

Screening Hardy Chrysanthemums for Resistance to *Fusarium oxysporum* f. sp. *chrysanthemi* Race 2

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ABSTRACT

Huang, H. C., Marshall, H. H., Collicutt, L. M., McLaren, D. L., and Kokko, M. J. 1993. Screening hardy chrysanthemums for resistance to *Fusarium oxysporum* f. sp. *chrysanthemi* Race 2. Plant Pathol. Bull. 2:103-105.

Twenty four entries of hardy chrysanthemum including 10 commercial cultivars and 14 experimental lines were screened for resistance to wilt caused by *Fusarium oxysporum* f. sp. *chrysanthemi* race 2 using an artificial inoculation technique. Among the 10 cultivars tested, Morden Fiesta, Morden Garnet, Susan Brandon, Morden Gaiety, Morden Delight and Morden Cameo were highly resistant to the disease, showing little or no wilt symptoms on leaves after inoculation for 32 days; whereas Morden Eldorado, Brown, Morden Canary and Morden Everest were susceptible to highly susceptible, showing severe wilting of leaves. Eight of the 14 experimental lines, 7618, 7751, 7773, 7517, 7764, 7510, 7731, and 7924 were also highly resistant to the disease. This study suggests that plant loss due to *Fusarium oxysporum* f. sp. *chrysanthemi* race 2 in Canadian prairie gardens could be avoided by growing disease resistant cultivars of hardy chrysanthemum.

Key words: hardy chrysanthemum, resistance, fusarium wilt, *Fusarium oxysporum*.

INTRODUCTION

Hardy chrysanthemum (*Chrysanthemum morifolium* Ramat.) cultivars show regional adaptation. Only those originating on the Canadian prairies or the most northerly plains states of USA grow well in the prairie climate (5). Recent advances in breeding, especially at the Agriculture Canada Research Station, Morden, Manitoba, have made available a good selection of new hardy chrysanthemum cultivars adapted to prairie conditions (5).

Huang *et al.* (4) reported a severe natural outbreak of fusarium wilt on hardy chrysanthemums in Morden, Manitoba in 1979. They identified the disease-causing organisms as *Fusarium oxysporum* f. sp. *chrysanthemi* race 2, which differs from other fusarium pathogens of chrysanthemum, *F. oxysporum* f. sp. *chrysanthemi* Litt., (2) and *F. oxysporum* f. sp. *tracheiphilum* (E. F. Smith) race 1 (1). The objective of this study was to assess resistance to *F. oxysporum* f. sp. *chrysanthemi* race 2 in hardy chrysanthemums including commercial cultivars and experimental lines.

MATERIALS AND METHODS

Stolons of 24 chrysanthemum lines were planted in soil in wooden flats (45 × 32 × 8 cm) and kept for 7 weeks under greenhouse conditions. Roots of young plants developed from stolons were washed with tapwater and inoculated with *F. oxysporum* f. sp. *chrysanthemi* race 2 (DAOM 175160) using the root dipping technique described by Huang *et al.* (4). The inoculated plants were transplanted into individual holes of a "Styroblock 20" container (Beaver Plastic Ltd., 12806–63 Street, Edmonton, Alberta, Canada) containing Cornell peat-lite mix (3). In the first test, 14 plants of each cultivar or line were used, 10 inoculated with *F. oxysporum* and four uninoculated, and in the second test, 20 plants were used, 10 inoculated and 10 controls. The inoculum concentration was determined for the second test only; it contained 9.1×10^6 macro- and micro-conidia per milliliter.

After inoculation, the plants were kept for 32 days in a growth cabinet at $32 \text{ C} \pm 1 \text{ C}$ and 16 hr photoperiod and assessed for wilt symptoms a scale

of 0, highly resistant (no wilting), to 4, highly susceptible, leaves brown and plants dead (4). The disease reaction of each cultivar or line was determined by calculating the disease index (D. I.) using the formula: $D. I. = \Sigma (nw)/T$, where n = number of plants in each wilt rating, w = wilt rating, and T = total number of plants.

