ELYMANA VIRESCENS, A NEWLY DESCRIBED VECTOR OF WHEAT STRIATE MOSAIC VIRUS[1]

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Abstract

Wheat striate mosaic virus (WSMV) was shown to be transmitted by the leafhopper Elymana virescens (F.). However, fewer adult E. virescens became inoculative (23%) after an acquisition access period of 3 days than did Endria inimica (Say) (90%) - a known vector of the virus. In addition, the minimum incubation period of WSMV was much longer in E. virescens (15-18 days) than in E. inimica (4 - 6 days). Wheat (Triticum durum Desf.) plants that became infected after being inoculated by viruliferous E. virescens showed typical bacilliform WSMV particles (about 260 X 80 mu in size) both in the cytoplasm and in the nucleus of the parenchymatous leaf cells.

Introduction

Up to the present study the leafhopper Endria inimica (Say) was the only vector reported to transmit the North American wheat striate mosaic virus (WSMV) (7). The virus is transmitted in a persistent manner and has been shown to multiply in the leafhopper vector (5). This communication reports the transmission of WSMV by Elymana virescens (F.) and the efficiency of this newly described vector to transmit the virus as compared to that of E. inimica.

The particles of WSMV are bacilliform in shape, about 260 X 80 mu in size, and can easily be identified in infected plants (3). For this reason, ultrathin sections of wheat (Triticum durum Desf. cv. Ramsey) leaves that became infected after being inoculated by viruliferous E. virescens, were also examined in an electron microscope.

Materials and methods

The virus was maintained in wheat plants infected by means of viruliferous leafhoppers, E. inimica. Colonies of virus-free leafhoppers were reared and maintained on healthy wheat plants. Adult E. virescens collected from the Central Experimental Farm, Ottawa, were maintained on healthy barley (Hordeum vulgare L.) plants. Although WSMV has not been reported from the Ottawa area, samples of field-collected leafhoppers were tested in groups on healthy wheat plants (1 week each on four successive plants) to ensure that the leafhoppers were not carrying WSMV. None of the test plants developed symptoms of WSMV.

"Exposed" leafhoppers were obtained by caging virus-free insects on WSMV-infected wheat plants. During the incubation period of WSMV in the insects, groups of exposed leafhoppers were maintained on wheat plants and were transferred to new plants every 3 or 4 days (5). Not all exposed insects transmitted the virus when tested singly for their ability to do so; those that did have been referred to as "inoculative". During the acquisition access or test feeding periods, leafhoppers were held in a growth room with a night-day temperature range of 19-21 C and 10,000 lux of light for 16 hours a day. After each test feeding, the plants were sprayed with nicotine sulphate and were held in a greenhouse for at least 4 weeks to observe possible symptom development.

For electron microscopy, wheat leaves were processed and sectioned following the procedure described earlier (6) and examined in a Siemens Elmiskop I.

Results and discussion

To determine the percentage transmission by E. virescens and to compare it with E. inimica, adult leafhoppers of both species were caged for various periods on the same WSMV-infected plants. After the acquisition access period, the exposed leafhoppers of the two species were maintained separately for 2 additional weeks on healthy plants and the surviving insects were then tested singly for 2 weeks for their inoculativity on wheat seedlings. The combined results of two such experiments with each acquisition access period showed (Table 1) that, in each case, fewer E. virescens transmitted the virus than did E. inimica. These results indicate that E. virescens is a less efficient vector of WSMV as compared to E. inimica.

Although the symptoms produced on wheat plants by inoculative E. virescens were typical of WSMV, attempts were made to transmit the virus from such infected plants to healthy wheat seedlings by using E.

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Table 1. Transmission of wheat striate mosaic virus by Elymana virescens as compared with Endria inimica after different acquisition access periods

Acquisition access period (in days)*	Transmission by: Elymana virescens	Endria inimica
1	0/36 (0%)	18/30 (60%)
2	1/30 (3%)	29/36 (81%)
3	9/43 (23%)	37/41 (90%)

* After each acquisition access period, leafhoppers were maintained for 2 additional weeks on healthy plants and then were tested singly for 2 weeks for their inoculativity on healthy wheat seedlings. Numerator is the number of insects that became inoculative; denominator is the number tested.

inimica„ Groups of 20 healthy adult E. inimica were caged for 3 days on the infected plants and were then tested singly for their inoculativity as described above. The results of two such experiments showed that 26/31 (84%) E. inimica became inoculative.

To obtain further evidence that the symptoms produced on wheat plants by the viruliferous E. virescens were indeed caused by WSMV, ultrathin sections of infected leaves were examined in the electron microscope. Typical WSMV particles were found in both cytoplasm and nucleus of the parenchymatous cells (Fig. 1).

The minimum incubation period of WSMV in E. inimica has been reported to be between 4 and 6 days and the maximum between 24 and 28 days (7). To determine the incubation period of the virus in E. virescens, 50 adult leafhoppers were given an acquisition access period of 3 days and were then transferred singly to wheat seedlings every 3 or 4 days, up to 28 days after the start of acquisition.

