Silky Bent Grass (Apera spica-venti [L.] Beauv.) - a New Host and Reservoir of Wheat Dwarf Virus*

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Abstract

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Wheat dwarf virus (WDV) was detected by serological assays and transmission tests in samples of silky bent grass (Apera spicaventi [L.] Beauv) that were taken in the field and showed signs of dwarfing, leaf yellowing and inflorescence reduction. This grass species is a new WDV host, not described until now. Transmission to spring wheat and spring barley demonstrated that silky bent grass is a host of wheat and barley strains of this virus. Transmission tests indicated that this grass is an efficient source of infection for the vector of the virus, the leafhopper Psammotettix alienus Dahlb. Surveys at nine localities revealed a medium to high incidence of WDV in silky bent grass, which is a weed species frequently infesting cereal stands in the Czech Republic. As a natural reservoir of the virus this grass can play an important role in its epidemiology.

Key words: wheat dwarf virus; silky bent grass; reservoir in nature

Wheat dwarf virus (WDV) is a leafhopper-borne gemi- Many plants of silky bent grass with symptoms suggestnivirus (LINDSTEN et al. 1980) described for the first time in the former Czechoslovakia (VACKE 1961). It causes severe damage to winter wheat (Triticum aestivum L. emend Fiori et Paol.) and winter barley (Hordeum vulgare L.) not only in this country, but also in other European countries. The range of its experimentally infected hosts, studied in the early seventies, includes more than 30 plant species of the family Poaceae (VACKE 1972). Avena sativa L., Secale cereale L., Bromus secalinus L. and Lolium multiflorum Lam. were identified as spontaneously infected host plants at that time. In the following years WDV was also isolated from Avena fatua L., B. inermis Leyss., B. tectorum L., Hordeum murinum L., Lolium perenne L. and L. temulentum L. (VACKE 1981)

A strain of WDV adapted to barley and not transmissible to wheat, was identified in the early nineties (LIND-STEN & VACKE 1991). There is also evidence that the virus isolates from wheat that have recently spread in this country are not infective to barley. Besides their ability to infect barley or wheat, or other specific hosts, both strains are serologically identical. They do not differ in other characteristics either. Host plants common for both strains include Avena fatua L., A. sativa L., A. sterilis L., Lagurus ovatus L. and Poa annua L. (LINDSTEN & VACKE 1991).

ing infection by WDV were observed during surveys carried out in fields of winter wheat and winter barley in 1998. Demonstration of a new host of WDV, description of isolates obtained from silky bent grass and the importance of this weed as a source of infection are the subjects of this communication.

MATERIAL AND METHODS

Samples of silky bent grass with virus-like symptoms were taken from winter wheat stands with severe WDV infection and a heavy infestation with this grass species at six localities of the Kroměříž and Vyškov districts, and from winter barley stands at three localities in the Litoměřice district. These samples were used for transmission and other experiments after they were transplanted to flower pots.

Serological detection of WDV in silky bent grass was carried out by DAS ELISA technique, using antibodies produced by the Sanofi company. Leaf samples of the examined plants were frozen before homogenization and sap extraction.

Nymphs and adults of the leafhopper Psammotettix alienus from virus-free greenhouse rearings were used in

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experiments on WDV transmissibility from infected individuals of silky bent grass to indicator species, in experiments aimed at infection of this grass with the type strains of the virus, and in the course of studies on transmission efficiency. The spring wheat cv. Jara was used as an indicator for the wheat strain, while the spring barley cv. Olbram was used for the barley strain. Test plants were inoculated at the stage of two leaves, silky bent grass at the stage of advanced tillering. Three leafhoppers per plant were used for inoculation feeding in experiments on virus transmission to indicator plants, and for experiments on virus reinfection of virus-free silky bent grass. In experiments in which the efficiency of WDV transmission was studied, the vectors were tested individually after acquisition feeding on silky bent grass and control plants. The acquisition feeding period of vectors lasted 3 days, the inoculation feeding period 5 days.

RESULTS

The sap from leaf samples of virus-infected silky bent grass taken in the field showed positive reactions with antibodies to WDV in immunoenzymatic assays. Spectrophotometric absorbancy at a wavelength of 405 nm ranged from 1.627 to 1.791. The values recorded in silky bent grass samples taken from winter barley stands were a little lower than in samples from winter wheat stands. The differences were not significant.

The experiments on WDV transmission from spontaneously infected silky bent grass to the respective indicators of strains, i.e., spring wheat or spring barley, was carried out with groups of leafhoppers of *P. alienus* and yielded positive results. Spring wheat was successfully reinfected with virus from six samples of the grass taken from winter wheat stands that were infected by the wheat strain of WDV; spring barley was reinfected with two of these samples. The virus isolate was successfully transmitted to spring barley from four samples of the grass taken from winter barley stands infected with the barley strain of WDV. These results indicate that silky bent grass is a host of both wheat and barley strains of WDV. This conclusion was also confirmed by the results of an experiment in

which virus isolates were transmitted by individual leaf-hoppers (Table 1). Further affirmation came from infection by the type isolates of the wheat strain, WDV-Ru-W, and of the barley strain, WDV-Ru-B. In this experiment six out of ten seedlings of silky bent grass were infected with the wheat strain, and four of ten seedlings with the barley strain. The symptoms that appeared in infected plants corresponded to those observed in spontaneously infected plants. Presence of WDV was detected by immunoenzymatic assays.

