

**EVALUATION OF INFLUENCE OF
SELECTED INSECTICIDES
ON MORTALITY OF SIBERIAN MOTH LARVAE
(*DENDROLIMUS SUPERANS SIBIRICUS* TSCHETV.)**

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Abstract. The influence of Fastac 100 EC, Marshal 250 CS and Nomolt 150 SC insecticides on the (L₁) caterpillars of Siberian Silk Moth (*Dendrolimus superans sibiricus*) was investigated. Three different concentrations were prepared for each insecticide. It has been shown that all variants of the tested insecticides reduced the population of the larvae, whereby in case of Fastac 100 EC infusion, no statistically significant differences between the investigated concentrations were obtained. The most effective insecticide was Fastac 100 EC which, regardless of the concentration used, caused 100% mortality within 48 hours from application.

Key words: *Dendrolimus superans sibiricus*, insecticides, toxicity, forest protection

INTRODUCTION

Siberian Silk Moth (*Dendrolimus superans sibiricus* Tschetverikov; *Lepidoptera*; *Lasiocampidae*) is a very dangerous coniferous tree pest in Siberia. It feeds on all age groups of coniferous trees, yet it prefers older ones. In terms of species, it prefers to feed on larch, followed by pine and spruce. Its Asian range covers the whole Asian part of Russia, Kazakhstan, northern part of China, North Korea, South Korea, and northern Mongolia.

In the recent years, the Siberian silk moth has been transferred to northern and central parts of European Russia [Gninenko 2000]. During the V EPPO Forest Panel held between March 13th and 15th 2002 in Vilnius, the representatives of the Russian Federation announced that the Siberian silk moth feeds massively on spruce and its range moves westwards at the rate of 20km/year. In turn, during the IX EPPO Forest Panel in Grisslehamn in Sweden (September 26th-29th 2004) the representative of the Russian

party stated that the Siberian silk moth increased the rate of its westbound movement to as much as 50 km/year.

Conifer forests are dominant throughout Central Europe, while in Poland they constitute as much as 80% of all forest areas, out of which larch and pine account for 71%. Simultaneously, the area of Poland is subject to strong influence of both continental as well as Atlantic climate. It allows for acclimatization of species that come from various climatic areas. In case of mass occurrences, the Siberian silk moth is expected to cause severe damages to Central European wood production industry, as inferred from the raw fact that, according to the analyses, it already caused damages bigger than all other conifer pest species together in Siberia [Gninenko and Orlinskii 2002].

The number of insecticides applied in plant protection against the pest within European Union is diminishing due to gradual withdrawal of the insecticides that are most harmful to the environment. Simultaneously in Poland, another reason for dramatic decrease in the number of pesticides allowed for use in forestry, are the limitations resulting from FSC regulations – an organization certifying the forest management in State Forests. In the “Instruction for application of means of plant protection in certified forests” of 1st June 2007 the majority of the pesticides registered for use in forests has been marked as “highly dangerous”. For example: from among 30 insecticides registered by the Minister of Agriculture and Rural Development for application in forestry, as much as 25 were placed on the list of chemicals banned by FSC. In case of emergency instigated by the pest or diseases, the pesticides other than those listed there will be allowed to use, though under the condition that afterwards a report stating the reason and substantiation of the application of the banned pesticide must be sent to SGS QUALIFOR [Środki... 2007].

The insecticides tested in the discussed experiments are allowed by the aforesaid regulating bodies, and hence in case of danger of pest occurrence, they can be readily applied without any additional authorization.

THE GOAL OF THE REPORT

The aim of the report was to establish the toxicity of selected insecticides towards the youngest caterpillar stadium (L_1) of the Siberian silk moth (*Dendrolimus superans sibiricus*).

METHODOLOGY

Influence of the selected insecticides on the caterpillars of Siberian silk moth was established on the basis of contact and stomach method.

The following three insecticides were tested:

- Fastac 100 EC – active substance – alpha-cypermethrin,
- Marshal 250 CS – active substance – carbosulfan,
- Nomolt 150 SC – active substance – teflubenzuron.

Each of the insecticides selected for the experiments was prepared in three different concentrations. Default concentrations were those suggested by the manufacturers for

prevention treatments. Thus prepared solutions were tested by spraying them onto larch twigs, and subsequently by feed them to the caterpillars. The control samples for all experiments were the larch twigs dipped in water. The test for each concentration was repeated five times with five caterpillars in each. First data collection was performed after 12 hours from the start of the experiment by counting the caterpillars that were alive, and subsequently once in each 24 hours for the next 10 days.

RESULTS AND DISCUSSION

The obtained results are shown in Table 1. Due to the fact that in the control group the larvae mortality rate was not recorded, the adjustment by natural mortality rate was not introduced.

