

Pigeon Pea Witches' Broom in Florida

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ABSTRACT

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Witches' broom disease of pigeon pea was noted for the first time in 1980 in several plantings in southern Florida. Extensive damage occurred in some of these plantings. Mycoplasma-like organisms of typical polymorphic morphology were present in sieve-tube elements of diseased plants. Rhabdovirus particles were observed in plants with a mild foliar vein-yellowing but not in witches' broom-affected plants. Insect surveys revealed the presence of two common leafhopper species, *Empoasca plebeia* and *Acinopterus* sp. It is believed that this is the same disease affecting pigeon pea in other areas of the Caribbean.

Additional key words: *Cajanus cajan*

Pigeon pea (*Cajanus cajan* (L.) Millsp.) is an edible grain legume of high protein content that is widely cultivated in the tropics (8). The influx of a large Latin American population into southern Florida has created a market for this crop. In the winter and spring of 1980-1981 and again in the spring of 1982, witches' broom was found affecting pigeon pea in scattered plantings throughout the Homestead area. Several plantings were extensively damaged with as many as 75% of the plants showing symptoms.

Pigeon pea witches' broom has been reported from several Caribbean islands including Hispaniola (2,5), Puerto Rico (4,5,10), and Jamaica (10). A similar disease, pigeon pea rosette, occurs in India (6). The initial descriptions of pigeon pea witches' broom reported a mycoplasma-like organism (MLO) and a rhabdovirus in diseased plants (2,5). A later paper from Puerto Rico (4) reported the MLO to be associated with a bushy canopy condition and the rhabdovirus to occur in plants with a pale mosaic. In addition, that paper reported the witches' broom condition to be caused by feeding injury from the leafhopper *Empoasca fabae*.

We report the occurrence of pigeon pea witches' broom in Florida and its association with an MLO. A rhabdovirus was found associated with a mild vein-yellowing condition but not with witches' broom.

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MATERIALS AND METHODS

Surveys were made of pigeon pea plantings in the Homestead area of southern Florida in December 1980, February 1981, and February 1982. Stem and petiole samples of witches' broom and healthy pigeon pea were fixed for 18 hr in 0.1 M collidine-buffered 2% glutaraldehyde-2% paraformaldehyde, pH 7.4, postfixed for 6 hr in 0.1 M collidine-buffered 2% osmium tetroxide, and held in 0.5% aqueous uranyl acetate for 16 hr, all at 4 C. Some specimens were stained with lead aspartate solution (11) for 1 hr at 60 C. Specimens were dehydrated either in a graded ethanol-acetone series or in 2,2-dimethoxypropane followed by acetone. After embedment in Spurr plastic, ultrathin and semithick (about 300 nm) sections were stained with uranyl acetate. Sections that did not receive lead stain en bloc were also stained with lead citrate. Sections were examined in a Phillips EM201 transmission electron microscope.

Insect populations were surveyed on three dates in the spring of 1982 in a field with a high incidence of witches' broom. Insects were collected in pigeon pea fields by sweep net and by aspirator from individual plants.

Several diseased plants were removed from the field and placed in pots under intermittent mist in a screenhouse. In addition, stem cuttings taken from plants with and without witches' broom were placed in intermittent mist for rooting or were grafted onto healthy pigeon pea plants in a screenhouse.

RESULTS

Disease survey. Two pigeon pea plantings of 0.5 ha or more were heavily infested with witches' broom, one with 75% of the plants affected. Backyard and small garden plantings were seldom found affected by this disease. Pigeon pea

is perennial, and plants observed to be affected in December 1980 and from which all brooms were removed were still affected in February 1982.

Symptom description. Symptoms of pigeon pea witches' broom in Florida consist of proliferation of shoots from axillary buds with shortening of internodes and stunting of leaves (Fig. 1). Fruiting ceased on affected portions of plants, and flowers were not produced except for the rare development of a colorless, stunted, and highly distorted floret (Fig. 2). Witches' broom often occurred as small dense tufts of proliferated shoots with greatly reduced leaves developing from nodes of affected branches (Fig. 3). Plants removed from the field to a screenhouse continued to produce broomed shoots with stunted leaves even though no insects were present. Attempts to root or graft broomed pigeon pea were unsuccessful. Cuttings from nonbroomed plants were successfully rooted and one of these showed a mild yellowing of foliar veins.

