important weed in rape (Collin, 1999). In Slovakia, rape is a very important and widespread crop and, in spite of this, there is no information about the interaction of rape – *O. ramosa*. It is difficult to say if the reason is different *O. ramosa* strains, or resistant varieties of rape. Ranking tomato cultivars for *Orobanche* resistance indicated the existence of different resistance mechanisms in these cultivars (Qasem, Kasrawi 1995).

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SPREAD OF DODDER (*CUSCUTA* SPP.) IN THE AGROECOSYSTEMS OF SLOVAKIA: IS IT AN EMERGING PROBLEM?

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Summary

During 2000, field surveys of dodder (*Cuscuta* spp.) occurred at cropland were done in Slovakia. From among 150 localities surveyed, 96 have been found infested by dodder. The existence of four dodder species was revealed: *Cuscuta campestris* Yuncker, infested vegetable crops (potato, sugar beet, alfalfa and tobacco) and variety of weeds (together 18 species, especially *Polygonum* spp.), *C. epithymum* (L.) Murr., parasited exclusively on alfalfa and accidentally on weeds growing in this crop, *C. europaea* L. and *C. lupuliformis* Krocker occurred only at field margins, along rivers and roads, where *Urtica dioica* L. and *Rubus* spp. served as hosts. Dodders were distributed throughout south of Slovakia, with maximum occurrence in the western part of state. *C. campestris* was not found in cold climatic regions with altitude higher than 240 m, while *C. epithymum* was recorded up to 398 m and *C. europaea* up to 720 m a. s. l.

Key words: *Cuscuta campestris*, *Cuscuta epithymum*, *Cuscutaceae,* dodder, host plants, distribution

Introduction

Dodders (*Cuscuta* spp.; Cuscutaceae) are annual stem parasites with leafless, thread-like, orange or yellow stems that twine over other plants. They can be problematic in agricultural crops, especially alfalfa, tomatoes, potato and sugar beet. In addition, dodder seed is difficult to exclude from commercial alfalfa, clover, or flax seed (Parker & Riches 1993).
Cuscuta spp. are distributed worldwide (Holm et al. 1979) and have very low host specificity attacking many different host plants simultaneously. Although dicots are preferred, attack on monocots has been observed also. (Erdös 1971, Nikitin 1983).
There is five species from Cuscutaceae known in Slovakia. *Cuscuta epithymum* L., *C. epilinum* Weihe, *C. europaea* L. and *C. lupuliformis* Krocker are native (Dostál & Červenka 1992). Only invaded species is *C. campestris* Yuncker, which was introduced from North America to Europe in 1883 (Jehlík 1998).
Biological control is a particularly attractive means of suppressing dodders in crop because, owing to their intimate relationship with the host plant, it is difficult to apply chemical herbicides in such a way the crop is not adversely affected (CAB, 1987). Hence, it is surprising that little effort has been made to achieve biological control of these weeds worldwide. This study is the first step to biological control of dodders in Slovakia. The aim of this work was to determine the infestation and its extension, the dodder species composition as well as their host range.

Material and methods

During the growing season 2000 the occurrence of *Cuscuta* spp. was observed in the agroecosystems of Slovakia following the natural phenology of dodders. 150 localities were chosen in different geographic and climatic regions. Collections were

made depending on the amount of variation in the geography and land use. Collecting sites were grassy or weedy roadsides, fallow fields and *Cuscuta spp.* – infested cropland planted with various crops. At each locality plants were identified. Identification was based on the flower structure.

Results

Altogether 4 species of dodders were found on 96 different localities in agroecosystems of Slovakia. The complete list of localities visited their associated dodder species and plant species infested is given in Table 1.

Table 1 Host plants and distribution of dodders (*Cuscuta* spp.) recorded in agroecosystens of Slovakia during growing season 2000.