RESULTS

The two screening tests showed significant differences ($P < 0.01$) in resistance to wilt caused by *F. oxysporum* f. sp. *chrysanthemi* race 2 among hardy chrysanthemum cultivars and lines. Of the 24 entries

TABLE 1. Wilt reaction of 24 hardy chrysanthemum (*Chrysanthemum morifolium*) cultivars or lines to *F. oxysporum* f. sp. *chrysanthemi* race 2

Cultivar or line	Disease index ¹	
	Test 1	Test 2
7418	4.0 a ²	—
7778	4.0 a	—
Morden Eldorado	4.0 a	3.4 ab ²
Brown	4.0 a	—
7727	3.6 ab	2.4 cd
7744	3.1 abc	—
Morden Canary	2.7 bcd	2.7 bc
Morden Everest	2.2 cde	3.6 a
7743	2.0 def	2.5 cd
7746	1.9 def	—
Morden Fiesta	1.8 defg	0 d
Morden Garnet	1.4 efg	0 d
7618	1.1 fgh	0 d
7751	0.8 gh	1.8 d
Susan Brandon	0.3 h	0.4 d
Morden Gaiety	0.2 h	0 d
7773	0 h	0 d
7517	0 h	0 d
7764	0 h	—
7510	0 h	—
Morden Delight	0 h	0 d
Morden Camco	0 h	0 d
7731	0 h	—
7924	—	0 d

¹ Wilt index: 0 = highly resistant; 1 = resistant; 2 = moderately resistant; 3 = susceptible; and 4 = highly susceptible.

² Means within each column followed by the same letter are not significantly different at the 0.05 level (Duncan's Multiple Range Test).

evaluated, six commercial cultivars, Morden Cameo, Morden Delight, Morden Gaiety, Susan Brandon, Morden Garnet, and Morden Fiesta as well as eight experimental lines, 7924, 7731, 7510, 7764, 7517, 7773, 7751, and 7618 were resistant to the pathogen (Table 1). Leaves of resistant plants showed slight or no wilting. Four commercial cultivars, Morden Eldorado, Brown, Morden Canary and Morden Everest, and four experimental lines, 7418, 7778, 7727, and 7744, were susceptible, showing severe wilting of leaves (Fig. 1). All uninoculated plants remained healthy and free of wilt symptoms during the test period.

DISCUSSION

This study confirms previous findings that some commercial hardy chrysanthemum cultivars have a high level of resistance to this new race of fusarium wilt pathogen (4). Huang et al. (4) reported that the breeding line 7778 × 7744 was susceptible to *F. oxysporum* f. sp. *chrysanthemi* race 2, with 54% of plants wilted under natural field conditions. The susceptibility of this line is predictable, as indoor screening shows both lines 7778 and 7744 are susceptible. The present study suggests that breeding for resistance is an effective method to avoid loss due to *Fusarium oxysporum* f. sp. *chrysanthemi* race 2 in Canadian prairie gardens.

Fusarium resistant cultivars of hardy chrysanthemums are readily available from nurseries in western Canada; gardeners are advised to grow cultivars that are resistant to *F. oxysporum* f. sp. *chrysanthemi* race 2 to minimize losses caused by this disease. The fusarium-resistant commercial cultivars identified in this study should be used as breeding stock to develop new cultivars with desirable characteristics.

ACKNOWLEDGEMENTS

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LITERATURE CITED

1. Armstrong, G. M., and Armstrong, J. K. 1965. Wilt of chrysanthemum caused by race 1 of the cowpea Fusarium. Plant Dis. Rep. 49:673-676.
2. Armstrong, G. M., Armstrong, J. K., and Littrell, R. H. 1970. Wilt of chrysanthemum caused by *Fusarium oxysporum* f. sp. *chrysanthemi*, forma specialis nov. Phytopathology 60:496-498.
3. Boodley, J. W., and Shelldrake, R., Jr. 1977. Cornell Peat-Like Mixes for Commercial Plant Growing. N. Y. State Coll. Agric. Life Sci., Info. Bull. 43. 8 pp.