Table 1 deals with the efficiency of leafhopper transmission of the two WDV strains from silky bent grass to wheat and barley. For comparison, the results of WDV transmissions from the main host species of cereals were included. The data illustrate that the transmission efficiency of vectors that performed their acquisition feeding on infected silky bent grass was relatively high with the wheat strain (73.9% and 77.8%), as well as with the barley strain (61.2% and 64.7%). A slightly higher efficiency of WDV transmission by leafhoppers was found after feeding on infected winter wheat or winter barley.

Surveys in areas with an increased or high incidence of WDV in stands of winter cereals revealed a moderate or severe infection of silky bent grass by this virus. At Litenčice (Kroměříž district), in a field of winter wheat severely damaged by WDV and heavily infested with silky bent grass, 50–60% of its plants were infected. Significant numbers of infected plants of silky bent grass (15–30%) were found in WDV infected stands of winter wheat that had a low infestation with this grass at Rataje, Střílky, Strabenice, Hoštice (Kroměříž district) and Slavkov (Vyškov district). An incidence of 10–15% infection of silky bent grass with WDV was observed in winter barley stands at Kostelec, Budyně and Roudníček (Litoměřice district).

The effects of WDV on silky bent grass became evident in dwarfed plants, which in some cases reached 20% of the height of uninfected plants. Such plants had apparently been infected early, i.e., in the fall. The moderate dwarfing in most plants was caused by spring or summer infection. Infected plants had a higher number of tillers than healthy ones. Chlorotic spots on leaves and their grad-

Table 1. Transmission of different isolates of WDV by the leafhopper Psammotettix alienus to test plants

Locality	Source of infection	Transmission to			
		spring wheat		spring barley	
		positive/total	percent of transmission	positive/total	percent of transmission
Litenčice	Apera spica-venti	34/46	73.9	0/29	0.0
Rataje	Apera spica-venti	35/45	77.8	0/32	0.0
Roudníček	Apera spica-venti	0/30	0.0	30/49	61.2
Kostelec	Apera spica-venti	0/32	0.0	27/42	64.3
Litenčice	winter wheat	38/45	84.4	0/40	0.0
Kostelec	winter barley	0/42	0.0	28/42	66.7

