Reaction of additional barley cultivars to two aster yellows strains

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All twelve cultivars of barley tested were susceptible to both strains of aster yellows mycoplasmalike organism (AY-MLO) transmitted by the aster leafhopper, *Macrosteles fascifrons.* Infection ranged from 8% to 68% depending on strain of MLO and barley cultivar. Overall, the eastern strain (NAY-MLO) infected a higher percentage of plants than did the western strain (CAY-MLO). On average, symptoms of NAY (37 days) took longer to develop than did those of CAY (29.6 days). Symptoms of CAY were generally more pronounced than were those of NAY, especially on spring cultivars. The winter cultivars, Huron and OAC Elmira, infected with NAY-MLO, proved to be excellent sources of inoculum for the leafhopper.

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Les douze cultivars d'orge evalues furent susceptibles aux deux souches du mycoplasme de la jaunisse de l'aster (AY-MLO) transmit par la cicadelle de l'aster, *Macrostelesfascifrons.* L'infection s'echelonne de 8 % a 68 % selon la souche du mycoplasme et selon le cultivar d'orge. Au total, la souche provenant de l'est (NAY-MLO) a infecte un plus grand pourcentage de plants que la souche provenant de l'ouest (CAY-MLO). En moyenne, les symptômes provoques par le NAY se sont manifestes sur une periode de 37 jours et par consequent ont pris plus de temps a se developper que ceux provoques par CAY (*i.e.* 29,6 jours). Les symptômes de CAY furent generalement plus prononces que ceux de NAY, en particulier sur les cultivars de printemps. Les cultivars d'hiver (*i.e.* Huron et OAC Elmira) infectes avec NAY-MLO se sont averes d'excellentes sources d'inoculant pour la cicadelle.

Introduction

The susceptibility of barley, *Hordeum vulgare* L., to aster yellows (AY) was first demonstrated by Banttari and Moore (1960) when they successfully transmitted the causal mycoplasmalike organism (MLO) to and from the cultivar Vantage with the aster leafhopper, *Macrosteles fascifrons* (Stal). Later, Banttari (1964) reported that the cultivars Trophy and Blackhulless also were susceptible and that the symptoms produced closely resembled those of the aphid-borne barley yellow dwarf virus. A subsequent study by Chiykowski (1965) added twenty-four cultivars to the list of susceptible barleys and also showed that all were susceptible to both eastern and western strains of AY-MLO.

Although all of the cultivars tested earlier have been supplanted, no information is available on how currently grown cultivars react to AY-MLO. The present paper reports on the reaction of several currently grown winter and spring cultivars to two strains of aster yellows transmitted by the leafhopper *M. fascifrons.*

Materials and methods

Healthy stock cultures of *M. fascifrons* leafhoppers were reared on oats *Avena sativa* L. 'Exposed' leafhoppers for inoculating plants were obtained by first caging late instar nymphs on infected China aster, *Callistephus chinensis* Nees, for two weeks and then maintaining them on healthy asters for an additional two weeks. The two pathogen isolates used in this study, one representing the eastern strain (NAY-MLO), and the other,. the western strain (CAY-MLO), were the same as described previously (Chiykowski and Wolynetz 1981). The cultivars tested included five 6-row spring, three 2-row spring and four winter barleys (Table 1). For a test, five seedlings of each cultivar were grown in 13 cm fibre pots and inoculated one week after planting when the seedlings were about 12 cm high. The inoculation procedure consisted of caging three exposed leafhoppers on each seedling for 7 days in a growth room (9000 lx for 16 h/day) at 23°C. Following removal of the insects the plants were sprayed with malathion and placed in the greenhouse for symptom development. The test was repeated five times and the values reported are the percentages of plants infected of the twenty-five seedlings tested. The number of days for symptom expression was recorded and the average values for the five tests were calculated.

Two of the winter cultivars, Huron and OAC Elmira, also were evaluated as inoculum sources for NAY-MLO. Young adult *M. fascifrons* leafhoppers were caged on infected barley plants for two weeks and then maintained on healthy aster for an additional two weeks. Thirty exposed leafhoppers from each cultivar were tested singly for their inoculativity on aster seedlings for two weeks.

Results

All cultivars tested were susceptible to both strains of AY-MLO (Table 1). Percentage infection with CAY-MLO ranged from 16% on Huron, a winter barley, to 60% on Rodeo, a 2-rowed spring cultivar. With NAY-MLO, infection ranged from 8% on OAC Acton to 68% on OAC Elmira,

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both winter cultivars. There did not appear to be any correlation between barley type and susceptibility. With the exception of OAC Acton and Rodeo, NAY-MLO infected a higher percentage of plants than did CAY-MLO. OAC Acton was the only cultivar found to be considerably more susceptible to the western than to the eastern strain. Rodeo was the only cultivar that appeared to be equally susceptible to both strains.

