Dasheen Mosaic Virus Infection of Dieffenbachia Cultivars

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ABSTRACT

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Symptoms of dasheen mosaic virus infection were found in nine of 14 dieffenbachia cultivars surveyed in 20 nurseries. *Dieffenbachia maculata* 'Perfection' plants showed the most conspicuous symptoms, whereas *Dieffenbachia* × memoria-Corsii and *Dieffenbachia* × Bausei exhibited no symptoms. Manual inoculations of virus-free plants resulted in three general reactions: moderate acute phase followed by rapid recovery and a chronic phase of periodic expression of moderate to severe symptoms (Perfection); severe acute reaction, slow recovery, and a mild chronic phase (Rudolph Roehrs and *D. amoena*); and severe acute reaction resulting in plant death (memoria-Corsii and Bausei). The standard practice of shoot cutting for propagation did not have any discernible effect on symptom expression in Perfection stock plants. Immune electron microscopy assay of asymptomatic, infected leaf tissue revealed virus particles in only one of six samples. Results indicated that control of dasheen mosaic virus is necessary primarily in the cultivar Perfection and is dependent upon use and maintenance of virus-free plants.

Dieffenbachias are widely grown in Florida for sale by the foliage plant industry; however, their production has been limited seriously in the past by diseases caused by systemic pathogens such as dasheen mosaic virus (DMV) (4,10). Production of pathogen-free plants, through the use of tissue culture techniques, was deemed the most successful means for reducing disease losses (2,6,9). Pathogen-free plants of *Dieffenbachia maculata* (Lodd.) G. Don 'Perfection' (also called Exotica) were produced and released in Florida on an ad hoc basis through the Florida Foundation Seed Producers, Inc. The object of this study was to determine the prevalence and potential importance of DMV infections in commercial dieffenbachia plantings.

MATERIALS AND METHODS

Incidence of DMV was assessed on the basis of foliar symptoms including ring spots, mosaic, and distortion on 14 commercially grown dieffenbachia cultivars in 20 nurseries in Florida during a 1-yr period.

Cutting removal, as a means of inducing DMV symptoms in stock plants, was tested on Perfection. Pathogen-free plants were obtained using the tissue culture techniques outlined by Taylor and Knauss (9). Cuttings from one selection of Perfection (2) were rooted in steam-sterilized potting medium consisting of Canadian peat, cypress shavings, and pine bark (2:1:1 by volume) amended with 6 kg of Osmocote (14-14-14) (Estech Corp., Chicago, IL), 4 kg of dolomite, and 1 kg of Perk (Agrico Chemical Co., Chicago, IL) per cubic meter of mix. An equal number of cuttings from the same selection of Perfection, but which had been manually inoculated with DMV, were rooted in the same manner.

Plants were maintained in a greenhouse on a raised bench in 15-cm pots. After 6 mo, they were transplanted to 20-cm pots. Treatments, replicated on 14 plants, were: DMV-infected plants, uncut; DMV-infected plants, cut; pathogen-free plants, uncut; and pathogen-free plants, cut. Cuttings were removed routinely in the two cutting treatments when shoots attained a length of 10 cm. At the same time, new leaves were rated for DMV symptoms on a scale of 1 (no symptoms) to 4 (severe mosaic and distortion). The experiment was repeated with identical procedures, except that five plants were used per treatment.

The reaction of eight dieffenbachia cultivars to DMV infection was tested by manual inoculation with DMV using infected Perfection leaves triturated in sterile distilled water as the inoculum and 320-mesh Carborundum as the abrasive. Ten plants of each of the following were produced from pathogen-free plants as described earlier: *D. amoena* Bull., *D. amoena* 'Tropic Snow,' *Dieffenbachia* × Bausei Hort. ex M. T. Mast. and T. Moore, *D. maculata*, *D. maculata* 'Lemon,' *D. maculata* 'Perfection,' *D. maculata* 'Rudolph Roehrs,' and *Dieffenbachia* × memoria-Corsii Fenzi. Plants were grown in a glasshouse for 6 mo, and symptoms such as mosaic, distortion, ring spots, and shoot or plant death were recorded. This test was performed three times during a 1-yr period.

Virus titers in symptomatic and asymptomatic tissues of Perfection were compared using the "modified Derrick" immune electron microscopy technique described by Milne and Luisoni (7). This procedure was used because it is more sensitive than the negative staining procedure used previously for dieffenbachia (11). DMV antiserum was diluted 1:100, and the preparation was stained in 2% uranyl acetate. Virus titers in symptomatic and asymptomatic tissues of the same leaf were based on the number of virus particles counted on individual 75 × 300 mesh grid squares.