Locality	Coordinates	Altitude (m)	Host plant
***Cuscuta campestris* Yuncker**			
Balog nad Ipľom	48°05'N 19°08'E	145	*Polygonum* spp.
Cabaj Čápor	48°15'N 18°02'E	165	*Polygonum* spp.
Čermany	48°28'N 18°02'E	190	*Polygonum* spp.
Demandice	48°08'N 18°47'E	143	*Nicotiana tabacum* L.
Egreš	48°37'N 21°37'E	153	*Convolvulus arvensis* L., *Sonchus* spp., *Elytrigia repens* (L.) Dev., *Daucus* spp.
Gemerský Jablonec	48°12'N 19°59'E	240	*Polygonum* spp.
Chanava	48°20'N 20°18'E	176	*Polygonum* spp.
Choča	48°22'N 18°20'E	180	*Polygonum* spp.
Iža	47°45'N 18°14'E	109	*Polygonum* spp., *Atriplex tatarica* L.
Jablonica	48°36'N 17°25'E	211	*Polygonum* spp.
Jahodná	48°03'N 17°42'E	110	*Polygonum* spp., *Datura stramonium* L.
Kálna nad Hronom	48°12'N 18°32'E	162	*Polygonum* spp.
Kamenín	47°53'N 18°39'E	127	*Medicago sativa* L., *Artemisia vulgaris* L., *Ambrosia artemisiifolia* L., *Capsela bursa-pastoris* (L.) Med., *Polygonum* spp., *Atriplex* spp.
Komárno - Lándor	47°48'N 18°08'E	109	*Polygonum* spp.
Krakovany	48°37'N 17°46'E	165	*Sonchus* spp., *C. arvensis*, *Polygonum* spp., *Tripleurospermum* spp.
Malé Ludince	47°59'N 18°42'E	136	*Urtica dioica* L., *Sonchus* spp., *C. arvensis*, *Pastinaca sativa* L.
Malé Kosihy	47°55'N 18°45'E	115	*Polygonum* spp., *Atriplex* spp.
Malé Kozmálovce	48°17'N 18°31'E	175	*Sonchus* spp., *Polygonum* spp., *M. sativa*
Maňa	48°09'N 18°17'E	131	*Polygonum* spp.
Michalovce	48°45'N 21°56'E	115	*Polygonum* spp.
Mužľa	47°48'N 18°36'E	121	*M. sativa, Polygonum* spp.
Neded	48°01'N 17°59'E	112	*Polygonum* spp.
Nevidzany	48°17'N 18°23'E	181	*Tripleurospermum* spp., *Polygonum* spp.
Poľný Kesov	48°10'N 18°04'E	172	*Polygonum* spp., *Sonchus* sp.
Olichov	48°21'N 18°29'E	209	*Polygonum* spp.
Selice	48°05'N 17°59'E	113	*D. stramonium*, *Polygonum* spp.
Sikenica	48°07'N 18°46'E	150	*M. sativa, Polygonum* spp.
Sládkovičovo	48°12'N 17°39'E	120	*Polygonum* spp.
Strážske	48°52'N 21°50'E	135	*Polygonum* spp., *Sonchus* spp.
Šamorín	48°02'N 17°19'E	130	*Polygonum* spp., *A. artemisiifolia*
Štefanovičová	48°11'N 18°06'E	160	*Polygonum* spp., *Chenopodium* spp., *Atriplex* spp.
Tehla	48°11'N 18°23'E	180	*Polygonum* spp.
Tesárske Mlyňany	48°20'N 18°22'E	165	*Polygonum* spp.
Trhová Hradská	47°59'N 17°45'E	112	*C. arvensis*, *Polygonum* spp.
Trstice	48°01'N 17°49'E	114	*M. sativa*, *Polygonum* spp., *Tripleurospermum* spp.
Turňa nad Bodvou	48°36'N 20°53'E	190	*Polygonum* spp., *Atriplex* spp.
Urmince	48°32'N 18°06'E	199	*Polygonum* spp.
Veľké Trakany	48°23'N 22°06'E	103	*Daucus* spp., *Polygonum* spp., A. vulgaris

