

Reciprocal Contact Transmission of Barley Stripe Mosaic Virus Between Wild Oats and Barley

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ABSTRACT

Chiko, A. W. 1983. Reciprocal contact transmission of barley stripe mosaic virus between wild oats and barley. *Plant Disease* 67:207-208.

Contact transmissibility of barley stripe mosaic virus (BSMV) was examined in field plots using seed-infected plants of wild oats (*Avena fatua*), Herta barley (*Hordeum distichum*), and Conquest barley (*H. vulgare*) as virus sources and healthy plants of the same species as test material. The virus was transmitted by contact from wild oats to both Herta and Conquest barley but in reciprocal tests was transmitted only from Conquest barley to wild oats. The frequencies of contact transmission of BSMV in these tests were lower than the frequencies of contact transmission of the virus from infected to healthy plants of either Herta or Conquest barley. There was no evidence of contact transmission of BSMV from infected to healthy wild oats. Results obtained in this study support the notion that wild oats are involved in the epidemiology of BSMV in barley.

Wild oat (*Avena fatua* L.) plants naturally infected with barley stripe mosaic virus (BSMV) were first detected in Manitoba in 1973 and the virus was transmitted through 22% of the seeds collected from such plants (2). In subsequent mechanical inoculation tests, BSMV was transmitted from barley to wild oats and from wild oats to both wild oats and barley (2,5). These findings

indicated that wild oats might be involved in the epidemiology of BSMV in barley. In the aforementioned inoculation tests, however, a highly susceptible nonlicensed barley cultivar was used both as a virus source and test plant, and procedures used to inoculate test plants were probably considerably more rigorous than processes involved in natural contact transmission of BSMV.

The present study was conducted to more critically evaluate the possible role of wild oats in the epidemiology of BSMV in barley. Contact transmissibility of the virus was examined in field plots using seed-infected plants of wild oats, Herta barley (*Hordeum distichum* L. emend. Lam.), and Conquest barley (*H. vulgare* L. emend. Lam.) as virus sources and healthy plants of the same species as test material.

MATERIALS AND METHODS

Seed sources. Contact transmission

tests were conducted in 1977 and 1978 using the following seed sources: BSMV-infected seed of wild oats, Herta barley, and Conquest barley (IWO, IHB, and ICB, respectively) and healthy seed of wild oats, Herta barley, and Conquest barley (HWO, HHB, and HCB, respectively). Herta was the most common two-row barley cultivar grown in Manitoba from the early 1960s to the early 1970s, whereas Conquest was the most common six-row barley cultivar grown in all three Canadian prairie provinces from the mid-1960s to the mid-1970s. Infected seed of each of these cultivars was obtained from plants inoculated mechanically in the field at the late-tillering stage with isolate C4 of BSMV. Of four isolates of the virus from barley previously tested, only isolate C4 was transmitted to wild oats (5). Infected seed of wild oats, produced in a greenhouse, was second- or third-generation increases of seed from naturally infected plants (2). A different lot of seed from each infected species was used in 1977 and 1978, whereas the same lot of seed from each healthy species was used in both years.

The percentage of seed infected with BSMV in each of the seed lots used was estimated by a combination of seedling examinations and infectivity assays. For each lot, 150 seeds were sown in sterile flats of soil in a greenhouse (about 27 C, 15-hr photoperiod with supplementary fluorescent light). When most seedlings were in the three-leaf stage (16–21 days after seeding), all plants with symptoms and 50 randomly selected symptomless

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Contribution 921 from the Research Station, Winnipeg.

Accepted for publication 12 July 1982.

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0191-2917/83/02020702/\$03.00/0
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Table 1. Contact transmission of barley stripe mosaic virus (BSMV) from plants in source rows to plants in test rows in field plots in 1977 and 1978^a

Virus source row ^b	Test rows	No. of plants in test rows with barley stripe mosaic symptoms ^c	
		1977	1978
Herta barley	Wild oats	0	0
Herta barley	Herta barley	52 (5) ^d	12 (4)
Conquest barley	Wild oats ^e	5 (4)	0
Conquest barley	Conquest barley	74 (5)	12 (5)
Wild oats	Herta barley ^e	7 (4)	1 (1)
Wild oats	Conquest barley ^e	3 (3)	3 (2)
Wild oats	Wild oats	0	0

^a Each treatment consisted of two test rows on either side of a virus source row (five replicates per treatment).

^b Grown from seed of plants infected with BSMV.

^c Total for five replicates.

^d Number of replicates with at least one plant with symptoms in test rows.

