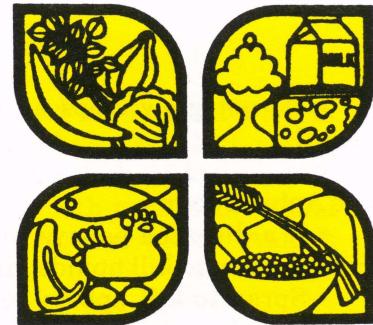


**HAWAII COOPERATIVE EXTENSION SERVICE**  
Hawaii Institute of Tropical Agriculture and Human Resources  
University of Hawaii at Manoa  
**COMMODITY FACT SHEET PA-4(A)**  
**FRUIT**



**PAPAYA RINGSPOT VIRUS (PRV): A SERIOUS DISEASE OF PAPAYA**

M. S. Nishina, Extension Agent, HITAHR, Hawaii County  
W. T. Nishijima, Extension Specialist, Plant Pathology  
F. Zee, Curator, National Clonal Germplasm Repository, Hilo  
C. L. Chia, Extension Specialist, Horticulture  
R. F. L. Mau, Extension Specialist, Entomology  
D. O. Evans, Research Associate, Horticulture

## INTRODUCTION

Papaya Ringspot Virus (PRV) causes a deadly disease of papaya that severely reduces production and kills the plants.

PRV is found in some areas of Hawaii but not in others. It is very important to suppress outbreaks of PRV where it occurs and to keep it from invading new areas.

PRV has no chemical cure. Control is by prevention, primarily through sanitation. Sanitation includes controlling the aphid vectors of the disease and removing and destroying all plants infected with the disease, including papaya plants and alternate host plants.

All papaya growers, including home gardeners and commercial growers, need to be on guard against PRV. Anyone observing suspected PRV symptoms should call the nearest Department of Agriculture or Cooperative Extension Service office.

## SYMPTOMS

### Leaves

Reduced and poor growth at the top of the plant (Figure 1). Early symptoms include:

- New leaves mottled with yellow in mosaic patterns between the leaf veins.
- New leaves also crinkled or bumpy rather than flat; they may be deformed, with narrow, stringy leaf lobes consisting mostly of veins.

### Fruit

Symptoms include:

- Ring-shaped spots on the fruits (Figures 2, 3).
- Reduced fruit growth at the top of the fruit

column. PRV infection will reduce the size of fruits; newer fruits at the top of the column will be smaller than normal.

### Stems

Symptoms include:

- "Water-soaked" spots and streaks on green stems and leaf petioles (Figure 4).

### Insect Vectors

Indicators are:

- Aphids feeding on the younger papaya plant tissues.
- Aphids in quantity on other crops nearby.

### Alternate Host Plants

The principal alternate hosts are cucurbits, such as:

- Watermelon (*Citrullus vulgaris* Thunb.)
- Cucumber (*Cucumis sativa* L.)
- Pumpkin (*Cyclanthera pedata*)
- Summer squash (*Cucurbita pepo* L.)
- Muskmelon (*Cucumis melo* L.)

These crops and cucurbit weeds can be sources of PRV infection, especially when growing upwind of papaya plantings.

## CONTROL

### Alternate Host Plants

- Do not move papaya or cucurbit plant material into papaya-growing areas.
- Do not move papaya or cucurbit transplants from one area to another. Use seeds; seeds do not carry PRV.
- Do not grow cucurbits near papaya fields.
- Do not allow cucurbit weeds to grow near papaya fields.

- Do not grow crops on which aphids breed heavily.

#### The Aphid Vector

- If a diseased papaya plant is found, immediately spray to kill aphids, then remove the tree.
- Spray to kill aphids before rogueing alternate host plants.

#### Sanitation

- Cut down and kill infected papaya plants.

- Do not allow regrowth from the stumps. Spray stumps with glyphosate (Roundup) to discourage regrowth.

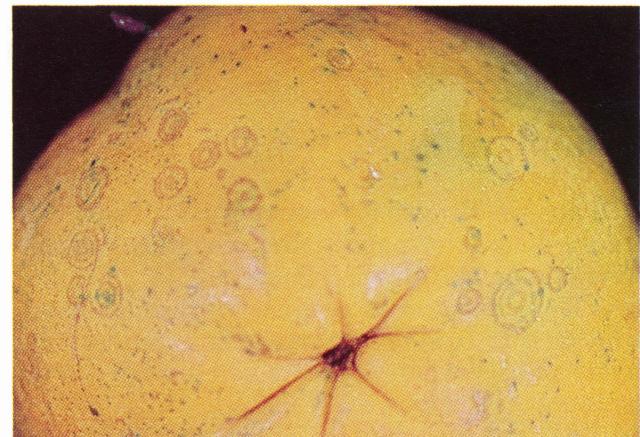
- Destroy alternate host plants.

