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Short communication

First report of barley yellow dwarf luteovirus on *Miscanthus* in the United Kingdom

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Abstract. Barley yellow dwarf luteovirus (BYDV) was detected in field grown *Miscanthus sacchariflorus* propagated from root cuttings. Inoculation of BYDV to *M. sinensis* plants grown from seed had an adverse effect on shoot growth and leaf development.

Plant biomass is an energy resource and there is renewed interest in investigating the potential of growing plants and trees as fuel crops to utilize set-aside arable land.

One plant genus under investigation at Rothamsted is the oriental grass, *Miscanthus*. There are about 20 species of *Miscanthus*, and cultivars of *M. sinensis* and *M. sacchariflorus* are of most interest because they have potential to give high yields of dry matter. Dry matter yields from sites in Europe ranged between 12 t and 44 t per ha per year [Harvey and Sylvester Bradley, 1992] but there are no data on yield in the UK.

There have been few reports of the susceptibility of *Miscanthus* spp to disease. In Taiwan, native species of *Miscanthus* have been found to be highly resistant to Culicolus smut *Ustilago scetaminea* and downy mildew *Peronosclerospora sacchari* and breeding programmes are being used to transfer this resistance to *Saccharum – Miscanthus* hybrids [Chen and Lo, 1988]. A geminivirus has been identified from *M. sacchariflorus* in Japan [Yamashita et al., 1985] but the insect vector is unknown.

We report here the identification of barley yellow dwarf luteovirus (BYDV) in *M. sacchariflorus* and *M. sinensis* grown in the UK from micropropagated plants imported from Germany and the effects of infection on seedlings of *M. sinensis*.

Barley yellow dwarf is a disease with a worldwide distribution and many members of the Gramineae are susceptible including all cereals and many grasses. Infection of small grain cereals can decrease yield by 50% or more and affect the quality of the grain; infection of pasture grasses can decrease dry matter yield by 20% [Bruehl, 1961; Plumb, 1992]. During a field study at Rothamsted of *M. sinensis* 'Giganteus' and *M. sacchariflorus* in 1992,

reddish-purple areas were observed on older leaves in late May. By early August most of the older leaves were discoloured but newly emerged leaves remained green. Single leaves showing discolouration were collected from plants and tested by indirect enzyme-linked immunosorbent assay (ELISA) using polyclonal coating antibodies and monoclonal detecting antibodies raised against isolates of each of the three serotypes of BYDV prevalent in the UK [Torrance et al., 1986; Pead and Torrance, 1988]; the RPV-like isolates that are most efficiently transmitted by the aphid *Rhopalosiphum padi*, the MAV-like isolates which are most efficiently transmitted by the aphid *Sitobion avenae*, and the PAV-like isolates that are transmitted by both aphids. The monoclonal antibodies specific for the RPV-like, PAV-like, and MAV-like isolates are designated, MAC 92, MAC 91, and MAFF 2, respectively. In ELISA, BYDV-serotypes were detected by monoclonal antibodies to all three serotypes but only with monoclonal antibodies to the MAV-like serotypes were the results strongly positive (Table 1).

The plants tested from the field crop were all grown from rhizome root cuttings. As all the plants tested were infected the effect of infection on productivity could not be measured. Therefore, tests were done to assess the susceptibility, and to measure the effect, of BYDV infection on the early growth of *M. sinensis*. Virus-free aphids, *R. padi* and *S. avenae* were fed for 48 h on oat (*Avena sativa* cv. Dula) leaves infected with the RPV-like and MAV-like serotypes of BYDV respectively; virus-free *R. padi* were fed on oats infected with the PAV-like serotype.

Twenty four plants of *M. sinensis*, grown from seed were each inocu-

Table 1. Mean values of indirect ELISA absorbance at 405 nm detected using specific monoclonal antibodies MAC91, MAC92 and MAFF2

Species	MAC91[1]	MAC92	MAFF2	Serotypes present
Samples				
1. *M. sacchariflorus*	0.048[2]	0.047	0.399	PAV-RPV-MAV
2. *M. sacchariflorus*	0.042	0.028	0.234	MAV
3. *M. sacchariflorus*	0.071	0.042	0.351	PAV-MAV
4. *M. sinensis 'Giganteus'*	0.027	0.033	0.243	MAV
5. *M. sinensis 'Giganteus'*	0.047	0.049	0.320	PAV-RPV-MAV
6. *M. sinensis 'Giganteus'*	0.040	0.033	0.264	MAV
Positive controls				
MAV-like serotype	0.021	0.029	0.288	
PAV-like serotype	0.330	0.018	0.067	
RPV-like serotype	0.034	1.405	0.080	
Threshold				
2× healthy control means	0.044	0.046	0.102	

[1] Torrance et al. [1986]; Pead and Torrance [1988].
[2] Underlined values > 2× healthy control

lated, 21 days after sowing, with BYDV. Eight plants were each inoculated with one of the three BYDV serotypes using 10 aphids per plant. As controls for transmission, and to measure the percentage infectivity of the inoculating aphids, 10 single aphids from each virus source plant were transferred to further oat plants; eight seedlings of *M. sinensis* were not inoculated but kept in the same conditions as those that were. All aphids were allowed to feed on the test plants for 48 h and were then killed by spraying with pirimicarb (0.5 g a.i. l^{-1}). The aphid free plants were then placed in a glasshouse at approximately 20 °C. Seven weeks after inoculation, 1 g of fresh leaf material was collected from each inoculated and uninoculated plant and tested for the presence of BYDV by ELISA. No plants showed any obvious symptoms of discolouration but two plants gave positive reactions to the MAFF 2 monoclonal antibody indicating the presence of the MAV-like serotype (Table 2). No other *M. sinensis* plants gave a positive reaction in ELISA but of the oats inoculated by single aphids from infected hosts, 50% were infected by the PAV-like serotype, 90% with the RPV-like serotype, and 50% with the MAV-like serotype. No uninoculated plant gave a positive reaction in ELISA.

Thirteen weeks after inoculation measurements were made on two healthy plants chosen at random and the two plants that had reacted positively in ELISA. The sample size was too small to draw any conclusions but the infected plants were smaller and had fewer, shorter, narrower leaves than healthy plants. However, stem diameter was less affected.

Because the propagation of *Miscanthus* spp for biomass production is

Table 2. Mean values of indirect ELISA absorbance at 405 nm using specific monoclonal antibodies MAC91, MAC92 and MAFF2 on *Miscanthus sinensis*

	MAC91	MAC92	MAFF2	Serotype
Plants				
1.	0.030	0.043	0.229[1]	MAV
2.	0.026	0.047	0.076	
3.	0.024	0.032	0.040	
4.	0.028	0.061	0.186	MAV
5.	0.026	0.059	0.049	
6.	0.040	0.061	0.053	
7.	0.031	0.035	0.039	
8.	0.022	0.033	0.039	
Positive controls				
MAV-like serotype	–	–	0.250	
PAV-like serotype	0.211	–	–	
RPV-like serotype	–	0.358	–	
Threshold				
2× healthy control means	0.072	0.088	0.094	

[1] Underlined values > 2× healthy control

currently either by micropropagation or by division of rhizomes, there is a real possibility of infection by BYDV being distributed in planting material. The little evidence gained so far suggests that infection can decrease many components of growth and, in consequence, the full potential of these crops as producers of biomass may not be being assessed.

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