

FLEA BEETLES (CHRYSOMELIDAE: ALTICINAE) SPECIES OCCURRING ON AMARANTHUS spp. IN SLOVAKIA

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ABSTRACT

Occurrence and abundance of flea beetle species associated with *Amaranthus* spp. was studied in Slovakia with the aim to assess their potential as biological control agents. Insects were collected by sweeping/catching at 10 localities three times during the growing season. Together 13 species from the subfamily Alticinae were collected on *A. retroflexus* L. and *A. caudatus* L. plants by sweeping net. They were *Altica oleracea* (L.), *Chaetocnema concinna* (Marsh.), *C. leavicolis* Thoms., *C. tibialis* (Ill.), *Longitarsus longipennis* Kutsch., *L. melanocephalus* Deg., *L. nasturtii* (F.), *L. pellucidus* Foudras, *Phyllotreta atra* (F.), *P. cruciferae* (Goeze), *P. nigripes* (F.), *P. vittula* (Redt.) and *Psylliodes chrysocephala* (L.). *C. tibialis* contained 41.17- 97.45 percent of all flea beetles population and it was found at all observed localities. It comprised 94.85-99.74 percent of flea beetles on cultivated *A. caudatus*. Another two *Chaetocnema* species, *C. concinna* and *C. leavicolis* did not overcome more than one percent of *C. tibialis* population. *P. vittula* was present at each locality. All the other species occurred on *Amaranthus* plants were probably concomitant. Species composition of subfamily Alticinae on cultivated species *A. caudatus* did not differ significantly from those on *A. retroflexus*.

KEYWORDS : *Amaranthus*, biological control, flea beetles, Alticinae

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Introduction

Amaranthus spp. belong to the most important weeds in Europe [25], including Slovakia [6]. It was the reason why this weed was chosen for biological control research within the framework of COST (European Cooperation in the Field of Scientific and Technical Research) – Action [17]. The aim of the *Amaranthus* working group was to study potential biological control agents.

The pigweed flea beetle *Disonycha glabrata* (F.) was found suppressing pigweeds in South America [2, 30] and this species is still being promoted as a biological control agents in warm areas of U.S.A. [29].

In the Palearctic, most flea beetle species belong to cosmopolitan genera *Altica*, *Aphthona*, *Chaetocnema*, *Epitrix*, *Longitarsus*, *Neocrepidodera*, *Phyllotreta* and *Psylliodes*. Many of them are economically important pests. Some are considered highly beneficial for their role in suppressing noxious weeds [13]. According to literature in Europe, only *Chaetocnema tibialis* (Ill.) was reported as a host for *Amaranthus hybridus* and *A. retroflexus* [7, 20].

The aim of this study was to collect information on occurrence and abundance of flea beetle species associated with *Amaranthus retroflexus* L. in Slovakia. Because cultural species of *Amaranthus* are also grown in Slovakia (even on small areas), the surveys on *Amaranthus caudatus* L. – a cultural species, were conducted in the same time.

Methods

In 1995-1997, field surveys of flea beetles (Chrysomelidae: Alticinae) associated with *Amaranthus retroflexus* L. (wild species) and *Amaranthus caudatus* L. (cultivated species) plants were carried out in the first week of July, August and September at 10 localities from different climatic regions of Slovakia characterised according to Koneček [12]. The characteristic of surveyed localities is in Table 1a.

Table 1a. Characteristic of localities regularly surveyed in the study

Locality	Geographic coordinates	Relief	Altitude (m)	Climatic region [12]
Trebišov	48°36'N 21°43' E	Plain	109	warm, temperate dry
Neded	48°01'N 17°58' E	Plain	111	warm, dry
Kamenica nad Hronom	47°50'N 18°44' E	Hilly	117	warm, dry
Nitra – Janíkovce	48°18'N 18°08' E	Plain	135	warm, temperate dry
Vranov	48°51'N 21°43' E	Hilly	145	warm, temperate wet
Nitra – Malanta	48°19'N 18°09' E	Hilly	180	warm, temperate dry
Bátka	48°23'N 20°12' E	Hilly	200	warm, temperate dry
Sliač	48°08'N 19°08' E	Basin	300	warm, temperate wet
Spišské Podhradie	49°00'N 20°47' E	Basin	435	cold
Liptovský Hrádok	49°03'N 19°44' E	Basin	654	cold

Insects were collected by sweeping/catching (3 x 25 randomly chosen plants). Because *Amaranthus* plants were different in size, a stem length of 1m was used as the "standard plant".

