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THE EFFECT OF METHANOLIC EXTRACTS OF SELECTED PLANT SPECIES ON FEEDING OF LARGE PINE WEEVIL *HYLOBIUS ABIETIS* (L.) BEETLES*

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Abstract. The aim of the study was to verify whether methanolic extracts prepared from plants of 26 selected species contained substances reducing feeding of *Hylobius abietis* beetles on shoots of *Pinus sylvestris.* Experiments were conduced under laboratory conditions. A statistically significant reduction in the size of damage was recorded on pine twigs treated with methanol extracts of leaves of *Trifolium repens*, *Lupinus polyphyllus*, *Robinia pseudoacacia*, *Tanacetum vulgare*, *Nicotiana tabacum*, *Sambucus nigra*, *Convallaria majalis* and *Lycopersicon esculentum.* Probably the strongest antifeedants were methanolic extracts of leaves of *Lupinus polyphyllus*, *Robinia pseudoacacia* and *Convallaria majalis*.

Key words: *Hylobius abietis*, methanolic extracts, antifeedants, deterrents

INTRODUCTION

Plant origin preparations have been used for centuries to limit the damage caused by some insect species. Such examples include rotenoids obtained from roots of some tropical plants from family *Fabaceae* and genera *Derris*, *Lonchocarpus*, *Tephrosia* and *Milletia.* These plants contain many glycosides, e.g. rotenone, a highly effective insecticide against numerous insect species, unfortunately exhibiting high toxicity also against warm-blooded animals [Goszczyński 1993]. Preparations produced from margosa tree *Azadirachta indica* (A. Juss.) exhibit high effectiveness as deterrents and insecticides [Malinowski 1997]. Natural pyrethrines, which at high insecticide activity exhibit low toxicity against mammals, may be obtained from flowers of different *Chrysanthemum* spp. [Goszczyński 1993]. Synthetic pyrethroids, exhibiting similar properties, have found wide applications in plant protection.

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At present, in connection with increased requirements connected with environmental protection, attempts are being undertaken with increasing frequency to implement natural origin preparations in plant protection practice. It seems that this type of preparations may be used against some polyphagous forest insects [Korczyński 1992]. Studies on the possible applications of plant origin preparations to reduce the harmfulness of pine weevil *Hylobius abietis* (L.) have been carried out for a long time [Korczyński and Ejchorst 2000 a, b, Korczyński and Kowańdy 2001, Korczyński and Owczarek 2001, Kuźmiński 2002 a, b, 2003 a, b, 2004]. Recently Korczyński and Kuźmiński [2007] have analysed e.g. response of pine weevil beetles to the smell of methanolic extracts obtained from 22 plant species and showed that some species exhibited repellent action against the pine weevil. This study presents the effect of methanolic extracts on feeding of beetles of this species on pine twigs.

MATERIALS AND METHOD

Extracts of 24 plant species were prepared from their dried and powdered leaves. Bulbs were used in case of two species (*Allium cepa* and *Allium sativum*). Extracts were produced by adding 6 g plant powder to 100 g pure methanol. Containers with a suspension of the powder in methanol were stored for 24 h at approx. 22°C. Next the extracts were filtered.

The effect of methanolic extracts on the size of feeding of pine weevils was assessed by supplying beetles with Scots pine twigs immersed for 20 s in a methanolic extract and control twigs treated with pure methanol. After the surface of twigs dried they were placed in Petri dishes together with pine weevils. In each dish there were 6 sections of pine twigs treated with the preparation, 6 sections of control twigs and 20 large pine weevil beetles. In one experiment 8-10 Petri dishes with a diameter of 20 cm and height of 2.5 cm were used.

Beetles of the large pine weevil required for the experiments were caught in central western Poland, in the Oborniki Forest District (the Regional Directorate of State Forests in Poznań). The ratio of males to females was on average 1:1. Pine weevils were pre-starved for 24 h in order to increase their interest in food during the experiment. In the experiments pine weevils could feed on the bark of test twigs for 4 h, after which the size of bark damage caused by beetles was assessed.

In order to analyse the significance of differences between the mean volume of feeding on sections of twigs treated with the preparation and the mean size of feeding on control sections the t Student's test was applied for pairs of observations [Ruszczyc 1978].

