reached 78.6% in A, 41.4% in B, 34.3% in C and 6.2% in D. In all variants, it was significantly lower that in control – 91.2 and 92.9% (ANOVA, Tukey HSD test). Differences in defoliation among all variants were statistically significant (Table 2).

Table 2. Differences in defoliation - surface application [Tukey HSD test; (P <0.01), n=20, MAIN EFFECT: Treatment]

Treatment	(A)	(B)	(C)	(D)	CONTROL1	CONTROL 2
Average def.	78.571%	41.389%	34.286%	6.238%	91.191%	92.857%
A	•	0.0012**	0.00012**	0.00012**	0.00669**	0.00137**
B		•	0.33555**	0.00012**	0.00012**	0.00012**
C			•	0.00012**	0.00012**	0.00012**
D				•	0.00012**	0.00012**
CONTROL1					•	0.99708

The results of preliminary experiments with combinations of *Btk* and Neem products showed some possibilities for using this control strategy. Combinations of *Btk* and Neem it could be possible to use in aerial treatment mainly, where application of chemical preparations is forbidden, but protection of forest stands against defoliation it is necessary. Aerial treatments against gypsy moth are frequently done in forest stands influenced by oak decline by using *Btk*, or viruses. However, when population density is very high (over 5 egg masses / tree) the larvae can cause heavy defoliation in spite the fact, that treatment was done. In forest stands influenced by oak decline even medium defoliation (over 40%) can cause deterioration of tree health. Successfully testing the *Btk* and Neem combination could be involved to strategy “Control in Advance” NOVOTNÝ & TURČÁNI (1997) in the most endangered stands (in that strategy, the treatment is done in time, when abundance is not extremely high).

Application of pure Neem products it is impossible to do in conditions of Slovak forests, because high prive of application. However, some situations are known when application of Neem could be suitable to use. As it is possible to see from Figure 1, defoliation during high abundance of caterpillars can reach 60 (sometimes more) % in spite the treatment by using *Btk* only. The relative price of this application reachs coefficient Kp = 2,5. After totally replacement *Btk* by Neem products it is possible to expect defoliation only 10 (or less) %, but the price of this application is 3 times higher (Kp=7,5). On the basis of data from literature (Novotný and Surovec, 1992) it is known, that defoliation up to 30 (40)% does not cause to defoliated trees serious deterioration of health. Decreasing the defoliation together with still high efficiency of treatment could be probably reached by using optimised structure of applicated preparations (combinations of *Btk* and Neem). In that case it will be necessary to use sublethal dose of Neem preparations together with sublethal dose of *Btk*. To prepare the optimised combination of *Btk* and Neem it is necessary to lead another experiments. During making these experiments it is necessary to study the mechanisms of activity of both preparations (*Btk* and Neem) on target organisms. Not everything is clear on that area. For example, how is it possible, that total effect of Neem and *Btk* on target insect is stronger, when it is possible to predict, that relation between them will be negative? It is mainly antifeedant effect of Neem, which can negatively influences affect of *Btk* (because caterpillars have to consume some area of foliage, to be infested by spores of *Btk)*.



Conclusions

1) Unfortunately, the experiments were leaded in 1998 only and were not repeated on different climate conditions. From this reason they could be considered as preliminary only.

2) Defoliation in oak stands treated by 2.0 l and 4.0 (NAl4.0) l NeemAzal – T/S combined with 2.0 l Istroecol was statistically different as in control and reached only 3 to 4 %. The efficiency of Neem on gypsy moth larvae seems to be high.

3) Among different variant as the most suitable variant was found C (NeemAzal –T/S –0.01 l + *Btk* -0.01 l) defoliation 34% and D (NeemAzal –T/S –0.02 l + *Btk* -0.01 l) - defoliation 6%.

4) It is necessary to continue experiments to optimise treatment variants for different health conditions of oak stands (healthy stands, stands influenced by oak decline...).

References

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