Collected insects were put to death, sorted and identified.

Adults of *C. concinna* and *P. vittula* were put in Petri dishes together with the leaves of *A. retroflexus* and *A. caudatus*. During seven days the Petri dishes were checked for the damage of leaves caused by feeding of flea beetles.

Results

Together 13 species from the subfamily Alticinae were collected on *A. retroflexus* and *A. caudatus* plants by sweeping net in Slovakia. They were *Altica oleracea* (L.), *Chaetocnema concinna* (Marsh.), *C. leavicolis* Thoms., *C. tibialis* (Ill.), *Longitarsus longipennis* Kutsch., *L. melanocephalus* Deg., *L. nasturtii* (F.), *L. pellucidus* Foudras, *Phyllotreta atra* (F.), *P. cruciferae* (Goeze), *P. nigripes* (F.), *P. vittula* (Redt.) and *Psylliodes chrysocephala* (L.).

Genus *Chaetocnema* was predominated almost at each locality. The most numerous species was *C. tibialis* (Table 1).

Table 1. Number of *Chaetocnema tibialis* (Ill.) adults on *Amaranthus retroflexus* L. and *Amaranthus caudatus* L. (only at the locality Nitra - Malanta*) plants at different localities of Slovakia during 1995-1997. Insects were collected by sweeping net on 75 plants.

Year Month Locality	1995			1996			1997		
	July	August	Sept.	July	August	Sept.	July	August	Sept.
Trebišov	8	7	11	20	91	20	22	22	6
Neded	125	76	52	7	7	25	19	4	0
Kamenica nad Hronom	45	209	36	273	502	163	12	5	0
Nitra - Janíkovce	6	30	80	15	210	74	8	5	8
Vranov	4	3	7	14	29	16	3	0	0
Nitra - Malanta*	31	86	79	213	30	4	6	25	2
Nitra - Malanta	3	318	84	7	237	52	3	1	0
Bátka	41	157	78	2	36	6	5	4	1
Sliač	10	162	23	2	5	0	2	1	0
Spišské Podhradie	0	1	9	5	3	3	3	2	7
Liptovský Hrádok	3	1	4	1	0	6	2	1	2

In the west of Slovakia the population of this species was higher than it was in the east of Slovakia. *C. tibialis* contained 41.17-97.45 percent of all flea beetles population and it was found at all observed localities. Another two *Chaetocnema* species, *C. concinna* and *C. levicollis* did not overcome more than one percent of *Ch. tibialis* population.

Flea beetles (Chrysomelidae: Alticinae) species occurring on *Amaranthus* spp. in Slovakia

Phyllotreta sp. was the second numerous genus observed on *A. retroflexus* plants. *P. vittula* was the most abundant species within of this genus (Table 2) and the number of individuals ranged from 4.25 to 70.00 percent of flea beetles population.

Table 2. Number of *Phyllotreta vittula* (Redt.) adults on *Amaranthus retroflexus* L. and *Amaranthus caudatus* L. (only at the locality Nitra – Malanta*) plants at different localities of Slovakia during 1995-1997. Insects were collected by sweeping net on 75 plants.

