EFFECT OF EXTRACTS FROM GERANIACEAE PLANTS ON PIERIS BRASSICAE L.

WPŁYW WYCIĄGÓW Z ROŚLIN BODZISZKOWATYCH NA BIELINKA KAPUSTNIKA

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ABSTRACT

The conducted studies comprised the analyses of activity of extracts derived from selected plants of the Geranium family on some processes of large white butterfly (Pieris brassicae) development (oviposition, survival of eggs and caterpillar feeding). The results proved that all tested extracts showed activity against large white butterfly. Geranium pratense L. and Geranium senquineum L. showed better activity than other Geranium plants. Water extracts from these species protected cabbage plants against laying eggs, while applied on eggs caused their mortality. Alcohol and water extracts from G. pratense L. and water extracts from G. senquineum L. increased an amount of food put on mass gain of caterpillars.

Key words: Pieris brassicae, Geraniacae, plant extracts

ABSTRACT

Analizowano oddziaływanie ekstraktów uzyskanych z wybranych roślin z rodziny Bodziszkowate na: rozwój bielinka kapustnika (przebieg składania jaj, przeżywalność jaj oraz na żerowanie gąsienic). Stwierdzono, że wszystkie testowane wyciągi, wykazywały aktywne działanie w stosunku do bielinka kapustnika. Szczególnie wyróżniały się bodziszek łąkowy i bodziszek czerwony. Wodne wyciągi z tych roślin chroniły rośliny kapusty przed składaniem na nie jaj przez samice, a zastosowane na jaja, powodowały ich zamieranie. Alkoholowy i wodny wyciąg z bodziszka łąkowego oraz wyciąg wodny z bodziszka czerwonego wpływały na zwiększenie ilości pokarmu zużywanego na przyrost masy ciała gąsienic.

Słowa kluczowe: Pieris brassicae, Geraniacae, ekstrakty roślinne

DETAILED ABSTRACT

Celem badań była analiza działania ekstraktów uzyskanych z wybranych roślin z rodziny Bodziszkowate (Geraniaceae), na rozwój bielinka kapustnika (przebieg składania jaj przez samice, na przeżywalność jaj oraz na żerowanie gąsienic).

W badaniach testowano alkoholowe i wodne ekstrakty uzyskane z następujących roślin Bodziszkowatych: Pelargonia – Pelargonium x hortorum Bailey, Iglica pospolita – Erodium cicutarium L., Bodziszek czerwony – Geranium senquineum L., Bodziszek błotny – Geranium palustrae L., Bodziszek łąkowy – Geranium pratense L., Bodziszek żałobny – Geranium phaeum L., Bodziszek cuchnący – Geranium robertianum L.

W warunkach polowych testowano wodne wyciągi roślinne. Rośliny kapusty opryskiwano testowanymi wyciągami bezpośrednio przed okresem masowego składania jaj przez motyle bielinka kapustnika. Prowadzono obserwacje nad przebiegiem składania jaj oraz analizowano wpływ testowanych ekstraktów na rozwój jaj bielinka na roślinach.

Obserwacje nad wpływem alkoholowych i wodnych ekstraktów roślinnych, na intensywność żerowania gąsienic prowadzono w laboratorium. Na podstawie uzyskanych różnic pomiędzy masą liści i gąsienic, przed rozpoczęciem i po zakończeniu doświadczenia, ustalano: masę pokarmu zjedzonego przez gąsienice, ilość pokarmu zużytego na przyrost 1 mg masy ich ciała oraz obliczano bezwzględny wskaźnik deterentności.

W wyniku przeprowadzonych doświadczeń stwierdzono, że wszystkie testowane wyciągi z roślin bodziszkowatych, wykazują aktywne działanie w stosunku do bielinka kapustnika. Analiza ich oddziaływania na przebieg składania jaj przez samice oraz na rozwój jaj wykazała, że szczególnie wyróżniają się bodziszek łąkowy i bodziszek czerwony. Wodne wyciągi z tych roślin chronią rośliny kapusty przed składaniem na nie jaj, a zastosowane na jaja, wpływają na ich zamieranie. Analiza wartości bezwzględnego wskaźnika deterentności wskazuje, że żerowanie aktywniej ograniczają ekstrakty alkoholowe z badanych roślin. Najsilniejsze działanie antyfidantne wykazują alkoholowe i wodne ekstrakty z bodziszka łąkowego i bodziszka cuchnącego. We wszystkich kombinacjach doświadczalnych stwierdzono niewielkie przyrosty masy ciała gąsienic w porównaniu do uzyskanych w kombinacjach kontrolnych.

Przyczyną takiego oddziaływania, są zapewne różnice w zawartości wtórnych metabolitów roślinnych o charakterze allelozwiązków, które są czynnikami regulującymi zachowanie owadów [4, 5, 6, 8, 11]. Rośliny bodziszkowate zawierają liczne pochodne związków fenolowych. Mogą one pełnić funkcje obronne – przed patogenami lub regulacyjne, jako inhibitory enzymów. Ponadto stanowią najważniejszą barierę przeciwko żerowaniu owadów na roślinach [2].