Table 1. Susceptibility of barley cultivars to two strains of aster yellows transmitted by *Macrosteles fascifrons*.

Cultivar	Percentage infection by [a]	
	Western strain (CAY-MLO)	Eastern strain (NAY-MLO)
Spring		
6-row		
Bruce	28	56
Kippen	20	36
Leger	36	64
Mingo	36	56
Vanier	44	60
2-row		
Birka	36	52
Mic Mac	44	60
Rodeo	60	64
Winter		
Huron	16	36
OAC Halton	36	56
OAC Acton	32	8
OAC Elmira	24	68
Average	34	51

[a] Based on 25 inoculated seedlings per cultivar per MLO strain.

Although infected plants of all cultivars showed some of the symptoms described previously (Chiykowski 1965), differences in symptom expression were observed between pathogen strains on the same cultivars and between spring and winter cultivars. While plants of both spring and winter cultivars infected with CAY-MLO displayed a general, severe chlorosis of new leaves, only spring cultivars showed pronounced bright yellow blotches on older leaves. Symptoms of NAY-MLO infection consisted of a mild general chlorosis of new growth on both winter and spring cultivars and leaf blotching on spring cultivars that was considerably less pronounced than that caused by CAY-MLO. Leaf rolling of both spring and winter cultivars was more pronounced on plants infected with CAY-MLO than with NAY-MLO.

Disease symptoms on plants infected with CAY-MLO appeared in from 20 to 55 days (Table 2). The mean time for symptom expression ranged from a low of 24 days on OAC Kippen to a high of 37.6 days on OAC Elmira. Symptoms on plants infected with NAY-MLO appeared in from 22 to 58 days. The mean time for NAY symptom expression ranged from a low of 30.6 days on Mingo and Birka to a high of 50.1 days on Huron. On average, symptoms of CAY (29.6 days) required less time to develop than did those of NAY (37 days). With some cultivars, such as Birka and Mic Mac, symptom expression time was essentially the same for both pathogen strains. With others, such as Huron, the difference was quite pronounced, with symptoms of NAY taking twice as long to appear as those of CAY.

Both winter cultivars tested as acquisition hosts proved to be excellent sources of NAY-MLO inoculum for *M. fascifrons*. The percentage of insects that became inoculative after feeding on infected plants of Huron and OAC Elmira was 83% (25/30) and 70% (21/30), respectively.

Discussion

The susceptibility of all cultivars tested to the two strains of AY-MLO and the relatively high percentage infection in most cultivars suggests that aster yellows has the potential of being an economically important disease of barley. In addition, barley could play a role in the epidemiology of this disease in other crops, providing a source of both inoculum and leafhoppers during the growing season. Winter barley especially may be important in this regard, serving as a primary source of both disease inoculum and leafhoppers in the spring. The present study has shown

Table 2. Days required for symptom expression in cultivars of barley infected with aster yellows.

	Western AY-MLO		Eastern AY-MLO	
Cultivar	Range	Mean (SD)	Range	Mean
Bruce	20-41	28.0 (7.6)	32-57	44.9 (6.8)
OAC Kippen	22-26	24.0 (1.9)	39-58	47.3 (7.4)
Leger	21-55	32.6 (13.1)	23-52	36.6 (10.9)
Mlngo	22-36	27.1 (6.2)	23-55	30.6 (7.9)
Vanier	20-50	27.0 (9.6)	25-51	33.4 (7.0)
Birka	21-50	30.9 (9.1)	22-47	30.6 (6.9)
Mic Mac	20-54	30.5 (10.6)	25-39	31.2 (4.6)
Rodeo	21-43	30.1 (7.0)	22-52	36.7 (7.9)
Huron	22-30	24.5 (3.7)	29-58	50.1 (9.5)
OAC Halton	20-47	29.9 (9.8)	25-56	37.2 (9.8)
OAC Acton	22-51	31.3 (10.4)	36-42	39.0 (4.2)
OAC Elmira	22-50	37.6 (11.4)	29-57	38.5 (9.9)
Average		29.6 (9.1)		37.0 (9.8)

that a high percentage of leafhoppers become inoculative after feeding on such cultivars as Huron and OAC Elmira. Winter barley also is a known overwintering host of the leafhopper vector (Miller and DeLyzer 1960). Insects emerging from and feeding on barley plants infected the previous fall would be inoculative by the time they mature and migrate to other susceptible crops such as vegetables, ornamentals and grains.

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