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Dasheen Mosaic Potyvirus of Edible and Ornamental Aroids[1]

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INTRODUCTION: Members of the *Araceae* are widespread throughout the world, but are most abundant in the tropics. This family of monocotyledons has about 2,950 species distributed among 106 genera (Mabberley 1989). Typically, inflorescences are comprised of an unbranched spadix on which mutliple tiny, individual male and female flowers are borne. Surrounding this inconspicuous inflorescence is a petal-like bract called a spathe (Everett 1980). Edible aroids are of great importance as staples in the diets of people throughout the tropics. Only limited acreage is devoted to these crops in South Florida. The ornamental aroids, however, comprise about a third of Florida's foliage industry.

Dasheen mosaic virus (DsMV), first described by Zettler *et al. in* 1970 from dasheen *(Colocasia esculenta* (L) Schott), is an aphid-transmitted virus assigned to the genus Potyvirus in the family Potyviridae. DsMV has a world wide distribution but has been found naturally only in members of the family *Araceae* (Zettler and Hartman 1987; Zettler and Hartman 1986; Zettler *et al.* 1978). Prior to the advent of commercial tissue culture in the 1970s, DsMV caused substantial problems in ornamental aroids. DsMV infects both edible and ornamental species in at least 16 genera of *Araceae.* Most of the edible species belong to the genera *Colocasia* and *Xanthosoma,* while the ornamental genera include *Alocasia, Aglaonema, Anthurium, Caladium, Dieffenbachia, Philodendron, Spathiphyllum, Zantedeschia* and several others.

DsMV severely impacts ornamental and edible aroids. For instance, yield losses may range from 40% to 61% in caladiums (Hartman and Zettler 1974; Knauss *et al.* 1975). Chase *et al.* (1981) and Zettler *et al.* (1980) reported substantial yield reduction with the number of cuttings produced by *Dieffenbachia maculata* (Lodd.) Bunting 'Perfection' plants. Furthermore, ,Wisler *et al.* (1978) found a 66% reduction in vine length of *Philodendron scandens* K. Koch & Sello. A 33% to 43% reduction in average corm weight of field-grown edible aroids was reported by Liu *et al.* (1988).

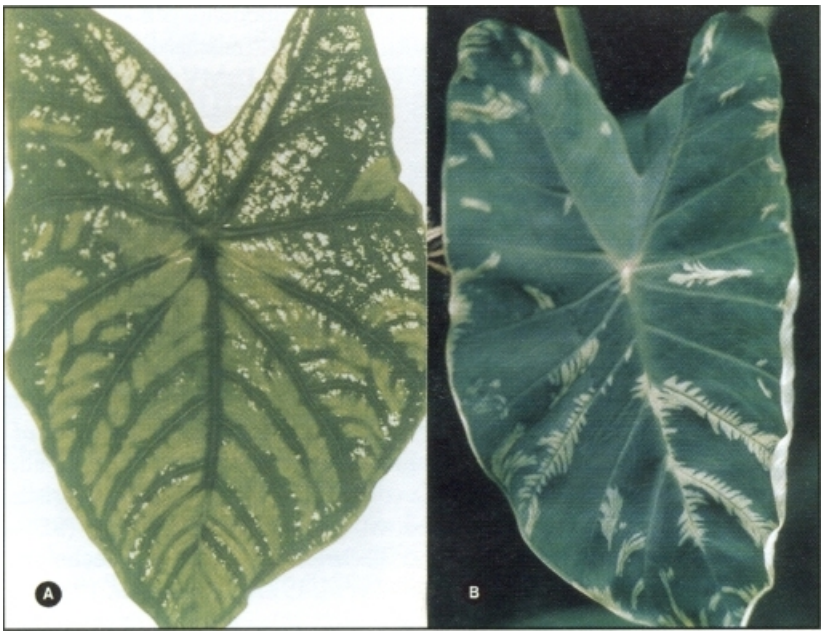

Fig. 1. Feathering along the leaf veins is often seen in *(A) Caladium x hortulanum* and *(B) Colocasia esculenta.*

SYMPTOMS: Symptom expression is often intermittent or seasonal. Alconero and Zettler (1971) reported the alternation of symptomatic and asymptomatic leaves on the same

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Colocasia esculenta plants and Zettler and Hartman (1987) reported that symptoms in *Dieffenbachia* occur most often during spring and autumn months. Foliar mosaic symptoms often appear as a localized "feathering" of white tissue along the veins on several cultivars of *Caladium bicolor* (Ait.) Vent., *Colocasia esculenta* (Fig. 1) or *Xanthosoma* spp. (Zettler *et al.* 1978; Buddenhagen *et al.* 1970). Feathering is often observed on the predominantly white *Caladium* cultivars such as 'White Christmas', 'Candidum', and 'Candidum Junior', but less frequently observed on other colored cultivars. Striking white feathering is often associated with DsMV-infected *Colocasia.* An individual plant may have leaves with pale green feathering symptoms, whereas others may have severe or slight vein-banding symptoms or no visible symptoms at all. Symptoms of DsMV in *Zantedeschia* (calla-lily) and many cultivars of *Dieffenbachia* include severe distortion and reduction in the leaf blade (Fig. 2), but are usually much less evident on *Aglaonema* and *Spathiphyllum* (Zettler *et al.* 1978; Buddenhagen *et al.* 1970). *Philodendron bipinnatifidum* Endl. cv. Xanadu as well as cultivars of *Dieffenbachia x memoria-corsii* Fenzl are hypersensitive to DsMV and die rapidly following exposure to the virus.

