

**PLANT EXTRACTS AS A POTENTIAL SOURCE  
OF ANTIFEEDANTS. INFLUENCE OF EXTRACTS  
OF TOBACCO – *NICOTIANA TABACUM* L.  
ON THE LARGE PINE WEEVILS – *HYLOBIUS ABIETIS* (L.)**

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**Abstract.** The aim of the study was to determine whether extracts of tobacco leaves may reduce feeding of the large pine weevils on twigs of pine – *Pinus sylvestris*. The research was conducted in laboratory conditions. The research proved statistically significant decrease in damage size on the pine twigs as a result of application of each tested extract.

**Key words:** large pine weevil, *Hylobius abietis*, plant extracts, antifeedants, deterrents, tobacco, *Nicotiana tabacum*

**INTRODUCTION**

The biggest damages in young coniferous forests in Poland are caused by large pine weevil – *Hylobius abietis* (L.). Nationwide measures for control of the population size of this insect are taken annually, whereby in certain regions, the cost of treatments against the large pine weevils far exceeds the total cost of other damage-preventing treatments against all other insect species.

Due to the lack of possibility of forecasting the level of threat to young forests by the large pine weevil (a sufficiently effective method has not been developed, so far) – apart from the so-called traditional methods, granulated or liquid insecticides are used as well. They are often used in a preventive manner – through dipping the seedlings in a given insecticide prior to its planting. Such manner is moderately effective, however in some extent it contradicts the current trends in environmental protection.

Thus, it may be stated that the protection of young coniferous forests from damages caused by large pine weevil remains a difficult problem and results in necessity to develop new, alternative methods of pest damage prevention. It would provide considerable profits for not only forestry in Poland, but within the whole distribution area of pine tree – *Pinus sylvestris* L. as well.

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A certain opportunity lies in plants, and more specifically, in natural substances produced by them and showing specific influence on the insect behaviour [Wyrostkiewicz 1984, 1992, Adhikary 1985, Pathak and Krishna 1985, Schmutterer 1985, Banasik and Ignatowicz 1995, Malinowski and Woreta 1997, Woreta 1997, Kuźmiński 2002 a, b, 2003, 2004, Korczyński and Kuźmiński 2007 a, b].

One of the plants is the common (cultivated) tobacco – *Nicotiana tabacum* L. extracts of which are used as insecticides in gardening and agriculture [Korszikow et al. 1991]. Furthermore, it has been proved that the lupine-tobacco extract shows high biological activity towards the Large white butterfly – *Pieris brassicae* and Colorado potato beetle – *Leptinotarsa decemlineata*, as a highly effective deterrent [Wyrostkiewicz et al. 1996]. For this reason, the influence on tobacco-based extracts on large pine weevils is a very interesting issue.

This work is a fragment of a series of detailed studies on the influence of plant-derived substances on the large pine weevils – *Hylobius abietis*. The aim of the present work is to determine the effect of the tobacco preparations on the feeding of large pine weevils on pine twigs.

## METHODOLOGY

The overground parts of the plant were collected during the flowering peak of tobacco. The plant preparations were either in the form of juice or derived from dried leaves: aqueous suspension of powder, cold extract, infusion and hot extract. Dextrin in the amount of 3% (by weight) was added to all preparations in order to increase their adherence.

The method of evaluation of influence of plant preparations on the feeding rate consisted in dipping of the test sections of pine twigs in individual preparations and subsequent feeding of thus prepared twigs to the beetle. The sections of fresh pine twigs were dipped in respective preparations and, as a control group, in 3% dextrin water solution.

Experiment for each preparation consisted of 12 Petri glasses of 20 cm diameter. 6 sections of preparation-dipped pine twigs, 6 control twigs and 30 large pine weevils of random sex were placed in each glass. Prior to their use in the experiment, the insects were not fed for 24 hours. The experiment time was 6 hours. Afterwards, the size of bark damages was determined and measured in square millimeters.

The results of feeding reactions were processed with application of the Student's t-test for paired samples. The statistical analysis was performed with the STATISTICA 5.1\* software by StatSoft. The ratio of males to females was 1:1.