Year	1995			1996			1997		
	July	August	Sept.	July	August	Sept.	July	August	Sept.
Locality									
Trebišov	14	1	7	41	44	2	10	2	1
Neded	7	2	11	0	2	9	2	2	1
Kamenica nad Hronom	5	0	8	69	1	7	14	4	1
Nitra - Janíkovce	1	2	8	3	3	3	6	1	0
Vranov	5	4	3	11	23	0	1	1	0
Nitra - Malanta*	0	0	0	4	2	1	1	0	0
Nitra - Malanta	6	8	3	2	17	0	3	0	0
Bátka	1	1	17	1	1	1	5	0	0
Sliač	3	2	7	2	12	0	2	1	0
Spišské Podhradie	0	2	0	0	16	10	0	0	0
Liptovský Hrádok	0	1	4	0	4	2	1	0	0

Its occurrence was higher in the east of Slovakia during 1995-96. The species was present at each locality. In 1997 the population was relatively high also in the west of Slovakia, but it was not found at cold locality of east Slovakia – Spišské Podhradie.

Laboratory tests showed that *C. tibialis* adults fed on *A. retroflexus* and *A. caudatus* leaves. The adults of *P. vittula* did not feed the leaves of both amaranth species.

P. atra was collected at 9 from 11 observed localities (Table 3) and its population did not exceeded 7.32 percent of flea beetle population.

Table 3. Number of *Phyllotreta atra* (F.) adults on *Amaranthus retroflexus* L. and *Amaranthus caudatus* (only at the locality Nitra – Malanta*) plants at different localities of Slovakia during 1995-1997. Insects were collected by sweeping net on 75 plants.

Year	1995			1996			1997			
	Month	July	August	Sept.	July	August	Sept.	July	August	Sept.
Locality										
Trebišov	0	0	0	2	5	0	0	0	0	0
Neded	0	0	1	0	0	1	0	0	0	0
Kamenica nad Hronom	0	0	0	7	0	0	0	0	0	0
Nitra - Janíkovce	0	0	0	1	0	0	1	0	0	0
Vranov	0	0	0	0	0	0	0	0	0	0
Nitra - Malanta*	0	0	0	8	2	2	0	0	0	0
Nitra - Malanta	4	17	4	4	0	0	0	1	0	0
Bátka	0	0	0	0	3	0	0	0	0	0
Sliač	0	0	0	0	1	0	0	0	0	0
Spišské Podhradie	0	0	0	0	1	0	0	0	0	2
Liptovský Hrádok	0	0	0	0	0	0	0	0	0	0

P. nigripes was found only randomly and its maximum proportion was 0.85 percent of flea beetles population. *P. cruciferae* was observed once during three years at locality Nitra - Malanta (Table 5).

L. pellucidus was common *Amaranthus* plants (Table 4) in Slovakia. It occurred at all localities, except of Neded (west of Slovakia).

Flea beetles (Chrysomelidae: Alticinae) species occurring on *Amaranthus* spp. in Slovakia

Table 4. Number of *Longitarsus pellucidus* Foudras adults on *Amaranthus retroflexus* L. and *Amaranthus caudatus* (only at the locality Nitra - Malanta*) plants at different localities of Slovakia during 1995-1997. Insects were collected by sweeping net on 75 plants.

Year Month Locality	1995			1996			1997		
	July	August	Sept.	July	August	Sept.	July	August	Sept.
Trebišov	0	0	0	0	1	1	0	0	1
Neded	0	0	0	0	0	0	0	0	0
Kamenica nad Hronom	0	0	1	0	1	0	0	1	0
Nitra - Janikovce	0	0	0	0	0	0	0	1	0
Vranov	0	0	0	0	1	0	0	0	0
Nitra - Malanta*	0	0	0	0	1	1	1	1	0
Nitra - Malanta	0	1	0	0	0	0	0	2	0
Bátka	0	3	0	0	0	1	0	0	0
Sliač	0	0	0	3	0	5	0	0	0
Spišské Podhradie	0	0	0	0	1	0	0	0	0
Liptovský Hrádok	0	0	0	0	1	0	0	0	3

The highest numbers of *L. pellucidus* were observed in Sliač (18.6% of all flea beetles collected) and Liptovský Hrádok (33.3%). The other *Longitarsus* species (*L. longipennis*, *L. melanocephalus*, *L. nasturtii*) were present on a few localities in a small scale (Table 5).