INTRODUCTION

Chemical pest control involves a regular introduction of new insecticides coupled with the prevention of pests from resistance development. At the same time natural environment and human health protection measures are considered. Today, when integrated methods of insect pest control are widely introduced, there occurs an increase of interest in natural chemicals produced by plants.

Most plants contain or produce compounds showing biological activity against insects. Two types of substances are recognized that play significant role as insecticides or deterrents - basic feeding substances essential for proper metabolism process of insects and secondary plant's metabolites negatively affecting on insect biology. These compounds disturbing either growth or development of pests can be utilized in control of their populations. Moreover, plant substances introduced into environment do not pose a contamination risk due to degradation process. In addition they do not show negative influence on plants [1, 4, 6, 7, 9, 11].

The research hypothesis assumed that the compounds of secondary metabolism found in Geraniaceae plants can effect insect population.

The aim of conducted investigation was an analysis of activity of extracts obtained from selected plants of Geranium family against laying process of eggs, survival of eggs and caterpillar feeding.

MATERIAL AND METHODS

The studies included an alcohol and water extracts obtained from the following Geranium plants: Pelargonium x hortorum Bailey, Erodium cicutarium L., Geranium sanquineum L., Geranium palustre L., Geranium pratense L., Geranium phaeum L., Geranium robertianum L.

Alcohol extracts were prepared according to method described by Kiełczewski et all. [3] and water extracts according to Wyrostkiewicz [12]. Sandovit liquid was added to decrease surface pressure.

Studies were carried out in field and laboratory conditions. Water extracts were tested in field conditions on plots 5x5 m each. Five plants treated as replications were selected for the observations. Two experiments were carried out. In the first experiment cabbage plants were sprayed with the tested compounds directly before mass oviposition of P. brassicae (50ml on the plant). The observations on

Table 1 Influence of extracts from *Geranium* plants on caterpillar feeding of *Pieris brassicae*
Tabela 1 Wpływ wyciągów z roślin bodziszkowatych na żerowanie gąsienic bielinka kapustnika

Plants Rośliny	Absolute coefficient od deterrence Bezwzględny wskaźnik deterentności		Changes of the body mass Zmiany masy ciała (mg)		Food consumption per 1mg of the body weight increase Zużycie pokarmu na przyrost 1mg masy ciała (mg)	
	Alcohol extracts Wyciągi alkoholowe	Water extracts Wyciągi wodne	Alcohol extracts Wyciągi alkoholowe	Water extracts Wyciągi wodne	Alcohol extracts Wyciągi alkoholowe	Water extracts Wyciągi wodne
Pelargonium	36,2	2,6	40	106	4,4	4,1
E. cicutarium	36,2	25,3	24	32	6,9	6,8
G. senquineum	23,8	8,2	40	26	5,6	11,1
G. palustrae	28,6	17,7	31	27	9,1	7,8
G. pratense	49,8	41,9	21	20	11,6	10,6
G. phaeum	31,2	26,5	24	27	8,1	7,6
G. robertianum	39,3	47,2	20	24	8,0	5,4
Control+Sandowit			70	70	7,9	7,9
Control Kontrola			84	84	8,3	8,3
LSD (0,05)			24,123	30,147	5,592	5,517

course of oviposition process were performed after 2 and 4 days and each time number of eggs laid deposits was recorded. The purpose of the second experiment was to analyze the influence of tested extracts on development of eggs. The eggs (1-2 days old) already laid on cabbage plants were treated with water extracts and 2, 4 and 6 days after application, a number of dying eggs was estimated.

The investigations on an influence of water and alcohol extracts on intensity of caterpillar feeding were performed in laboratory conditions. Caterpillars stage L4 of Pieris brassicae , were collected from cabbage in the field. Weighed cabbage leaves were immersed in extract solutions and after drying out placed in Petri dishes. Next, 10 earlier weighed caterpillars at stage L4 , were put on each dish with cabbage leaves. and after 48 hours both leaves and larvae were weighed again. Each combination included three repetitions. Two control tests were made: with leaves treated with water and Sandowit, and with dry leaves. The differences between a weigh before and after a test became a base for the following parameters: amount of food eaten by caterpillars, amount of food put on mass gain of 1 g of a caterpillar and also an absolute index of deterrence (aid) according to a formula [3]:

$$aid = (K - T) : (K + T) \times 100.$$

Where:

K = amount of food eaten in control

T – amount of food eaten in a tested treatment

The obtained data were statistically analysed. The object averages were estimated by means of T-Tuckey test.

RESULTS

1. The influence of tested plant extracts on oviposition of large white butterfly females and also egg development

It was recorded that 2 and 4 days after application of water extracts from G. sanquineum, G. palustre and G. pratense there were no eggs laid on plants. Meanwhile, on plants treated with extracts from G. robertianum and E. cicutarium number of egg deposits was similar to control value (Fig. 1).

