

Evaluation of Pepper Cultivars Under Greenhouse Conditions for Resistance to a Defoliation Strain of Tobacco Mosaic Virus

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ABSTRACT

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Sixty-five pepper (*Capsicum annuum* and *C. frutescens*) selections representing 40 breeding lines from the United States and 25 entries from local sources were screened under greenhouse conditions for resistance to the Nigerian defoliation strain of tobacco mosaic virus (TMV-D). None of the U.S. or local pepper selections was immune to the virus. Initial reactions in all selections consisted of development of necrotic spots and subsequent abscission of all or most inoculated leaves. Subsequent systemic symptoms ranged from mosaic/mottle (moderately resistant reaction) to plant death (very susceptible reaction). Of the 65 pepper selections tested, 8 (12.3%), 41 (63.1%), and 16 (24.7%) gave resistant, moderately resistant, and very susceptible responses, respectively. In general, older plants survived inoculation with TMV-D better than younger ones.

Tobacco mosaic virus (TMV) occurs worldwide and can cause severe yield reductions in pepper (*Capsicum* spp.) (1). In 1982, an apparently new strain of TMV was isolated in Nigeria and designated defoliation strain TMV-D because of its unique symptoms on peppers and *Datura* spp. (4). Because TMV is readily transmitted (2,5), the use of TMV-resistant cultivars might be a practical and inexpensive method for controlling pepper diseases caused by TMV. Peppers resistant to TMV strains have been identified (3,4,6). In this paper, we report the results of our search for sources of resistance in peppers to TMV-D.

MATERIALS AND METHODS

A total of 65 pepper cultivars and breeding lines were evaluated under greenhouse conditions for their reactions to a defoliation strain of TMV (TMV-D). Of these, 40 were breeding lines from the United States furnished by S. S. Subbarayude, Department of Crop Protection, Ahmadu Bello University, Zaria, Nigeria. The remaining 25 peppers included cultivars Tca 14 and Usuede and lines arbitrarily designated N 1 through N 23 obtained from home gardens and farmers' plots in and around the University of Nigeria Campus at Nsukka.

Seeds of each cultivar or line were sown in steamed soil in plastic flats in the greenhouse, and at the two- to three-leaf stage, five transplants were placed in black polyethylene bags (25 × 17 cm)

containing steamed soil (topsoil/poultry manure, 20:1, v/v). The limited number of seeds available prevented further replications.

Unless otherwise stated, plants were grown to the four- to five-leaf stage before inoculation. The inoculum was prepared by grinding infected leaves of *Physalis floridana* in a mortar containing 0.05 M phosphate buffer, pH 8.0. Leaves of plants previously dusted with Carborundum were rubbed with a cheesecloth pad dipped in the inoculum. Immediately after application, the inoculum was washed off with tap water. About the same number of uninoculated plants served as controls. All plants were kept in an insectproof greenhouse and observed regularly until they fruited. Inoculated plants with symptoms were indexed on sensitive *P. floridana* or *Datura metel* to confirm infection by TMV-D. A disease index based on plant reactions was assigned to each cultivar 8-10 wk after inoculation.

Disease indices were as follows: 0-1 = resistant; 1.1-3 = moderately resistant; and 3.1-5 = susceptible to the defoliation strain of TMV. Severity ratings were based on a scale of 0-5, where 0 = no symptom, 1 = mosaic, mottle, mosaic/mottle with or without shoestringing; 2 = extensive systemic leaf spotting, necrotic stem streaks, abscission of uninoculated leaves; 3 = tip dieback, fruit deformation; 4 = tip dieback plus extensive flower or fruit abortion; and 5 = lethal systemic necrosis, plant death.

RESULTS

All 65 pepper entries tested in this study developed symptoms after inoculation with TMV-D. The earliest symptom, which usually appeared 2-3 days after inoculation, was local necrotic spots followed almost immediately by down-

ward curling and abscission. These symptoms were common to all cultivars tested. Defoliation started between 3 and 5 days after inoculation, depending on the cultivar. The most common symptoms found on plants that survived TMV-D attack were systemic mosaic or mottle or mosaic/mottle. Other symptoms that appeared on survivors included systemic necrotic spots, tip dieback, vein necrosis, streaks, green veinbanding, general chlorosis, vein yellowing, crinkle, puckers, interveinal chlorosis, leaf necrosis, leaf taller, shoestringing, leaf deformation, bud blight, concentric necrotic spots, stunting, flower abortion, witches' broom, and fruit abscission.