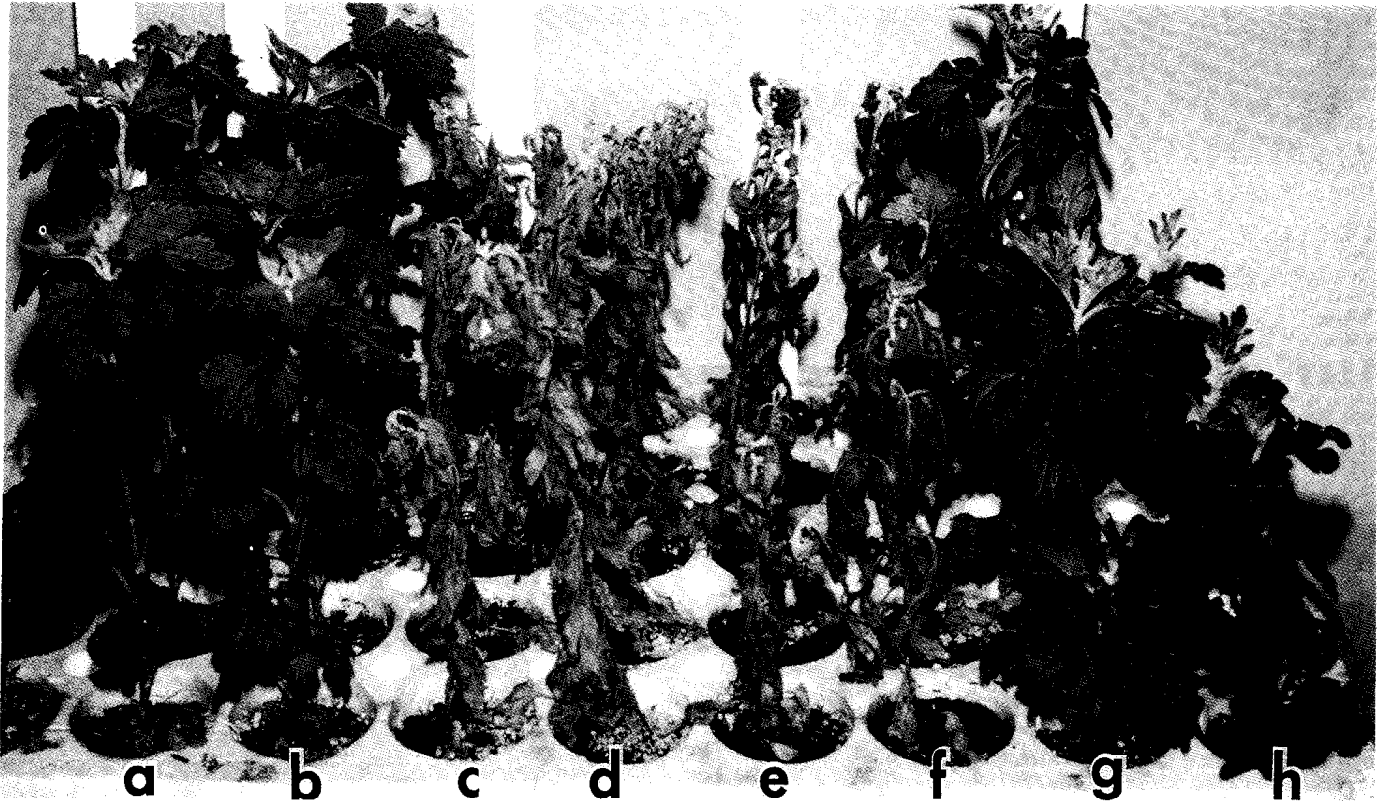


Fig. 1. Wilt reaction of hardy chrysanthemums to *Fusarium oxysporum* f. sp. *chrysanthemi* race 2 at 32 days after inoculation. Rows a-b, Morden Cameo; c-d, Morden Eldorado; e-f, Brown; and g-h, line 7751. The commercial cultivar Morden Cameo is highly resistant but Morden Eldorado and Brown are highly susceptible.

4. Huang, H. C., Phillippe, L. M., Marshall, H. H., Collicutt, L. M., and Neish, G. A. 1992. Wilt of hardy chrysanthemum caused by a new race of *Fusarium oxysporum* f. sp. *chrysanthemi* race 2. Plant

Pathol. Bull. 1:57-61.

5. Marshall, H. H. 1980. Hardy Chrysanthemums for Prairie Gardens. Agdex 200-22, Man. Agric., 3 pp.

摘 要

黃鴻章¹, Marshall, H. H.², Collicutt, L. M.², McLaren, D. L.², and Kokko, M. J.¹ 1993. 寒帶菊花萎凋病 (*Fusarium oxysporum* f. sp. *chrysanthemi* race 2) 之抗病篩選. 植病會刊 2:103-105. (1. 加拿大農業試驗所, Lethbridge, Alberta, Canada, 2. 加拿大農業試驗所, Morden, Manitoba, Canada).

用人工接種法測試 24 種寒帶菊花對 *Fusarium oxysporum* f. sp. *chrysanthemi* 生理小種二號所引起的萎凋病之抗病性。結果顯示十個商業品種中, Morden Fiesta, Morden Garnet, Susan Brandon, Morden Gaiety, Morden Delight 與 Morden Cameo 等六個品種具高度抗病性, 所有植株葉片於接種後 32 天仍無萎凋病徵或僅具極輕微之萎凋; 其他四個品種, Morden Eldorado, Brown, Morden Canary 及 Morden Everest 屬高度罹病性, 所有植株均呈現嚴重萎凋或枯死; 其餘 14 個品系中有八個品系 (7618, 7751, 7773, 7517, 7764, 7510, 7731 及 7924) 屬於抗病類型。此研究結果顯示在加拿大西部平原防治寒帶菊花萎凋病最有效之方法是栽培抗病性品種。

關鍵詞: 菊花 (*Chrysanthemum morifolium*)、抗病性、萎凋病、*Fusarium oxysporum*。