RESULTS

Symptoms of DMV infection were found in most dieffenbachia species and cultivars grown commercially (Table 1). *D. amoena* and Perfection were the most widely grown, and an average 60% of the plants showed symptoms. Symptoms in

Table 1. Occurrence of dasheen mosaic virus (DMV) in commercially grown dieffenbachias in Florida

Plant	No. with symptoms/ no. observed
Dieffenbachia amoena[a]	9/15
Bausei	0/3
Lemon[b]	1/8
D. maculata	0/1
Memoria-Corsii	0/1
Oerstedii	0/2
Perfection[c]	8/13
Rudolph Roehrs	8/9
Sunglow	2/2
Superba	3/3
Wilson's Delight	0/1

[a] Includes Tropic Snow.
[b] Includes Camille and Marianne.
[c] Also referred to as Exotica.

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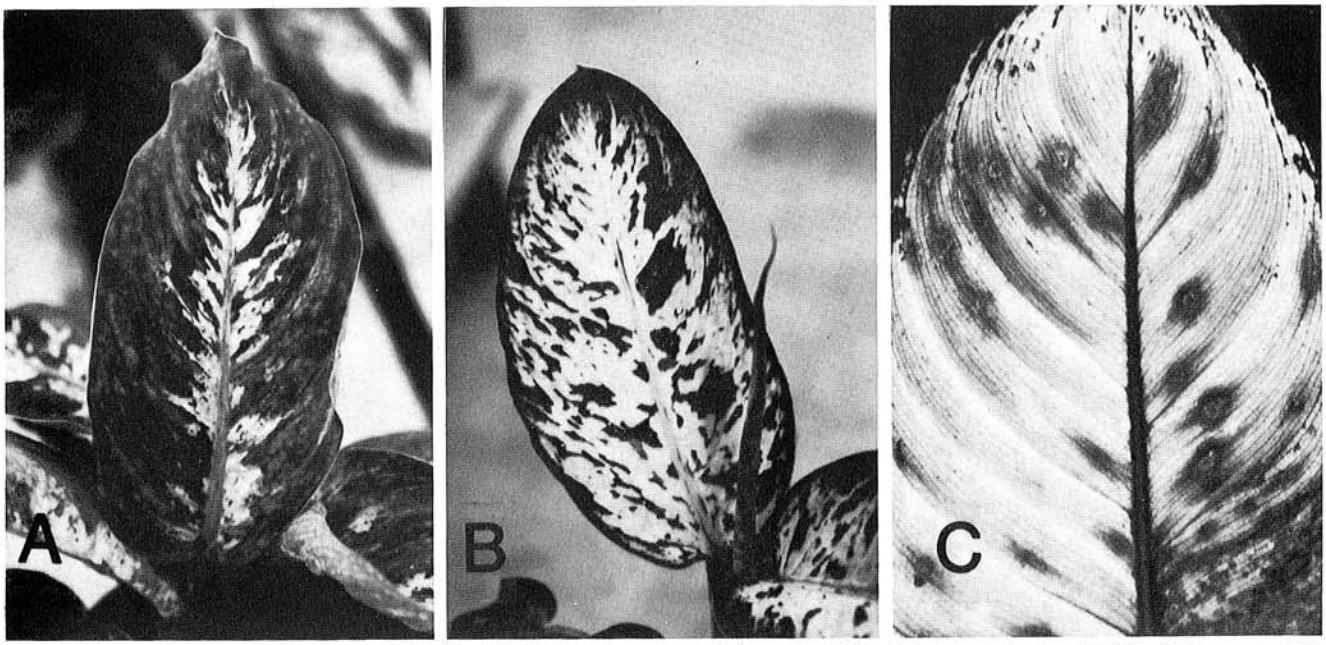

Fig. 1. Dieffenbachia leaves: **(A)** Symptomatic leaf from Perfection plant manually inoculated with dasheen mosaic virus (DMV). **(B)** Asymptomatic leaf from the same plant. **(C)** Typical ring spot symptoms on Rudolph Roehrs naturally infected with DMV.

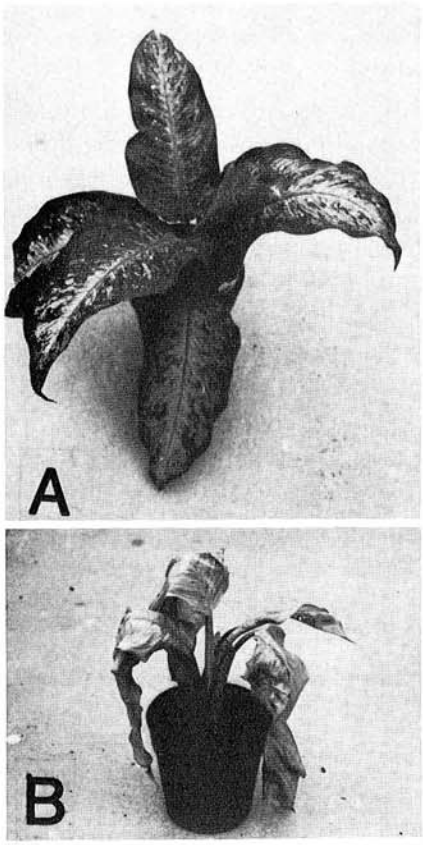

Fig. 2. Dieffenbachia × memoria-Corsii plants: **(A)** Healthy and **(B)** hypersensitive reaction to manual inoculation with dasheen mosaic virus.