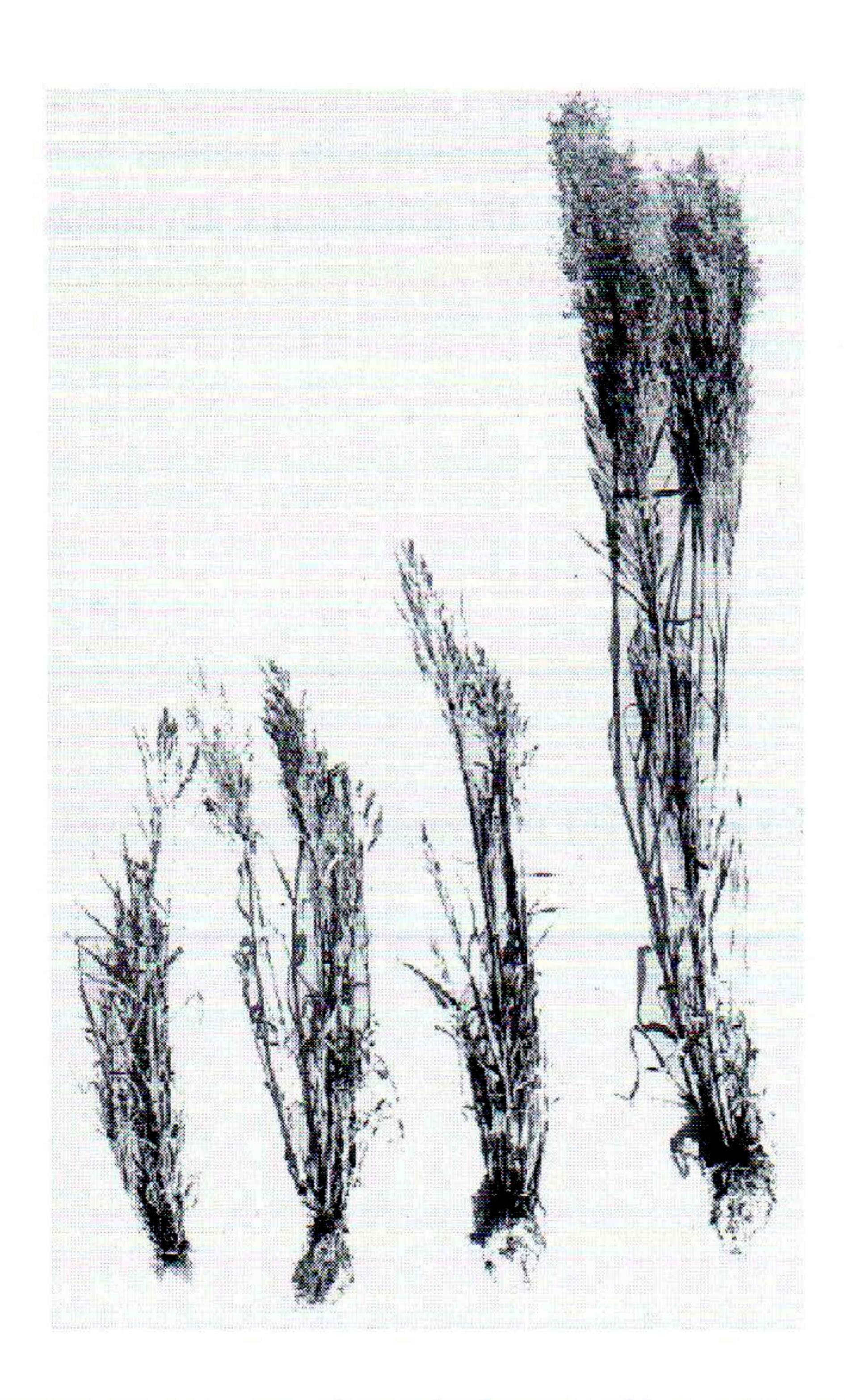


Fig. 1. Apera spica-venti plants infected with WDV; to the right a healthy plant

ual yellowing were further symptoms of virus infection. Severely dwarfed plants usually failed to head at all; in slightly dwarfed plants partial heading with a reduced inflorescence was observed (Fig. 1). There were no differences between the symptoms caused by infection with the wheat or barley strains of WDV.

DISCUSSION

The results of the experiments demonstrated that silky bent grass is a WDV host that has not been described until now. It is susceptible to infection by the wheat strain as well as barley strain of this virus. This host has to be added to the species Avena fatua, A. sativa, A. sterilis, Lagurus ovatus and Poa annua which are also hosts of both WDV strains. It will now be necessary to study the susceptibility of species of the genus Bromus which had been identified as spontaneous hosts of WDV before the two cereal strains had been differentiated (VACKE 1981, 1983).

Stands of winter cereal crops or their post-harvest volunteers, and volunteers of spring wheat, spring barley and oats are the main hosts, reservoirs and sources of infec-

tion under field conditions. They play a key role in virus epidemiology. Weed host species of grasses were attributed a secondary role (VACKE 1981, 1983) because the incidence of infected plants was sporadic or low. As indicated by the results of experiments and observations, silky bent grass is more important for virus epidemiology than the other grass species. Particularly stands of winter cereals are frequently infested by this grass species, and its incidence and distribution have had an increasing trend in this country. The severe infection by WDV demonstrates its higher susceptibility to virus infection. Relatively high infectivity of leafhoppers that were feeding on infected plants shows that silky bent grass is an efficient source of infection for both WDV strains. It is a reservoir for virus overwintering in the case of fall infection. It can also be an appropriate oviposition plant for vectors. Hatched young nymphs of P. alienus are infected in spring, thereby increasing the infection potential of the population in cereal fields. These nymphs, and adults as well, can increase the frequency of secondary infections of winter crops in spring and summer. Moreover, the barley strain can persist in plants of silky bent grass that are then sources for infection in winter wheat fields in which the wheat strain of WDV has spread. In a similar way the wheat strain can develop in fields of winter barley infected by the barley strain. Thus, the vector population in a weed-infested field of one cereal brings about the possibility of an infection potential by both virus strains.

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Souhrn

VACKE J., CIBULKA R. (1999): Chundelka metlice (Apera spica-venti [L.] Beauv.) – nový hostitel a rezervoár viru zakrslosti pšenice. Pl. Protect. Sci., 35: 47–50.

Ve vzorcích rostlin chundelky metlice (Apera spica-venti [L.] Beauv.) s příznaky zakrslosti, žloutnutí listů a redukce květenství odebraných v poli byla serologickými a přenosovými testy zjištěna infekce virem zakrslosti pšenice (WDV). Tento druh trávy je

novým, dosud nepopsaným hostitelem WDV. Reinfekcí na indikátorové rostliny (pšenici jarní a ječmen jarní) bylo prokázáno, že chundelka metlice je hostitelem jak pšeničného, tak ječného kmene tohoto viru. V přenosovém testu bylo zjištěno, že tato plevelná tráva je efektivním zdrojem infekce pro vektory viru křísy *Psammotettix alienus* Dahlb. Při průzkumu v devíti lokalitách byl pozorován střední až silný výskyt WDV na chundelce metlici, která v České republice hojně zapleveluje porosty obilnin. Jako rezervoár viru v přírodě může tato tráva hrát významnou roli v jeho epidemiologii.

Klíčová slova: virus zakrslosti pšenice; chundelka metlice; rezervoár viru

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