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\* StatSoft, Inc. (1997). STATISTICA for Windows [Computer program manual]. Tulsa, OK: StatSoft, Inc., 2300 East 14th Street, Tulsa, OK 74104, phone: (918) 749-1119, fax: (918) 749-2217, e-mail: info@statsoftinc.com, WEB: <http://www.statsoft.com>.

## RESULTS AND DISCUSSION

On the basis of the conducted experiments, it has been found that all tested preparations limited feeding of large pine weevils on pine twigs in a statistically significant manner (Table 1).

Since the preparations were tested in separate experiments, it is impossible to apply tests for direct comparison of their effectiveness. For that reason, in order to directly compare the results, the absolute deterrence ratio has been used – ADR [Kiełczewski et al. 1979, Wyrostkiewicz 1992, Wyrostkiewicz et al. 1996].

Table 1. Average size of damages caused by large pine weevil on twigs treated with different preparations of tobacco (*Nicotiana tabacum*) and evaluation of significance of differences between treatments, mm<sup>2</sup>

Tabela 1. Średnia wielkość uszkodzenia kory przez chrząszcze szeliniaka sosnowca pod wpływem preparatów z tytoniu szlachetnego (*Nicotiana tabacum*) oraz ocena istotności różnic między zabiegami, mm<sup>2</sup>

Type of preparation Rodzaj preparatu	Treatment Zabieg	Mean Średnia	Difference significance (t value) Istotność różnicy (wartość t)	Manner of action Wykazane działanie
Juice Sok	control kontrola	99.7	5.1425***	deterrent deterent
	preparation preparat	41.3		
Powder Proszek	control kontrola	169.1	6.6363***	deterrent deterent
	preparation preparat	45.4		
Infusion Napar	control kontrola	137.9	4.7850***	deterrent deterent
	preparation preparat	80.4		
Hot extract Wywar	control kontrola	128.9	2.4024*	deterrent deterent
	preparation preparat	90.8		
Cold extract Nastój	control kontrola	218.4	10.1733***	deterrent deterent
	preparation preparat	82.3		

\*Statistically significant difference with 95% probability.

\*\*Statistically significant difference with 99% probability.

\*\*\*Statistically significant difference with 99.9% probability.

\*Różnica statystycznie istotna z prawdopodobieństwem 95%.

\*\*Różnica statystycznie istotna z prawdopodobieństwem 99%.

\*\*\*Różnica statystycznie istotna z prawdopodobieństwem 99,9%.

Absolute deterrence ratio (ADR):

$$ADR = \frac{(K - T)}{(K + T)} \cdot 100$$

where:

K – feed mass in control group,

T – feed mass in tested group.

On the basis of obtained ratios, it may be stated that the most effective preparation was the aqueous suspension of powdered plant, whereas the least effective was the hot extract. Also highly effective in deterring of large pine weevils were the cold extract and juice (Fig. 1).