D. amoena were relatively inconspicuous, whereas those in Perfection ranged from slight mosaic to severe distortion (Fig. 1). One of eight Lemon plantings showed symptoms, and most Rudolph Roehrs, Sunglow, and Superba exhibited easily detectable, dark green ring spots. Bausei, memoria-Corsii, and several other cultivars were not commonly grown, and no symptoms of DMV were apparent on any of those plants.

Cutting removal did not affect symptom expression in DMV-infected plants. During a 12-mo period, horticultural quality of DMV-infected plants was consistently lower than that of DMV-free plants. The average DMV rating for virus-free plants was 1.1, whereas ratings ranged from 2.1 to 3.9 for infected plants. Symptoms were most severe in July through September and November through January. Similar seasonal fluctuations in symptoms have been noted by others (3,8).

Pathogen-free dieffenbachia cultivars that were manually inoculated with DMV reacted in one of three basic patterns (1): moderate acute symptoms followed by rapid recovery and moderate to severe chronic symptoms, severe acute symptoms followed by slow recovery and mild chronic symptoms, and severe acute symptoms culminating in death. Perfection and Lemon plants exhibited the first reaction. Perfection plants produced a mild mosaic on inoculated leaves within 10 days of inoculation (Fig. 1A), accompanied by distortion of new leaves within the first 20 days. All infected plants recovered and produced asymptomatic leaves within 60 days of inoculation. Lemon plants reacted similarly, except that the recovery period was 50–80 days. The chronic phase included periodic expression of moderate to severe DMV symptoms of stunting and severe leaf distortion, resulting in an unproductive plant with periods of no symptoms (Fig. 1B).

The second reaction was expressed by *D. amoena*, Tropic Snow, *D. maculata*, and Rudolph Roehrs. Local lesions were produced on inoculated leaves within 10–20 days after inoculation. Lesions coalesced into large necrotic areas on older leaves; necrotic spots developed on new leaves. Approximately 40% of the plants produced side shoots without symptoms within 100 days; the remaining 60% produced side shoots with severe local lesions, and plants died within 60–70 days. The chronic phase consisted of long periods in which no symptoms developed, along with occasional periods in which ring spots developed (Fig. 1C).

Bausei and memoria-Corsii showed the third reaction. Large necrotic areas formed on inoculated leaves within 10–20 days of inoculation (Fig. 2B), and plants died at varying rates between 25 and 45 days. All uninoculated plants remained healthy throughout these tests (Fig. 2A).

Virus particles were more abundant in extracts from symptomatic portions of Perfection leaves than in extracts from asymptomatic portions of the same leaves. In six leaves sampled, 494 particles (range of 39 to 107) were counted in symptomatic tissues and only seven (from a single sample) in asymptomatic tissues.

DISCUSSION

The influence of DMV on Perfection has been discussed previously (2,11). Our results further establish the importance of this virus in commercial dieffenbachia production in Florida. Nearly all of the major species and cultivars of dieffenbachias are symptomatic periodically. DMV has been found in dieffenbachias grown commercially in Europe (3,5,8) and Australia (R. S. Greber, *personal communication*).

The combination of acute and chronic

reactions (1) by DMV-infected Perfection plants is important because this is the only plant with a severe chronic phase. *D. amoena* and Rudolph Roehrs have a mild chronic phase; thus, on these cultivars the disease is not commercially important. DMV-infected Bausei and memoria-Corsii plants died shortly after inoculation; infected plants would thus be expected to be self-eliminating.

Quality ratings of DMV-infected Perfection plants were consistently lower than those of DMV-free plants, paralleling earlier studies that demonstrated that DMV infection reduced the quantity of cuttings produced (2). As noted previously (11), symptoms were expressed intermittently and quality ratings fluctuated accordingly. Nevertheless, the superiority of virus-free plants was always clearly evident.

Use of pathogen-free Perfection, now available through the tissue culture industry, should alleviate losses due to DMV. However, because these plants are not resistant and reinfection can occur, a system for inducing symptom expression is desirable to check for presence of virus in stock plants. Continuous cutting of dieffenbachias for propagation is routinely practiced in commercial production. Although some observations have suggested that this practice results in continuous expression of DMV symptoms, it was not supported by our tests. Induction of DMV symptoms is especially important in Perfection because symptoms are variable and periodically can result in severe losses in stock plants. Serological and leaf-dip assays have not been reliable in detecting DMV in asymptomatic tissue; therefore, careful monitoring and roguing of infected stock plants are recommended for control of this disease.

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