Veľký Ďur	48°12'N 18°27'E	185	*Polygonum* spp., *A. vulgaris*
Veľký Kamenec	48°22'N 21°49'E	124	*Polygonum* spp., *Chenopodium* spp.
Vlkas	48°07'N 18°17'E	130	*Polygonum* spp.
Volkovce	48°20'N 18°28'E	210	*Polygonum* spp.
Zbehy	48°22'N 18°02'E	144	*Polygonum* spp.
Zeleneč	48°20'N 17°36'E	146	*Malva* spp., *Atriplex* spp., *Tripleurospermum* spp., *Polygonum* spp.
Zlaté Moravce	48°23'N 18°24'E	196	*Polygonum* spp.
Želiezovce	48°03'N 18°40'E	137	*Solanum tuberosum* L., *S. nigrum* L., *Amaranthus* spp., *Chenopodium* spp., *Polygonum* spp.
Žitavce	48°12'N 18°18'E	141	*Tripleurospermum* spp., *Polygonum* spp., *Beta vulgaris* L., *C. arvensis*
***Cuscuta epithymum* L.**			
Čajkov	48°17'N 18°36'E	188	*Medicago sativa* L.
Čečejovce	48°36'N 21°04'E	205	*M. sativa*
Červený Hrádok	48°18'N 18°23'E	170	*M. sativa*
Dedina Mládeže	47°56'N 18°00'E	109	*M. sativa*
Dolná Strehová	48°15'N 19°30'E	182	*M. sativa*
Gemerský Jablonec	48°12'N 19°59'E	240	*M. sativa*, *Plantago lanceolata* L.
Hoste	48°16'N 17°38'E	126	*M. sativa*
Imeľ	47°54'N 18°09'E	111	*M. sativa*
Ipeľský Sokolec	48°01'N 18°49'E	116	*M. sativa*, *Chenopodium* spp.
Ivánka pri Nitre	48°14'N 18°07'E	146	*M. sativa*
Jatov	48°10'N 18°06'E	116	*M. sativa* L., *Cirsium arvensis* L.
Jur nad Hronom	48°08'N 18°39'E	146	*M. sativa*, *Plantago* spp.
Kostolné	48°44'N 17°42'E	219	*Medicago sativa* L.
Kubáňovo	48°04'N 18°49'E	127	*M. sativa*, Poaceae
Medzibrod	48°48'N 19°21'E	398	*M. sativa*
Melek	48°12'N 18°20'E	170	*M. sativa*, *Persicaria* spp.
Mochovce	48°16'N 18°27'E	270	*M. sativa*
Myjava	48°45'N 17°34'E	325	*M. sativa*
Nemčiňany	48°18'N 18°28'E	212	*M. sativa*, *Echinochloa crus galli* L.
Nová Ves n/Žit.	48°17'N 18°20'E	164	*M. sativa*
Pastovce	47°58'N 18°46'E	124	*M. sativa*, *Lamium purpureum* L.
Rankovce	48°48'N 21°28'E	364	*M sativa*
Sikenica	48°07'N 18°46'E	150	*M. sativa*, *Daucus carota*
Slepčany	48°19'N 18°20'E	160	*M. sativa*
Šaľa	48°09'N 17°53'E	118	*M. sativa*
Tekovské Nemce	48°22'N 18°32'E	244	*M. sativa, Trifolium pratense*
Veľké Bielice	48°38'N 18°21'E	200	*M. sativa*
Višňové	48°43'N 17°45'E	220	*M. sativa*
***Cuscuta europaea* L.**			
Bíňovce	48°30'N 17°29'E	198	*Urtica dioica* L.
Čamovce	48°15'N 19°53'E	213	*U. dioica*
Drieňov	48°52'N 21°16'E	226	*U. dioica*, *Calystegia sepium* (L.) R. Br.
Dubovec	48°17'N 20°10'E	182	*Rubus* spp., *U. dioica*, *Robinia pseudoacacia* L.
Egreš	48°37'N 21°37'E	153	*U. dioica*
Horná Baba	48°14'N 19°45'E	210	*U. dioica*
Horné Lefantovce	48°25'N 18°09'E	160	*Rubus* spp., *U. dioica*
Horné Vestenice	48°43'N 18°26'E	260	*U. dioica*, *Rubus* spp.
Hostie	48°27'N 18°27'E	290	*U. dioica*, *Rubus* spp.
Koplotovce	48°28'N 17°49'E	165	*Clematis* spp., *Rubus* spp.
Machulince	48°25'N 18°26'E	250	*Rubus* spp.
Malá Lehota	48°30'N 18°34'E	600	*Rubus* spp.
Maňa	48°09'N 18°17'E	131	*U. dioica*
Nevidzany	48°17'N 18°23'E	181	*U. dioica*
Nová Ves n/Žit.	48°17'N 18°20'E	164	*Rubus* spp., *U. dioica*
Obyce	48°26'N 18°27'E	250	*Rubus* spp., *U. dioica*
Pohorelá	48°40'N 20°01'E	720	*Rubus* spp.
Slaská	48°40'N 18°50'E	430	*U. dioica*, *Rubus* spp., *C. sepium*