Fig. 2. Severe reduction in leaves in *Dieffenbachia* sp. Healthy leaf on left

PATHOGEN: DsMV has flexuous, filamentous, non-enveloped particles which are 750 nm in length (Zettler *et al.* 1978). DsMV induces type-3 cylindrical inclusions and is a subdivision-III potyvirus according to the classification scheme of Edwardson and Christie (1991). This virus is aphid-transmitted in a non-persistent manner by the green peach aphid *[Myzus persicae* (Sulzer)] and the cowpea aphid *(Aphis craccivora* Koch) (Buddenhagen *et al.* 1970; Zettler et al. 1970). However, Morales and Zettler (1977) were unable to demonstrate DsMV transmission by banana aphids *(Pentalonia nigronervosa* Coquerel), which often colonizes members of the Araceae. DsMV is not known to be seed-transmitted (Zettler *et al.* 1970; van der Meer 1985), but is perpetuated by vegetative propagation (Zettler *et al.* 1970; Zettler and Hartman 1987; Gollifer *et al.* 1977).

VIRUS DISTRIBUTION: Because most cultivated aroids are vegetatively propagated, DsMV remains ubiquitous in many field-grown ornamental and edible aroids. However, many of the ornamental foliage aroids which were at one time uniformly infected with DsMV are now virus-free through the commercial use of tissue culture (Zettler and Hartman 1987). Foliage aroids have a relatively high cash value, thereby making tissue culture economically feasible (Zettler *et al.* 1991).

LABORATORY DIAGNOSIS: DsMV particles can be observed in stained DsMV-infected leaf extracts. Ultra-thin sections can reveal the proteinaceous, type-3 cylindrical or "pinwheel" inclusions induced by this virus (Christie *et al.* 1987; Edwardson and Christie 1991). Also, the proteinaceous, cytoplasmic inclusions can be stained with calcomine orange and Luxol brilliant green stain on epidermal peels and observed by using a compound light microscope (Christie and Edwardson 1986, 1974). Dasheen mosaic virus-infected plant sap treated with sodium dodecyl sulfate (SDS) readily reacts in double radial immunodiffusion tests as described by Purcifull and Batchelor (1977); and this technique has been frequently used for virus identification and indexing purposes (Abo El-Nil *et al.* 1977; Zettler *et al.* 1987; Li *et al.* 1994). While very reliable, the SDS immunodiffusion technique requires relatively large volumes of antiserum compared to ELISA (enzyme-linked immunosorbent assay). Only limited volumes of this antiserum are available from the American Type Culture Collection, 12301 Parklawn Dr., Rockville, MD 20852. Both double antibody sandwich ELISA (direct ELISA) and indirect ELISA can be used for indexing, identification, and characterization (Hu *et al.* 1995; Shimoyama *et al.* 1992; Rodoni and Moran 1988). *Philodendron bipinnatifidum* Endl. (= to *P. selloum* K. Koch) is widely used as an indicator plant for virus identification and as a purification host (Zettler and Hartman 1978; 1986; Zettler *et al.* 1978; Zettler *et al.* 1987).

CONTROL: Virus-free propagating units can be harvested from some of the vining ornamental aroids such as *Philodendron scandens (=* to *P. oxycardium* Schott) by growing them under optimal conditions and selecting relatively small asymptomatic shoots from actively growing plants (Wisler *et al.* 1978). Since symptom expression is often seasonal, cuttings should be observed over a period of several months to confirm their virus-free status (Wisler *et al.* 1978). DsMV-free plants can readily be obtained from infected stock material through the use of tissue culture. In fact, most of the popular foliage ornamentals including *Alocasia, Anthurium, Dieffenbachia,* some *Philodendron* spp., and *Spathiphyllum* are currently being propagated rapidly and economically using this method. Standard tissue culture methods may also be used to eliminate DsMV from infected *Xanthosoma* spp. and *Colocasia* spp. corms (Gomez *et al.* 1989). Infection or re-infection of greenhouse-grown ornamental aroids can be prevented by the selection of virus-free stock and the use of standard insect control practices (Wisler *et al.* 1978; Zettler and Hartman 1987). Likewise, wild (feral) taro can carry inoculum, but these are usually found along streams or other wetland locations. This virus can be controlled if DsMV-free stock is grown in isolation from all other aroid crops, volunteers and escaped and naturalized aroids (Zettler and Hartman 1986). Unfortunately, given the high costs of tissue culture and their relatively low cash value, DsMV-free field crops such as *Caladium, Xanthosoma,* and *Colocasia,* are not readily available commercially. Likewise it is difficult to isolate fields given the intensely localized nature of *Caladium* production and the cosmopolitan nature of the edible aroids. Nevertheless, roguing of infected plants and isolation of production fields as much as possible can delay infection/reinfection for several years (Zettler and Hartman 1986).

SURVEY AND DETECTION: The white feathering symptoms characteristic of DsMV can be detected by visual inspection of field-grown aroids such as *Xanthosoma* spp., *Colocasia spp.,* and some cultivars of *Caladium hortulanum,* such as 'Candidum', 'Candidum Junior' and 'White Christmas'. Symptoms are rarely observed on other *Caladium* cultivars such as 'Frieda Hemple' and 'Carolyn Whorton' (Zettler and Hartman 1986). Since symptom expression is often seasonal in these genera, the leaves of the entire plant need to be inspected (Zettler and Hartman 1986; Zettler and Hartman 1987). Mosaic and leaf deformation may be observed occasionally on some ornamental greenhouse-grown aroids such as *Dieffenbachia* spp., *Spathiphyllum* spp., and *Zantedeschia* spp. (Zettler and Hartman 1987). Like the field-grown aroids, ornamental greenhouse-grown aroids may express symptoms intermittently or be asymptomatic (Alconero and Zettler 1971; Zettler and Hartman 1987).

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