^e Infection of each plant with symptoms in test rows by BSMV was confirmed by infectivity and serological assays.

plants derived from each seed lot were tested for BSMV by infectivity assay. One or two of the uppermost leaves from each seedling assayed were ground with 0.5 ml of distilled water in a sterile mortar and the extract was rubbed on five corundum-dusted Black Hulless barley plants in the two-leaf stage. Symptoms in test plants were recorded 14 days after inoculation. In these assays, BSMV was detected in all seedlings with symptoms. Symptomless infection was rare in seedlings derived from infected wild oat seed but was relatively common in seedlings derived from infected Herta and Conquest barley seed.

The percentage of seed infected with BSMV (% SI) in each seed lot used in contact transmission tests was calculated as follows: % SI = (% seedlings with symptoms) + [(% symptomless seedlings infected) × (100 - % seedlings with symptoms)] / 100. For seed lots from infected wild oats, Herta barley, and Conquest barley, the respective % SI was 17, 37, and 48 in 1977 and 12, 54, and 63 in 1978. There was no evidence of BSMV infection in any of the healthy seed lots.

Contact transmission tests. Plots in the 1977 and 1978 tests were seeded on 25 and 30 May, respectively. Plot layouts were identical in both years. Each plot consisted of three parallel 5.1-m rows (200 seeds sown per row) spaced 15 cm apart. Adjacent plots were separated by barren 2.1-m-wide pathways. Treatments consisted of plots seeded in each of the following row sequences: 1) HWO-IHB-HWO, 2) HHB-IHB-HHB, 3) HWO-ICB-HWO, 4) HCB-ICB-HCB, 5) HHB-IWO-HHB, 6) HCB-IWO-HCB, and 7) HWO-IWO-HWO. These treatments and a control plot were arranged in a randomized complete block design with five replicates. Each control plot consisted of one row each of HWO,

HHB, and HCB, the positions of which were randomized.

Beginning at the early-tillering stage, plants in each plot were thoroughly examined periodically for barley stripe mosaic symptoms three or four times during the growing season. In both years, final examinations were made near the end of July, when most wild oat plants were at the watery-ripe stage and most Herta and Conquest barley plants were at the milky-ripe and soft dough stages, respectively. In cases of apparent interspecific contact transmission of BSMV, leaf samples were collected from each plant with symptoms in test rows and each sample was tested for BSMV by infectivity and serological assays (1).

RESULTS AND DISCUSSION

Results of contact transmission tests with BSMV are summarized in Table 1. In 1977 and 1978, BSMV was transmitted by contact from infected wild oats to both Herta and Conquest barley. The virus was transmitted from infected Conquest barley to wild oats only in 1977 and was not transmitted from infected Herta barley to wild oats in either year. In both years, BSMV was transmitted most frequently from infected to healthy plants of Herta and Conquest barley. There was no evidence of contact transmission of the virus from infected to healthy wild oats or of BSMV infection in any of the control plots in either year. In some treatments, differences in numbers of plants infected in test rows were probably partly attributable to differences in levels of BSMV infection in the seed sources used to establish virus source rows.

The maximum frequency of contact transmission occurred in 1977 with the treatment HCB-ICB-HCB in which approximately 4% of the plants in test

rows became infected with BSMV. This transmission frequency was relatively low compared with that obtained by Hagborg and Chelak (6) in a similar test using Plush barley. Low frequencies or lack of contact transmission of BSMV in my study may have been due to one or more of the following factors: genetic constitution of plants in virus source rows and test rows, strain composition of the virus isolates used, and environmental conditions. In both the 1977 and 1978 tests, most Conquest barley and wild oat plants were vigorous in appearance but most Herta barley plants were unthrifty. The latter condition may also have contributed to the apparent lack of contact transmission of BSMV from Herta barley to wild oats.

No attempt was made to determine the presence of BSMV in seed of any of the plants infected with the virus by contact transmission. However, in field-grown Conquest and Herta barley plants mechanically inoculated at the late-tillering stage with BSMV from leaves of seed-infected wild oat plants, 57 and 75% of the seeds from these respective cultivars were infected with the virus (A. W. Chiko, *unpublished*).

Numerous wild oat plants naturally infected with BSMV were detected in a field of barley near Dauphin, Manitoba, in 1978 (A. W. Chiko, *unpublished*). Therefore, the virus may be more common in wild oats than earlier observations suggested (2). Results obtained in my study clearly show that BSMV-infected wild oats have the potential for contaminating previously virus-free barley crops. Such contamination might account in part for the relatively common occurrence of the virus in commercial barley fields in some regions of the Canadian prairies (3), as opposed to its extreme rarity in Canadian pedigreed barley seed (4).

ACKNOWLEDGMENT

I am grateful for the able technical assistance provided by J. P. Burgoyne.

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