Spišské Podhradie	49°01'N 20°45'E	450	*U. dioica*
Veľké Pole	48°33'N 18°34'E	580	*Rubus* spp.
Veľké Chyndice	48°17'N 18°18'E	190	*U. dioica*
Závada	48°18'N 19°29'E	230	*Rubus* spp.
Zlatno	48°28'N 18°20'E	340	*U. dioica*, *Rubus* spp.,
***Cuscuta lupuliformis* Krocker**			
Čoltovo	48°30'N 20°23'E	227	*Rubus* spp.

Discussion

While five dodder species, *C. campestris, C. epilinum, C. epithymum, C. europaea* and *C. lupuliformis* are known in Slovakia (Dostál & Červenka, 1992), four of them were recorded during the surveys at agroecosystems in the growing season 2000. The missing species was *C. epilinum*, whose host plant is flax (*Linum usitatissimum* L.). The main reason of its absence is probably decrease of flax growing and the new technology used.
Of the four dodder species recorded at Slovakian cropland only *C. campestris* and *C. epithymum* were found regularly throughout south of Slovakia. *C. campestris* never exceeded 240 m a. s. l. and was found exclusively at the warmest localities of Slovakia, with maximum occurrence in the western part of state. Although distribution of *C. epithymum* was mentioned up to 980 m a. s. l. in Slovakia (Bertová et al. 1988), the maximum altitude recorded during this study was 398 m a. s. l.
From the literature it is known that 85 various crop plants and weeds serve as hosts for *C. campestris* (Erdös 1971). Our findings show crops parasitized by this species included potato (*Solanum tuberosum* L.), sugar beet (*Beta vulgaris* L.), alfalfa (*Medicago sativa* L.) and tobacco (*Nicotiana tabacum* L.). In addition, next 18 plants were found as hosts for *C. campestris*. Within these hosts, *Polygonum* spp. was the most common one occurring on 44 out of 47 localities observed. Similarly Jehlík et al. (1998) cited *Polygonum arenastrum*, *Artemisia vulgaris* and *Atriplex tatarica* like dominant hosts of *C. campestris* in Slovakia. Though in Hungary, *C. epithymum* was registered to grow on 91 host plants from different families (Erdös 1971), it was parasited explicitly on alfalfa and accidentally on weeds (such *as Plantago* spp., *Chenopodium* spp. and *C. arvense*) growing in this crop at Slovakian agroecosystems.
C. europaea L. and *C. lupuliformis* Krocker occurred only at field margins, along rivers and roads, where *Urtica dioica* L. and *Rubus* spp. served as hosts. *C. europaea* was also mentioned to parasite on *Salix* and *Alnus* (Dostál & Červenka 1992). We did not find the infestation of shrubs and trees by the species in Slovakia, with the exception of *Robinia pseudoacacia* infested at locality Dubovec. *C. lupuliformis* was found only at one locality (Čoltovo). This confirms, as stated equally Bertová et al. (1988), the species turn to be more rare in Slovakia because of luck of suitable localities.
Only problematic species are *C. campestris* and *C. epithymum* in the agroecosystems of Slovakia. While, *C. epithymum* is already infesting huge amount of alfalfa fields throughout the state, hitherto *C. campestris* is damaging crops at the warmest localities exclusively. On the other hand, there is a big potential of *C. campestris* to spread into agricultural crops. The reasons for such spread are different. Above all: 1) the great distribution of the main host plant (*Polygonum* spp.) throughout Slovakia and very low host specificity, 2) limited natural enemies of *C. campestris* expected (because it is invasive plants) in order to suppress population density and 3) expected warming, which can make the species more aggressive.
There are many options available to help decrease the crop infestations by dodders such as hand cultivation, spot or field burning, close mowing, later planting time, and crop rotation to cereals or corn (Dawson et al. 1994). Nevertheless, especially *C. epithymum* in alfalfa fields is still remaining a big problem in the south of Slovakia. Here, biological control is a particularly attractive means of suppressing dodders. In this way a search for biological control agents therefore seems to be warranted.

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