Electron microscopy. Electron microscopic examination of sieve-tube elements of the phloem of broomed plants revealed typical polymorphic MLOs. In ultrathin section, the MLO cells ranged from simple rounded bodies to filaments to large empty-appearing bodies 0.2-0.8 μ m in minor dimension (Fig. 4). Individual



Fig. 1. Witches' broom from diseased pigeon pea in Florida.

MLO cells were bounded by a single-unit membrane and contained ribosomes and DNA-like fibrils (Fig. 5). Semithick sections revealed more elongate to filamentous-appearing multibranched cells (Fig. 6). No helical MLOs were observed. Healthy plants and nonbroomed portions of witches' broom-diseased plants did not contain MLO. Rhabdoviruslike particles similar to those described by previous workers (2,4,5) were observed in vascular parenchyma of foliar samples from the plant with mild vein-yellowing but not in witches' broom-affected plants.

Insect survey. During March–September 1982, an insect survey was conducted in southern Florida. The



Fig. 2. Stunted and colorless floret (arrow) produced from a pigeon pea node with proliferating shoots.

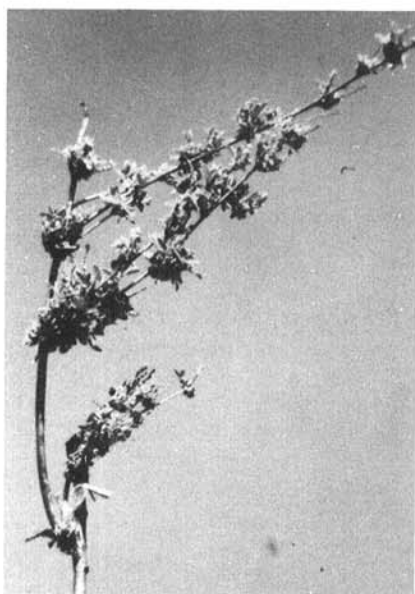
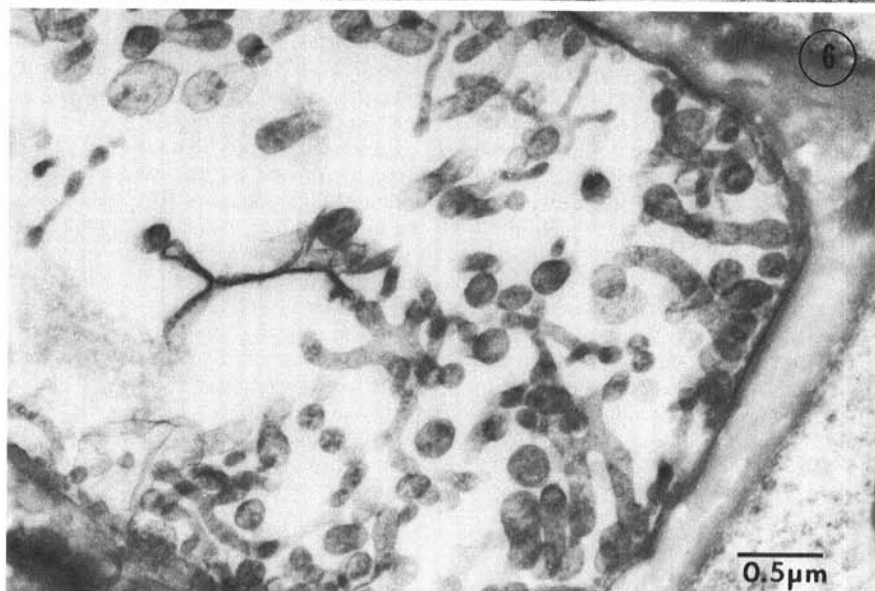
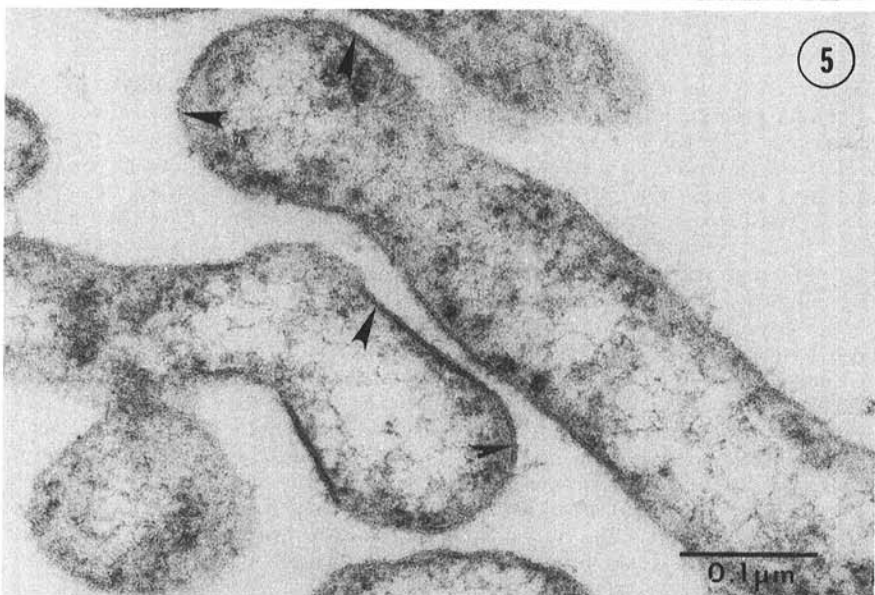
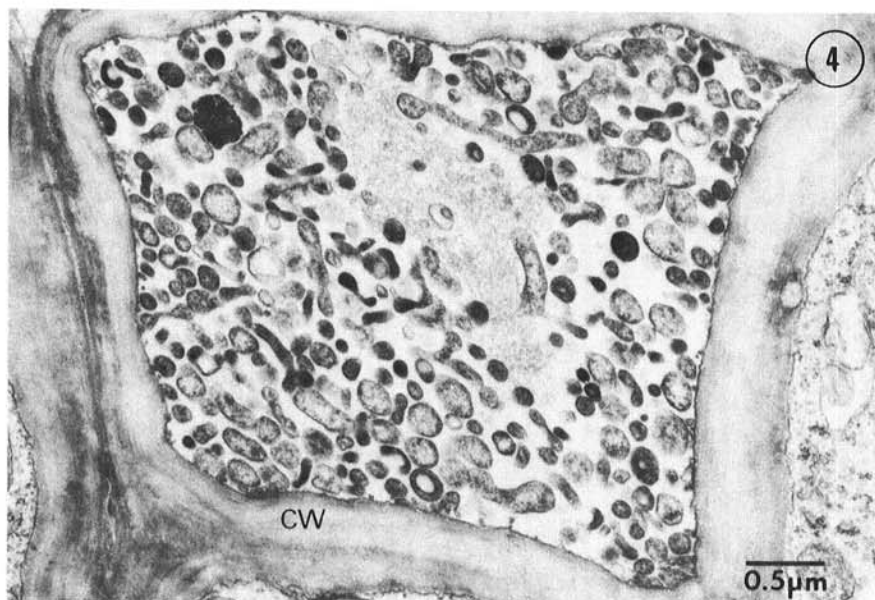


Fig. 3. Pigeon pea shoot severely affected by witches' broom disease.



Figs. 4–6. Mycoplasmalike organisms (MLO) within sieve-tube elements of witches' broom-diseased pigeon pea plants. (4) Ultrathin transverse section showing a single sieve-tube element containing polymorphic MLO; cw = cell wall. Bar = 0.5 μ m. (5) MLO cells showing unit membrane (arrows). Bar = 0.1 μ m. (6) Semithick transverse section showing filamentous morphology of MLO cells. Bar = 0.5 μ m.

leafhoppers commonly associated with pigeon pea plantings included *Agallia albidula* (Uhler), *Empoasca plebeia* DeLong & Davidson, *Hortensia similis* (Walker), *Oncometopia nigricans* (Walker), and *Acinopterus* sp. Research on rearing and testing of phloem-feeding leafhoppers is in progress.