RESULTS

Pine twigs treated with methanolic extracts of *Impatiens noli-tangere*, *Urtica dioica*, *Dryopteris filix-mas*, *Brassica oleracea*, *Tilia cordata* and *Allium sativum* were damaged by pine weevils to a higher degree than control twigs (Fig. 1). This may mean that methanolic extracts prepared from the above mentioned plants contain substances

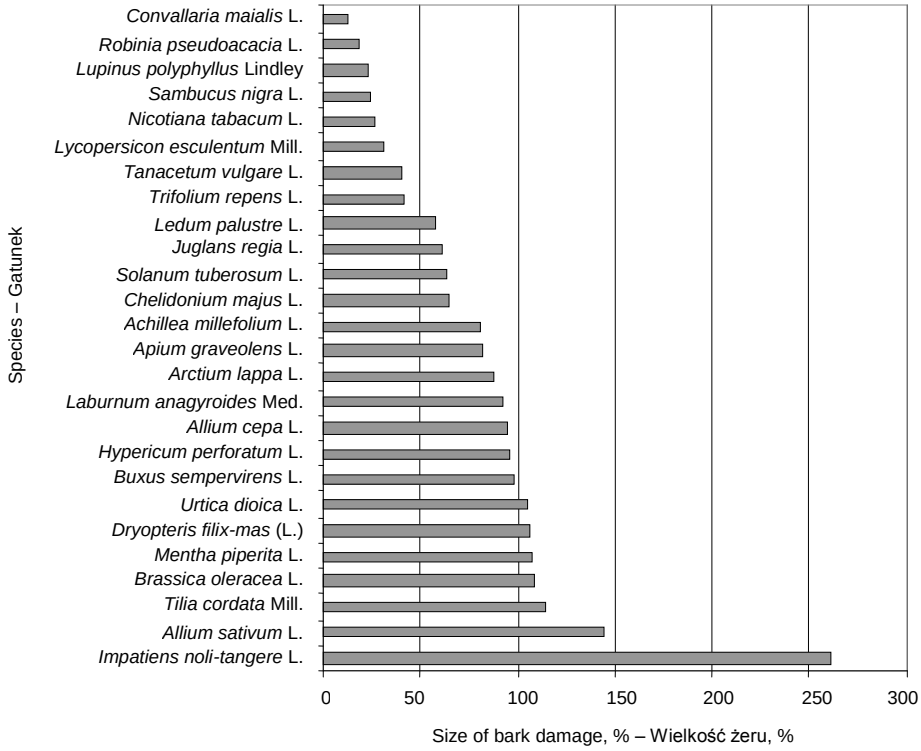

Fig. 1. Relative size of bark damage in relation to the control
Rys. 1. Względna wielkość uszkodzenia kory w stosunku do kontroli

increasing feeding by pine weevils. However, in all cases the differences were statistically non-significant, i.e. they might have been accidental (Table 1).

It needs to be observed that in earlier studies it was found that powder prepared from leaves of *Tilia cordata* attracted pine weevil beetles with its smell [Korczyński and Kuświk 2001]. In contrast, powder preparations from leaves of *Dryopteris filix-mas* to a significant degree reduced the size of damage to pine shoots, caused by pine weevils [Korczyński and Ejchorst 2000 b].

In most experiments presented in this paper it was found that twigs treated with a methanolic extract were damaged to a lesser degree than the control twigs (Fig. 1). It was shown that a statistically significant reduction of feeding by pine weevils on pine twigs occurred under the influence of extracts of plants belonging to the following species: *Trifolium repens*, *Lupinus polyphyllus*, *Robinia pseudoacacia*, *Tanacetum vulgare*, *Nicotiana tabacum*, *Sambucus nigra*, *Convallaria majalis* and *Lycopersicon esculentum.*

In an earlier study [Korczyński and Kuźmiński 2007] it was found that an oil extract of *Lycopersicon esculentum* leaves considerably reduced the size of damage to pine twigs, caused by pine weevils. Since in this study a reduction was shown in feeding by pine weevils under the influence of an extract of *Sambucus nigra*, it should be added here that no such effect had been recorded for the oil extract [Korczyński and Kuźmiński 2007] or powder preparation prepared from plants of this species [Korczyński and Ejchorst 2000 a, b].

Table 1. Damage to bark of pine twigs treated with a methanolic extract and control pine twigs, mm^2

Tabela 1. Uszkodzenia kory gałązek sosnowych traktowanych wyciągiem metanolowym i sosnowych gałązek kontrolnych, mm^2