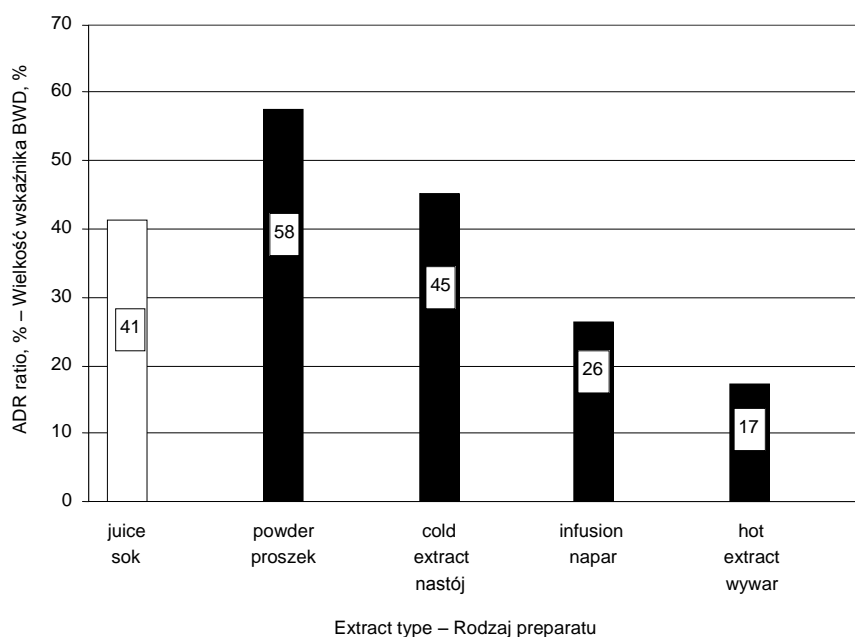


Fig. 1. Deterring effectiveness of *Nicotiana tabacum* preparations  
Rys. 1. Efektywność deterentna preparatów z *Nicotiana tabacum*

It is likely that the effectiveness of preparations is highly dependent upon the manner of preparation. Apart from direct antifeedant action of the aqueous suspension of powder, mechanical barrier may be of certain importance. The factors which presumably decrease the deterring activity of preparations are high temperature and the time of its action. It is confirmed by the fact that the preparations in which hot water was involved, show lowest ADR ratio. For example, the ADR for the infusion obtained by directly adding hot water to dried plants equalled 26% whereas the hot extract obtained by boiling previously soaked plants for 10 minutes scored ADR = 17%.

It is possible that these factors trigger the change of nicotine concentration in preparation – the content of this basic alkaloid in the tobacco leaves varies between 6 and 7 per cent [Rejewski 1992] which may affect its effectiveness. However, this may be confirmed after having conducted biochemical tests. It should be noted that the research by Korczyński and Kuźmiński [2007 a] did show neither a statistically significant influence of the tobacco leaves oil extract on the feeding of large pine weevil nor the influence of the smell of the tobacco alcohol extract on movement of pine weevils [2007 b], even though the alcohol extract exerted statistically significant deterring activity [Korczyński and Kuźmiński 2009]. It may lead to a conclusion that crucial factor determining the effectiveness of the preparation is the manner it is prepared in.

In conclusion, it should be stated that the water preparations from green parts of common (cultivated) tobacco limited the feeding of pine weevil on pine twigs, regardless of the manner of preparation. However, due to the ease of application of liquids in protection measures, simplicity of preparation of cold extract and its high effectiveness (higher than that of fresh juice) it seems that it is the most suitable preparation for practical use.

Obtaining of satisfying results of field study may allow for alternative use of the tobacco which may constitute an advantage for agriculture.

## CONCLUSIONS

1. Common (cultivated) tobacco – *Nicotiana tabacum* contains substances limiting the feeding of large pine weevils.
2. All tested tobacco-based preparations have shown deterring activity towards large pine weevils.
3. The effectiveness of preparations may be highly affected by the manner of preparation, hence various types should be tested.

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**PREPARATY ROŚLINNE JAKO POTENCJALNE ŹRÓDŁO  
ANTYFIDANTÓW. WPŁYW PREPARATÓW  
Z TYTONIU SZLACHETNEGO – *NICOTIANA TABACUM* L.  
NA CHRZĄSZCZE SZELINIAKA SOSNOWCA – *HYLOBIUS ABIETIS* (L.)**

**Streszczenie.** Praca jest fragmentem cyklu szczegółowych badań nad wpływem substancji pochodzenia roślinnego na chrząszcze *Hylobius abietis*. Celem jej było określenie wpływu preparatów otrzymanych z tytoniu szlachetnego na wielkość żerów chrząszczy szeliniaka sosnowca na gałązkach sosny. Badania zostały wykonane w warunkach laboratoryjnych. Preparaty roślinne przygotowywano w postaci soku, nastoju, naparu i wywaru oraz zawiesiny wodnej proszku. Wykazano statystycznie istotne zmniejszenie wielkości uszkodzeń na gałązkach sosnowych traktowanych każdym z testowanych preparatów.

**Słowa kluczowe:** szeliniak sosnowiec, *Hylobius abietis*, preparaty roślinne, antyfidanty, deterenty, tytoń szlachetny, *Nicotiana tabacum*

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