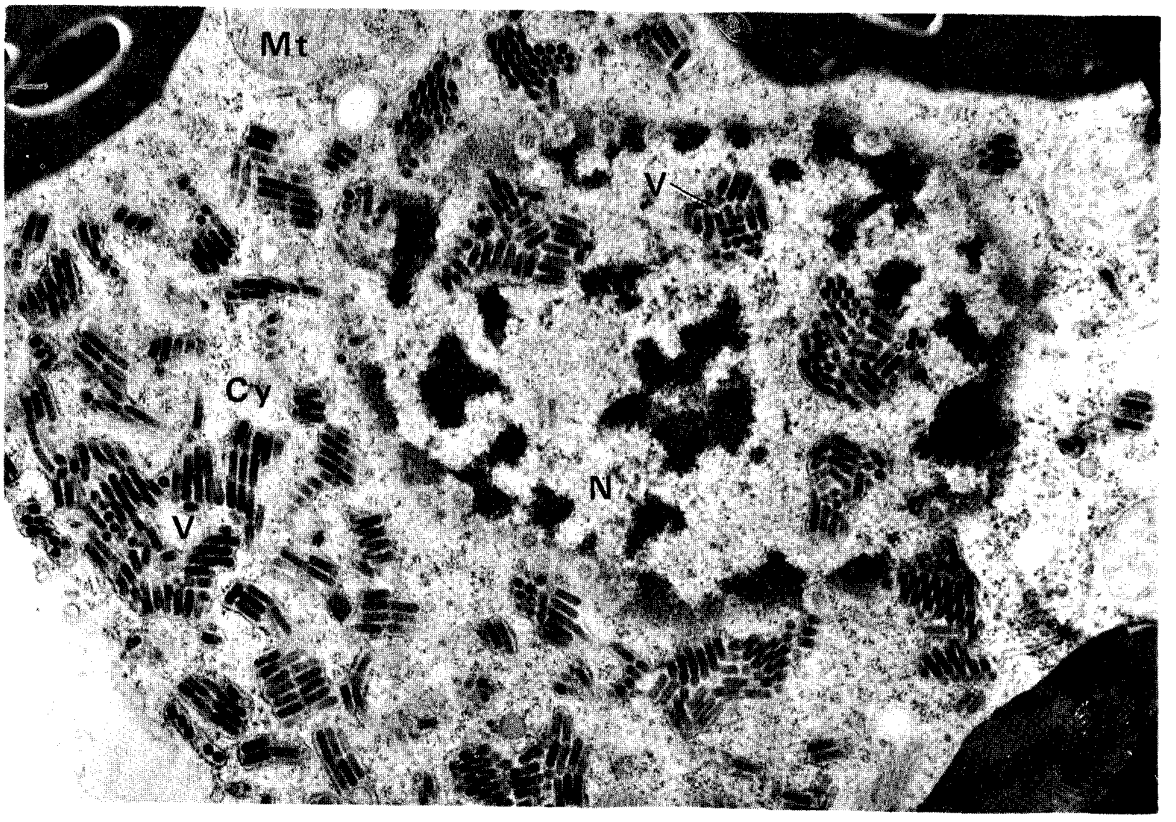

Figure 1. Electron micrograph of a section through a parenchymatous cell of a diseased wheat leaf. The plant had become infected by wheat striate mosaic virus after being inoculated by a viruliferous Elymono virescens. x 20,000. Note that the bocilliform virus particles (V) are present in both cytoplasm (Cy) and nucleus (N) of the cell. *Mt:* mitochondria.

A similar experiment was carried out with E. inimica. The results with E. inimica confirmed the earlier report by Slykhuis (7) regarding the incubation period of WSMV in this vector. The results with six E. virescens that became inoculative and survived for 28 days are given in Table 2.

Table 2. Transmission of wheat striate mosaic virus by inoculative Elymana virescens at different times after the start of a 3-day acquisition access period

Leafhopper number	Days from start of acquisition access period to test feed*				
	4 to 15	18	22	25	28
1	-**			+	+
2			+	+	+
3		+	+	+	+
4			+	+	+
5					+
6			+	+	

* After the acquisition access period of 3 days, leafhoppers were transferred singly to wheat seedlings every 3 or 4 days. Transmission results are given only for those leafhoppers that became inoculative and survived for at least 28 days.

** - = no symptoms on test plants; + = test plant became infected.

The minimum incubation period of WSMV in E. virescens was between 15 and 18 days and the maximum was between 25 and 28 days. The longer minimum incubation period of WSMV in E. virescens could result because of the slower movement of the virus from the gut to the hemolymph and then to the salivary glands (4) and/or the virus may multiply at a slower rate in E. virescens than in E. inimica.

It is noteworthy that E. virescens is also capable of transmitting the causal agent of aster yellows (1). It will be of interest, therefore, to study the interactions in E. virescens between WSMV and the agent of aster yellows disease, which is suspected to be caused by a Plycoplasma sp. (2).

Acknowledgment

I am thankful to Mr. William Bell for technical assistance.

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