Table 5. Number of adults of seven Alticinae species on *Amaranthus retroflexus* L. and *Amaranthus caudatus* (only at the locality Nitra - Malanta*) plants at different localities of Slovakia during 1995-1997. Insects were collected by sweeping net on 75 plants. PN - *Phyllotreta nigripes* (F.), PC - *Phyllotreta cruciferae* (Goeze), PH - *Psylliodes chrysocephala* (L.), AO - *Altica oleracea* (L.), LN - *Longitarsus nasturtii* (F.), LM - *Longitarsus melanocephalus* Deg., LL - *Longitarsus longipennis* L.

Year Month Locality	1995			1996			1997		
	July	August	Sept.	July	August	Sept.	July	August	Sept.
Trebišov	0	AO	LN	0	0	0	PN	0	AO
Neded	0	AO	AO	0	LN	LN	0	0	0
Kamenica nad Hronom	0	LN	0	0	AO	0	0	0	0
Nitra - Janikovce	0	0	0	PH	0	0	0	0	0
Vranov	PH	PH	PH	0	LM	0	0	0	PH
Nitra - Malanta*	0	0	0	PN	PC	0	PN	0	PH
Nitra - Malanta	PN	PN	0	PN	AO	AO	0	0	AO
Bátka	0	0	LN	0	0	0	0	0	0
Sliač	0	0	0	0	0	0	0	0	0
Spišské Podhradie	0	0	0	0	0	0	0	0	AO
Liptovský Hrádok	LL	0	0	0	0	0	0	0	0

A. oleracea and *P. chrysocephala* were found randomly at some localities (Table 5).

Species composition of subfamily Alticinae on cultivated species *Amaranthus caudatus* did not differ significantly from those on *A. retroflexus* at Nitra- Malanta locality. Predominating species on cultivated species was *C. tibialis*, which formed 94.85-99.74 percent of all flea beetles (Table 1). The species that occurred in a low numbers were *L. pellucidus*, *P. vittula*, *P. atra*, *P. nigripes* and *P. chrysocephala* (Tables 1, 4, and 5).

In average the number of flea beetles species was much lower in 1997 than in previous years. In 1997, high amount of precipitation was observed in July.

Discussion

Of the 13 *Alticinae* flea beetles collected on *Amaranthus* plants only *C. tibialis* and *P. vittula* were found regularly at all observed localities.

From the literature it is known that amaranth plants serve as a host for *C. tibialis* [2, 20, 21]. However, *C. tibialis* is a serious pest of sugar beet in Czech republic and Slovakia (former Czechoslovakia) [22], Portugal [19], Bulgaria [27], or in Turkey [32].

C. concinna is also the pest of sugar beet [4, 16]. During our survey it was present in a very small number on amaranth plants and for that reason the possible damages are economically not important. *C. concinna* and *C. laevicollis* seem to be more important in more wet and cold regions of Europe. Schmidt [24] indicated *C. concinna* as north European sugar beet flea beetle and *C. tibialis* as south European sugar beet flea beetle. *C. concinna* is the most important flea beetle in Great Britain [8].

P. vittula was reported as important pest of cereals [9, 18] and maize [26, 28]. This gives a reason for their higher number on weedy amaranth in maize crop than on cultivated species grown as monoculture. On the other hand, *P. vittula* was reported as a pest of crucifers and sugar beet [18]. It was found feeding on yellow mustard [11]. According to literature it seems that *P. vittula* is relatively polyphagous, but in our laboratory tests it did not feed on amaranth leaves.

All the other species occurred on *Amaranthus* plants were probably concomitant.

P. cruciferae is usual flea beetle on cruciferous plants of central Europa [10, 31]. It is the most abundant at the places of high population densities of *Brassica* spp. [5]. Probably this requirement caused its scarcity on *Amaranthus* plants.