Family Rodzina	Species Gatunek	Size of damage Wielkość uszkodzeń	
		extract wyciąg x ±SE	control kontrola x ±SE
Papaveraceae	*Chelidonium majus* L.	28.8 ±6.276 a*	44.4 ±8.056 a
Fabaceae	*Trifolium repens* L.	64.4 ±16.540 a	155.6 ±22.876 b
	Lupinus polyphyllus Lindl.	20.4 ±6.240 a	137.6 ±11.048 b
	Robinia pseudoacacia L.	25.2 ±5.200 a	131.2 ±10.976 b
	Laburnum anagyroides Medik.	51.6 ±7.816 a	56.0 ±7.452 a
Compositae	*Tanacetum vulgare* L.	15.6 ±4.192 a	38.8 ±7.304 b
	Arctium lappa L.	52.0 ±7.816 a	56.0 ±9.448 a
	Achillea millefolium L.	52.8 ±16.700 a	65.2 ±11.156 a
Solanaceae	*Lycopersicon esculentum* Mill.	48.0 ±15.992 a	151.2 ±12.548 b
	Solanum tuberosum L.	27.2 ±7.632 a	43.2 ±11.000 a
	Nicotiana tabacum L.	15.6 ±3.744 a	57.6 ±5.848 b
Balsaminaceae	*Impatiens noli-tangere* L.	107.6 ±34.028 a	41.2 ±9.908 a
Urticaceae	*Urtica dioica* L.	61.6 ±9.356 a	58.4 ±8.848 a
Caprifoliaceae	*Sambucus nigra* L.	31.2 ±6.164 a	126.4 ±8.604 b
Dryopteridaceae	*Dryopteris filix-mas* (L.) Schot.	52.8 ±8.172 a	49.6 ±10.452 a
Buxaceae	*Buxus sempervirens* L.	59.2 ±7.792 a	60.4 ±11.148 a
Cruciferae	*Brassica oleracea* L.	81.6 ±15.016 a	75.2 ±7.076 a
Apiaceae	*Apium graveolens* L.	83.2 ±12.856 a	101.2 ±11.624 a
Ericaceae	*Ledum palustre* L.	50.0 ±9.696 a	87.2 ±18.892 a
Juglandaceae	*Juglans regia* L.	31.2 ±7.400 a	50.4 ±11.080 a
Tiliaceae	*Tilia cordata* Mill.	59.6 ±17.184 a	52.0 ±11.456 a
Liliaceae	*Allium sativum* L.	63.2 ±14.652 a	43.6 ±6.064 a
	Allium cepa L.	82.4 ±14.972 a	87.2 ±23.740 a
	Convallaria majalis L.	15.2 ±7.324 a	118.8 ±11.824 b
Lamiaceae	*Mentha piperita* L.	24.0 ±4.772 a	25.6 ±5.372 a
Hypericaceae	*Hypericum perforatum* L.	39.6 ±13.992 a	41.2 ±8.488 a

x – mean.
±SE – standard error of mean.
*If numerical values in a given line are denoted with different letters (a, b), their means differ statistically significantly.
x – średnia.
±SE – błąd standardowy średniej.
*Jeżeli wartości liczbowe w danym wierszu są oznaczone odmiennymi literami (a, b), to średnie różnią się statystycznie istotnie.

CONCLUSIONS

1. Methanolic extracts of leaves of *Trifolium repens*, *Lupinus polyphyllus*, *Robinia pseudoacacia*, *Tanacetum vulgare*, *Nicotiana tabacum*, *Sambucus nigra*, *Convallaria majalis* and *Lycopersicon esculentum* contain substances reducing feeding by beetles of the large pine weevil on shoots of Scots pine.

2. Methanolic extracts of leaves of *Lupinus polyphyllus*, *Robinia pseudoacacia* and *Convallaria majalis* seem to reduce feeding by pine weevils to the highest degree.

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WPŁYW WYCIĄGÓW METANOLOWYCH Z WYBRANYCH GATUNKÓW ROŚLIN NA ŻEROWANIE CHRZĄSZCZY SZELINIAKA SOSNOWCA *HYLOBIUS ABIETIS* (L.)

Streszczenie. Celem badań było sprawdzenie czy ekstrakty metanolowe wykonane z 26 gatunków roślin zawierają substancje zmniejszające żerowanie chrząszczy *Hylobius abietis* na gałązkach *Pinus sylvestris*. Badania zostały wykonane w warunkach laboratoryjnych. Wykazano statystycznie istotne zmniejszenie wielkości uszkodzeń na gałązkach sosnowych traktowanych wyciągiem metanolowym z liści *Trifolium repens*, *Lupinus polyphyllus*, *Robinia pseudoacacia*, *Tanacetum vulgare*, *Nicotiana tabacum*, *Sambucus nigra*, *Convallaria majalis*, *Lycopersicon esculentum*. Prawdopodobnie najsilniejszymi antyfidantami były wyciągi metanolowe z liści *Lupinus polyphyllus*, *Robinia pseudoacacia* i *Convallaria majalis*.

Słowa kluczowe: *Hylobius abietis*, ekstrakty metanolowe, antyfidanty, deterenty

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