DISCUSSION

The witches' broom disease of pigeon pea in Florida has been shown to be associated with a nonhelical polymorphic MLO. Symptoms associated with the MLO in Florida are indistinguishable from those described for the MLO-rhabdovirus infections reported from other areas of the Caribbean, implicating the MLO as the major incitant of the disease. Our results agree with those of Licha-Baquero (4) that rhabdovirus is associated with a separate syndrome and does not appear to be associated with the witches' broom. She also reported that attempts to graft MLO-infected scions failed. On the contrary, Licha-Baquero reported MLO to occur only in association with a bushy canopy condition in Puerto Rico, whereas the witches' broom symptoms could be induced on seedlings in the greenhouse by the feeding of *E. fabae*. She reported that

removal of the insects resulted in recovery of the broomed plants. The plants she used were seedlings and leafhopper injury that killed the apical bud resulted in proliferation of axial shoots, thus giving rise to the broomed appearance.

Our results demonstrate a consistent association of MLO with witches' broom disease in Florida. Infected plants removed from the field to a greenhouse with concomitant insect control continued to produce stunted proliferated shoots from nodes. Witches' brooms are characteristic of many MLO-associated diseases (7). In addition, other known phytotoxemias induced by leafhoppers consist of chlorosis, stripping, vein-banding, and wilting but not witches' broom (1,3,9). We conclude that pigeon pea witches' broom in Florida is primarily associated with an MLO, although possible interactions with such insects as *E. plebeia* cannot be discounted. Differences in symptom expression of MLO infection in pigeon pea in various localities may be due to differences in pathogen strain, host cultivar, or environment.

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LITERATURE CITED

1. Carter, W. 1962. Insects in Relation to Plant Disease. John Wiley & Sons, New York. 705 pp.
2. Hirumi, H., Maramorosch, K., and Hichez, E. 1973. Rhabdovirus and mycoplasma-like organisms: Natural dual infection of *Cajanus cajan*. (Abstr.) Phytopathology 63:202.
3. Kunkel, L. O. 1933. Insect transmission of peach yellows. Contrib. Boyce Thompson Inst. 5:19-28.
4. Licha-Baquero, M. 1979. The witches' broom disease of pigeon pea (*Cajanus cajan* (L.) Millsp.) in Puerto Rico. J. Agric. Univ. P. R. 63:424-441.
5. Maramorosch, K., Hirumi, H., Kimura, M., Bird, J., and Vakili, N. G. 1974. Diseases of *Cajanus cajan* in the Caribbean area: An electron microscope study. FAO Plant Prot. Bull. 22:32-36.
6. Maramorosch, K., Kimura, M., and Nene, Y. L. 1976. Mycoplasma-like organisms associated with pigeon pea rosette disease in India. FAO Plant Prot. Bull. 24:33-35.
7. McCoy, R. E. 1980. Mycoplasmas and yellows diseases. Pages 229-264 in: The Mycoplasmas. Vol. 3. R. F. Whitcomb and J. G. Tully, eds. Academic Press, New York.
8. Morton, J. F. 1976. The pigeon pea (*Cajanus cajan* Millsp.) a high-protein, tropical bush legume. HortScience 11:11-19.
9. Severin, H. H. P., Horn, F. D., and Frazier, N. W. 1945. Certain symptoms resembling those of curly-top or aster yellows, induced by saliva of *Xerophloea vanduzeei*. Hilgardia 16:337-360.
10. Vakili, N. G., and Maramorosch, K. 1974. "Witches'-broom" disease caused by mycoplasma-like organisms on pigeon peas (*Cajanus cajan*) in Puerto Rico. Plant Dis. Rep. 58:96.
11. Walton, J. 1979. Lead aspartate, an en bloc contrast stain particularly useful for ultrastructural enzymology. J. Histochem. Cytochem. 27:1337-1342.