The observations of the influence of tested extracts on egg development of P. brassicae comprised recording dead eggs in deposits i.e. eggs not developing, dried and darken (Fig. 1). Considerable differences of eggs' conditions in particular experimental extracts were noted 6 days after treatment. The highest mortality (68%-43%) was recorded in treatments with G. pratense, G. sanquineum and G. palustre extracts. The lowest mortality (13%-16%) was defined for Pelargonium x hortorum and G. phaeum.

2. The influence of tested plant extracts on feeding of P. brassicae caterpillars

The analysis of the absolute index of deterrence (aid) describing the differences between amount of food eaten up by caterpillars in control and treatments indicate that alcohol extracts suppressed feeding process better than water extracts (Tab.1). The alcohol and water extracts from G. pratense and G. robertianum showed the strongest antifidant activity (aid ranged from 49.8 to 39.3). The extracts from other tested Geranium plants demonstrated weaker activity against P. brassicae.

The mass gain of caterpillars was stated in all experimental treatments (Tab. 1). However, the gains were not high (except for the test with water extract from pelargonium) as compared to the control.

The calculated amount of food used for mass gain of 1 mg of a caterpillar body indicate an increas of consumption of food by caterpillars treated with alcohol and water extracts from G. pratense and alcohol extract from G. palustre and water extract from G. sanquineum (Tab. 1).

DISCUSSION

The results obtained in the conducted studies allow concluding that all tested extracts from Geranium plants have indicated activity against large white butterfly. The activity of G. pratense and G. sanquineum was distinct. The water extracts from these species protected cabbage plants against egg lying and showed negative influence on large white butterfly development causing high mortality of laid eggs. The alcohol and water extracts from these plants also increased the amount of food put on mass gain of caterpillars.

The reasons of this interaction are probably differences in a content of secondary plant metabolites, which as allelo-compounds can affect insects' behavior. Allelo-compounds control a choice of host plants and can stimulate [8] or determine a process of egg lying [5, 11], and also affect insects' growth and behavior and take part in evolutionary processes.

Geranium plants contain numerous derivatives of phenol compounds and among other things gallic acid. Gallic acid is 3,4,5-trihydroxybenzoic acid and substrate taking part in different condensations what results in forming of tannins. Plants that are more frequently expose to either insect or other pathogen infections comprise more tannins. A synthesis of these compounds is also a response of a plant to insect infestation. Condensed tannins contain flavine structures. They can play protection role against pathogens or regulatory as enzyme inhibitory. Supposedly biological activity of tannins is related with inhibition of activity of some enzymes. Moreover, tannins are the most important barriers against feeding of insects on plants [2].

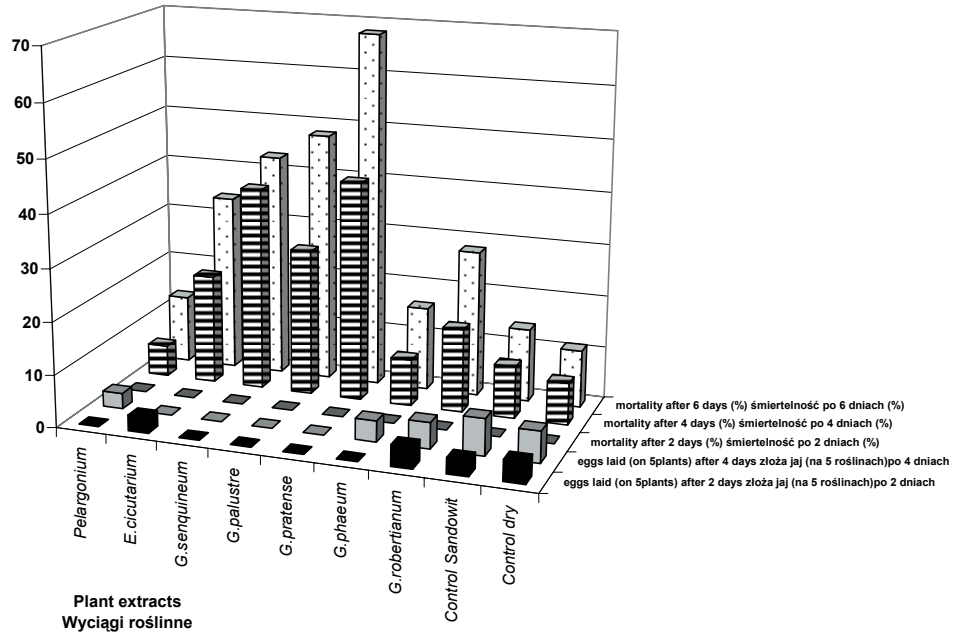

Fig. 1 Effect of water plant extracts on laying eggs and mortality of eggs

Ryc 1. Wpływ wodnych wyciągów roślinnych na składanie jaj i śmiertelność jaj

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