Although some pepper cultivars and lines were killed by TMV-D, others such as Tca 14, Usuede, and Cayenne Long Slim recovered from the initial shock reaction and grew to the fruiting stage. To determine whether age of plant at

Table 1. Effect of plant age (leaf stage) at inoculation on reactions of some pepper cultivars/lines to inoculation with a defoliation strain of tobacco mosaic virus (TMV-D) from pepper in Nigeria

Cultivar/line	Leaf stage	Survivals ^a
Cayenne Long Slim	6	1
	12	4
Early Cal Wonder	6	1
	12	1
Hungarian Yellow Wax (hot)	6	1
	12	4
Keystone Resistant Giant	6	0
	12	1
N 16	6	0
	12	0
N 17	6	0
	12	5
Pimento Select	6	2
	12	4
Pilite Yellow Sweet	6	0
	12	4
Sweet Banana	6	1
	12	4
Yolo Wonder A	6	0
	12	1

^aNumber of surviving plants of five originally inoculated.

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inoculation affected reaction, plants were inoculated at the six- and 12-leaf stages. Inoculated plants and controls were observed regularly for symptoms. Results of this study showed clearly that older plants usually survived inoculation with TMV-D better than younger plants. Some entries, however, such as Early Cal Wonder, Yolo Wonder L, Yolo Wonder A, Keystone Resistant Giant, and N 16 were highly susceptible regardless of whether they were inoculated at the six- or 12-leaf stage (Table 1).

Of the 65 pepper selections tested, 8 (12.3%), 41 (63.1%), and 16 (24.7%) gave resistant, moderately resistant, and very susceptible responses, respectively. Resistant cultivars/lines included Cubanella, Hungarian Sweet Wax (hot), Tabasco Mellheny, Tca 14, Usuede, N 22, and N 23. Moderately resistant cultivars/lines were Aconagua, Anaheim M, California Wonder PS, California Wonder 300, Caloro PS, Cayenne Long Slim, Cherry Sweet, College 64L, Danmeyere (SBEC), Dautsiga (SBEC), Fresno Chili Grande, Green Leaf Tabasco, Jalapeno M (market type), Keystone Resistant Giant, Kimba (SBEC), Mid California, Mid Way, Piliate Yellow Sweet, Pimento L, Pimento Select, Red Chili, Sakarho (SBEC), Santa Fe Grande, Sweet Banana, Tatasai L 2164, Yolo Wonder, Yolo Wonder A, Yolo Wonder L, N 1, N 3, N 4, N 5, N 7, N 8, N 9, N 10, N 14, N 17, N 18, and N 21.

Very susceptible cultivars/lines were Allbig, Cayenne LG Red Thick, Early Cal Wonder, Kashim Bargu (SBEC), Mercury, Red Cherry Large, Titan TMR, Long Yellow Sweet, N 2, N 6, N 11, N 13, N 15, N 16, N 19, and N 20.

Of the 40 U.S. breeding lines tested, 23 (57.5%) and seven (17.5%) gave moderately resistant and very susceptible responses, respectively. The corresponding values for the 25 local peppers used were 13 (52%) and nine (36%), respectively.

DISCUSSION

None of the 65 pepper entries tested was immune to TMV-D. Because the very susceptible pepper selections were killed outright, plants that survived and showed mild symptoms of mosaic, mottle, or both were considered to possess some resistance genes. The finding that more U.S. entries were resistant to TMV-D infection than local peppers can be attributed to the fact that the foreign peppers used were elite breeding stock already selected for their genetic resistance to viruses. Results of our study show, however, that some local peppers were resistant to this virus, suggesting that more local peppers should be included in future search for genetic resistance to TMV-D. The single replicate used in this study to determine disease reaction to TMV-D was a serious limitation imposed on us by limited number of available seeds. Therefore,

when seeds of the more resistant cultivars become available, further greenhouse and field trials would be desirable before cultivars/lines for a breeding program are selected. Because older plants of some cultivars/lines may be resistant to mechanical inoculation with TMV-D (Table 1), in the future, plants screened in the greenhouse should be inoculated during the seedling stage.

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