P. atra [10, 14] and *P. nigripes* [14] also attack cruciferous crops. They were found at 9 localities in a small number on *Amaranthus* plants. They are probably common insects in Slovak conditions able to exist not only on cultural but also on wild *Cruciferae*. *P. chrysocephala* is also usual on *Cruciferae* and its occurrence on *Amaranthus* was probably accidental.

L. pellucidus was usual insect collected on *Amaranthus* plants in Slovakia. According to literature, *L. pellucidus* is associated with *Convolvulaceae* [1, 15, 23]. Their presence on *Amaranthus* plants is temporary or because of climbing of *Convolvulus arvensis* on them. *C. arvensis* was often found to climb on *Amaranthus* plants. The host plant of *L. longipennis* is *C. arvensis* [31] and its occurrence on amaranth was probably only accidental. Similarly, host plants of *L. melanocephalus* are plants from the genus *Plantago* [10], and the host plants of *L. nasturtii* are Boraginaceae [10, 31].

A. oleracea is usual on cruciferous plants, and it is dangerous pest of rape [10]. But, it lives on the plants from family Polygonaceae like it is in case of *C. concinna* [31].

Our results showed that flea beetle species, which occurred on wild amaranth, were found also on cultivated species. It is clear that flea beetles occurring on amaranth plants in Slovakia are the pests of cultural crops. Even more, they do not distinguish between wild and cultural amaranth. Probably the same situation could develop when any insect species will be introduced from America.

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Detailed abstract in Slovak

Výskum zameraný na zistenie výskytu a početnosti skoëiek viazaných na druhy z rodu *Amaranthus* sa uskutoënil na Slovensku v rokoch 1995 - 1997 s cieľom stanovi• ich potenciál z pohľadu biologickej ochrany. Hmyz bol zbieraný metódou smýkania na 10 lokalitách, ktoré sa sledovali trikrát poës vegetaëného obdobia. Na druhoch *Amaranthus retroflexus* L. a *A. caudatus* L. bolo zaznamenaných spolu 13 druhov z podë¾ade Alticinae. Patrili k nim *Altica oleracea* (L.), *Chaetocnema concinna* (Marsh.), *C. leavicolis* Thoms., *C. tibialis* (Ill.), *Longitarsus longipennis* Kutsch., *L. melanocephalus* Deg., *L. nasturtii* (F.), *L. pellucidus* Foudras, *Phyllotreta atra* (F.), *P. cruciferae* (Goeze), *P. nigripes* (F.), *P. vittula* (Redt.) a *Psylliodes chrysocephala* (L.). *C. tibialis* tvorila v závislosti od lokality 41.17-97.45 % z populácie všetkých skoëiek a bola zaznamenaná na ka•dej sledovanej lokalite. Na kultúrnom druhu *A. caudatus* predstavovala 94.85-99.74 % zo všetkých skoëiek. Āalšie dva druhy z rodu *Chaetocnema*, *C. concinna* a *C. leavicolis* netvorili viac ako jedno percento z populácie *C. tibialis*. Rod *Phyllotreta* bol pozorovaný ako druhý najpoëetnejší. *P. vittula* sa vyskytovala na ka•dej lokalite a jej zastúpenie sa pohybovalo od 4.25 do 70.00 % z populácie všetkých skoëiek. Všetky ostatné druhy zaznamenané na rastlinách z rodu *Amaranthus* boli pravdepodobne iba sprievodnou faunou. Druhové zlo•enie podë¾ade Alticinae na kultúrnom druhu *A. caudatus* sa podstatne nelíšilo od druhového spektra zaznamenaného na burinnom druhu *A. retroflexus* na lokalite Nitra - Malanta. Prevládajúcim druhom bola *C. tibialis*. Druhy *L. pellucidus*, *P. vittula*, *P. atra*, *P. nigripes* a *P. chrysocephala* sa objavovali v menších množstvách.

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