Table 1. Mortality of the larvae by days of experiment, per cent
Tabela 1. Procentowa śmiertelność larw w poszczególnych dniach testu

Pesticide solution tested Testowany preparat	Control time – Termin kontroli										
	12 h	24 h	48 h	72 h	96 h	120 h	144 h	168 h	192 h	216 h	240 h
Fastac 100 EC 0.03%	88	88	100	–	–	–	–	–	–	–	–
Fastac 100 EC 0.02%	92	96	100	–	–	–	–	–	–	–	–
Fastac 100 EC 0.01%	96	96	100	–	–	–	–	–	–	–	–
Marshal 250 CS 0.15%	64	72	76	92	100	–	–	–	–	–	–
Marshal 250 CS 0.10%	20	52	64	72	92	100	–	–	–	–	–
Marshal 250 CS 0.05%	4	24	36	48	72	96	100	–	–	–	–
Nomolt 150 SC 0.10%	4	4	4	24	52	72	84	92	96	100	–
Nomolt 150 SC 0.075%	4	4	4	4	20	40	64	84	100	–	–
Nomolt 150 SC 0.05%	0	0	0	4	20	36	52	64	76	80	80

Based on Figure 1, it may be easily seen that the larvae are highly susceptible to Fastac infusion, which, regardless of the concentration used, caused 100% mortality already after 48h. After 12 hours of the test, the mortality recorded ranged between 88-96%. The susceptibility of larvae to Marshal 250 CS was significantly lower, where the goal of 100% mortality was achieved after 96 hours and only for the highest applied concentration of this insecticide.

Comparing the effectiveness of the tested chemicals, it can be concluded that the caterpillars feeding on the twigs sprayed with Nomolt died last, while those that fed on twigs treated with Fastac 100 EC died rapidly. Low mortality rate caused by Nomolt is the effect of action mechanism of this pesticide.

In case of Marshal and Nomolt, there is, as expected, a relationship between the decrease in concentration of the chemical and the increase in the survival time of the caterpillars. Such dependence was not observed in case of the preparations of Fastac 100 EC. After 12 hours, the mortality rate among the insects treated with Fastac 100 EC

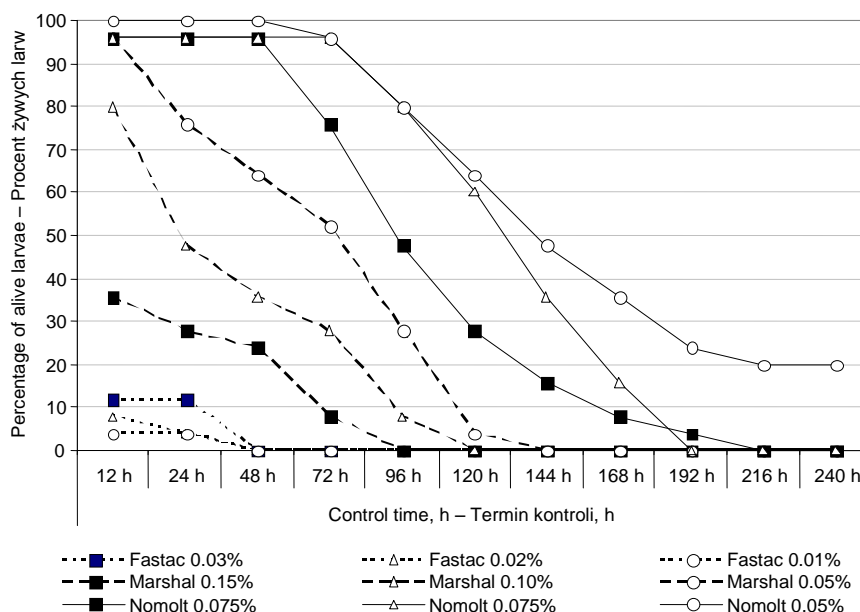


Fig. 1. Survival rate in subsequent days of the experiment, per cent

Rys. 1. Żywotność larw w poszczególnych dniach trwania doświadczenia, %

equalled respectively 88%, 92% and 96% and was reversely proportional to the concentrations applied. In all tested concentrations of this chemical, full (100%) mortality rate of larvae was achieved after 48 hours.

Statistically analysed results obtained after 12 and 24 hours show no significant differences between the concentrations of Fastac 100 EC pesticide (Table 2).

Clear influence on the mortality rate of the youngest larvae, in case of Marshal 250 CS had the concentration applied. The biggest tested concentration (0.15%) inflicted 64% mortality after 12 hours, while the dose of 0.1% and 0.05% caused only 20% and 4% mortality respectively. The efficiency of the 0.15% solution in the first stage of the experiment (after 12 and 24 hours) differed significantly from the other two (Table 3). Full (100%) mortality was achieved, respectively to the concentration, after:

- 96 hours – 0.15%,
- 120 hours – 0.10%,
- 144 hours – 0.05%.

The deferred reaction of the caterpillars to Nomolt 150 SC (as compared to Fastac 100 EC and Marshal 250 CS) is the result of the specificity of this chemical's action. It shows no contact action, but is based on chitin synthesis inhibitors, hence the insect's reaction occurs some time after the treatment. It is regarded as environment-friendly.

In first 48 hours, the influence of Nomolt 150 SC was almost unnoticeable. The mortality observed in this period reached 4% population for the concentrations of 0.10% and 0.075%, and no mortality at all for the concentration of 0.05%. After this period, a clear reaction of the caterpillars was visible, which were initially most apparently (statistically significantly) reduced by the concentration of 0.15% (Table 4). After 96,

Table 2. Mean survival rate of the caterpillars and statistic significance level test for Fastac 100 EC
Tabela 2. Zestawienie wyników średniej przeżywalności gąsienic i testów istotności dla preparatu Fastac 100 EC

Pesticide solution tested Testowany preparat	Control time – Termin kontroli									
	12 h					24 h				
	mean śred- nia	test F	F	p	signi- fican- ce istot- ność	mean śred- nia	test F	F	p	signi- fican- ce istot- ność
Fastac 100 EC 0.03%	0.6				a*	0.6				a
Fastac 100 EC 0.02%	0.4	3.88529	0.46154	0.64105	a	0.2	3.88529	1.14286	0.35130	a
Fastac 100 EC 0.01%	0.2				a	0.2				a

*Identical letters in the "significance" field mean that there are no statistically significant differences.

*Jednakowe litery w polu „istotność” oznaczają brak różnic statystycznie istotnych.

Table 3. Mean survival rate of the caterpillars and statistic significance level test for Marshal 250 CS
Tabela 3. Zestawienie wyników średniej przeżywalności gąsienic i testów istotności dla preparatu Marshal 250 CS

Pesticide solution tested Testowany preparat	Control time Termin kontroli h	Mean Średnia	Test F	F	p	Tukey's T test Test T Tukeya
Marshal 250 CS 0.15%	12	1.8	3.88529	19.0526*	0.00019	a*
Marshal 250 CS 0.10%		4.0				b
Marshal 250 CS 0.05%		4.8				b
Marshal 250 CS 0.15%	24	1.4	3.88529	27.25000*	0.00003	a
Marshal 250 CS 0.10%		2.4				b
Marshal 250 CS 0.05%		3.8				c
Marshal 250 CS 0.15%	48	1.2	3.88529	26.33333*	0.00004	a
Marshal 250 CS 0.10%		1.8				a
Marshal 250 CS 0.05%		3.2				b
Marshal 250 CS 0.15%	72	0.4	3.88529	20.22222*	0.00014	a
Marshal 250 CS 0.10%		1.4				b
Marshal 250 CS 0.05%		2.6				c
Marshal 250 CS 0.15%	96	0	3.88529	13.0000*	0.000992	a
Marshal 250 CS 0.10%		0.4				a
Marshal 250 CS 0.05%		1.4				b

*Various letters at individual concentrations mean statistically significant differences at significance level of $\alpha = 0.05$.

*Różne litery przy poszczególnych stężeniach oznaczają różnice statystycznie istotne na poziomie $\alpha = 0,05$.

Table 4. Mean survival rate of the caterpillars and statistic significance level test for Nomolt 150 SC
Tabela 4. Zestawienie wyników średniej przeżywalności gąsienic i testów istotności dla preparatu
Nomolt 150 SC

Pesticide solution tested Testowany preparat	Control time Termin kontroli	Mean Średnia	Test F	F	p	Tukey's T test Test T Tukeya
Nomolt 150 SC 0.10%	12	4.8	3.88529	0.49999	0.61862	–
Nomolt 150 SC 0.075%		4.8				–
Nomolt 150 SC 0.05%		5				–
Nomolt 150 SC 0.10%	24	4.8	3.88529	0.49999	0.61862	–
Nomolt 150 SC 0.075%		4.8				–
Nomolt 150 SC 0.05%		5				–
Nomolt 150 SC 0.10%	48	4.8	3.88529	0.49999	0.61862	–
Nomolt 150 SC 0.075%		4.8				–
Nomolt 150 SC 0.05%		5				–
Nomolt 150 SC 0.10%	72	3.8	3.88529	3.12500	0.08082	–
Nomolt 150 SC 0.075%		4.8				–
Nomolt 150 SC 0.05%		4.8				–
Nomolt 150 SC 0.10%	96	2.2	3.88529	9.52941	0.003326	a*
Nomolt 150 SC 0.075%		4				b
Nomolt 150 SC 0.05%		4				b
Nomolt 150 SC 0.10%	120	1.4	3.88529	9.73333	0.003076	a
Nomolt 150 SC 0.075%		3				b
Nomolt 150 SC 0.05%		3.2				b
Nomolt 150 SC 0.10%	144	0.8	3.88529	8.16666	0.00577	a
Nomolt 150 SC 0.075%		1.8				ab
Nomolt 150 SC 0.05%		2.4				b
Nomolt 150 SC 0.10%	168	0.4	3.88529	11.142857	0.00184	a
Nomolt 150 SC 0.075%		0.8				a
Nomolt 150 SC 0.05%		1.8				b
Nomolt 150 SC 0.10%	192	0.2	3.88529	6.88888	0.010177	a
Nomolt 150 SC 0.075%		0				a
Nomolt 150 SC 0.05%		1.2				b

*Various letters at individual concentrations mean statistically significant differences at significance level of $\alpha = 0.05$.

*Różne litery przy poszczególnych stężeniach oznaczają różnice statystycznie istotne na poziomie $\alpha = 0,05$.

120 and 144 hours, not significant differences were observed between the concentrations of 0.075% and 0.05%. After the passage of 144 hours, no longer the significant differences between the effectiveness of the concentrations of 0.10% and 0.075% were visible. Full (100%) mortality was reached after 196 hours for the concentration of 0.075% after 210 hours for the highest experimental concentration (0.10%). The lowest tested concentration (0.05%) reduced only 80% of the initial population.

SUMMARY AND CONCLUSIONS

Despite the fact that the results obtained for L₁ development stadium are of preliminary character, they also allow for some analysis and conclusions.

Upon analysis of the influence of FASTAC 100 EC it is clearly visible that each of the tested concentrations caused 100% mortality among the larvae after 48 hours of the experiment. No statistically significant differences between the concentrations of the pesticide were observed. If in case of further stages of larval development no such difference will be shown, this may allow for decrease of the suggested doses of the insecticide used in preventive treatment against Siberian silk moth.

Assuming that with increasing age, the resistance of the caterpillars to insecticides will be also increasing, it can be already presently stated that 0.05% of Nomolt 150 SC should not be used, as it caused only the 80% reduction among the youngest larvae. Very interesting may prove the interim concentration of the mentioned chemical, as no significant differences were observed between the doses of 0.1% and 0.075% (except for the control time of 96 and 120 hours), which caused the 100% in the shortest period of time (from among concentrations of this particular insecticide).

The results of the experiments indicate that each of the tested chemical may be effective in reduction of the populations of the Siberian silk moth. They should be treated with considerable reserve, as the proven toxicity of the concentrations above has to be confirmed for the L₂, L₃ and L₄ stages of larval development.

The authors of the present report currently continue their research on the effectiveness of selected chemical preparations in reduction of the Siberian silk moth larvae populations. The results of the research will be published on an on-going basis.

1. Except for the lowest concentration (0.05%) of Nomolt 150 SC all the variants of the tested pesticides caused 100% mortality among the caterpillars in the assumed time scale.

2. Fastac 100 EC proved to be most effective, as each of its concentrations caused 100% mortality rate after 48 hours.

3. In case of Marshal 250 CS a clear, reversely proportional influence of the applied concentration on the life time of the caterpillars is seen.

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**OCENA WPŁYWU WYBRANYCH INSEKTYCYDÓW
NA ŚMIERTELNOŚĆ GĄSIENIC BARCZATKI SYBERYJSKIEJ
(*DENDROLIMUS SUPERANS SIBIRICUS* TSCHETV.)**

Streszczenie. Zbadano wpływ preparatów Fastac 100 EC, Marshal 250 CS i Nomolt 150 SC na gąsienice stadium (L_1) barczatki syberyjskiej (*Dendrolimus superans sibiricus*). Dla każdego z preparatów przygotowano po trzy warianty stężeń. Wykazano, iż wszystkie warianty testowanych insektycydów redukowały liczebność gąsienic, przy czym nie wykazano statystycznie istotnych różnic pomiędzy badanymi stężeniami po zastosowaniu Fastac 100 EC. Największą skutecznością wykazał się Fastac 100 EC. Niezależnie od stężenia wyróżniał się 100-procentową śmiertelnością larw już po 48 h testu.

Słowa kluczowe: *Dendrolimus superans sibiricus*, insektycydy, toksyczność, ochrona lasu

Accepted for print – Zaakceptowano do druku: 9.12.2008

For citation – Do cytowania: Łabędzki A., Kuźmiński R., Leontiev D.F., 2009. Evaluation of influence of selected insecticides on mortality of Siberian moth larvae (*Dendrolimus superans sibiricus* Tschetv.). *Acta Sci. Pol., Silv. Colendar. Rat. Ind. Lignar.* 8(1), 27-34.