#### Getting Help

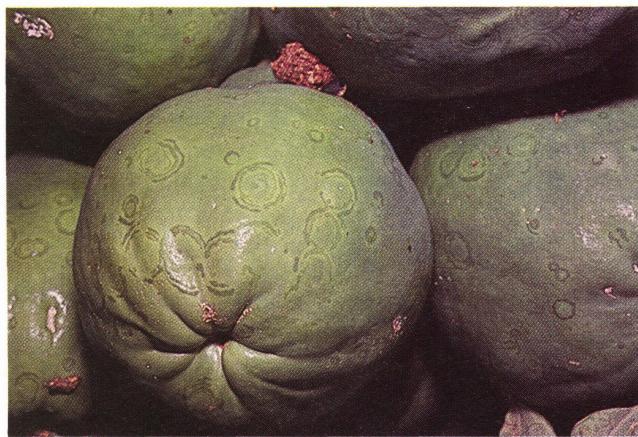
If PRV infection is suspected, call the nearest office of the Hawaii Department of Agriculture or the nearest County Extension Office of the University of Hawaii, College of Tropical Agriculture and Human Resources.



**Figure 1. Papaya plant infected with PRV.** Leaf growth is reduced, and the top of the leaf canopy appears open rather than full. Leaf petioles are drooping. Leaves are yellowed, with clearing between the veins and crinkled margins. Recent flowers have aborted, and the fruit column is not developing normally.



**Figure 3. Ringspots on mature fruit.**



**Figure 2. Ringspots on green fruit.**



**Figure 4. Stem symptoms.** Streaked parts of the stem appear to be water-soaked or oil-soaked. This may also occur on petioles.

## DETAILED DISCUSSION

### PRV Occurrence

Papaya Ringspot Virus is the most severe papaya disease and is often the limiting factor in papaya production throughout the world. It formerly was called "papaya mosaic" or "papaya mosaic virus."

PRV is widespread throughout Oahu. On Hawaii, it is common in North and South Kona, and outbreaks are frequent in the Hilo-Panaewa area. The important papaya production areas in Puna are currently (1989) free of the disease, but its spread into the Puna orchards is a constant threat. PRV was found in the Moloaa area of Kauai in 1985 and had previously been found in the Happy Valley area of Maui. Both Kauai and Maui are presently declared free of PRV. The virus has not been observed on Lanai or Molokai.

### Symptoms

Early leaf symptoms appear as stunting of young leaves at the crown of the tree (Figure 1). These symptoms include the upward curling of the leaf margins, with chlorotic mottling and blistering of the leaf surface. A severe symptom is "shoe-stringing" of the leaves, where the leaf blades are shrunken to little more than the width of the veins. Translucent water-soaked or oily-looking spots may occur on leaf petioles and on young, green parts of the stem (Figure 4). Chlorotic lesions ranging in color from tan to yellow may also be present along leaf veins and on the stem.

Initial fruit symptoms include slightly raised, circular spots on the fruit surface. The spots are initially about 1 mm in diameter with dark green outer rims and tan centers. In later stages, these spots may become ringspots 4–8 mm in diameter (Figures 2, 3). Fruits formed after the plant is infected usually have ringspots and may be distorted. Fruits that are maturing on the plant at the time of infection may not show symptoms.

The disease symptoms are generally more pronounced during cool winter months and suppressed during warmer weather. Fertilizer applications that green up diseased plants do not cure the virus.

### Transmission

PRV is transmitted by aphids, principally the green peach aphid. Aphids are usually found more abundantly on alternate hosts of PRV than on papaya, which is not normally a host plant of

aphids. Other aphids found to transmit PRV in Hawaii are the melon aphid, corn leaf aphid, potato aphid, and cowpea aphid. PRV is carried on the piercing-sucking mouth-part of the aphid after it feeds on an infected plant. Aphids usually move into papaya fields as a result of population pressure and wind direction. The disease can spread quickly if there is a source of infected plants in or around the orchard.

PRV can also be spread by mechanical means, such as tools contaminated with sap of infected plants, but this is not an important method of transmission. Tools can be cleaned of virus by dipping them in skim milk or chlorine bleach solution (1 part chlorine bleach to 9 parts water).

There are three key facts about aphid transmission that affect the way PRV spreads and is controlled.

#### 1. *Aphids do not prefer to feed on papaya plants.*

Once they have entered the papaya field, the aphids may feed on many papaya plants in a short time as they search for a desirable host. By feeding for only a few seconds, an aphid can pick up the virus or infect a plant. This means that the disease can spread rapidly once infected aphids enter a papaya field.

#### 2. *The virus is short-lived (nonpersistent) in the aphid.*

After the aphid has picked up the virus from an infected plant, it can transmit the virus for only a short time (1/2-hour to 1 hour). Because aphids fly poorly, they are likely to move only a short distance within that period. This means that if the area around a papaya field is kept clean of alternate host plants and infected papaya plants, the field will more likely be kept virus-free.

#### 3. *Aphids are slow and nonaggressive flyers but can be dispersed considerable distances by wind.*

This means that sanitation in the immediate vicinity of a papaya field does not guarantee protection from PRV if aphids can be blown in from nearby areas. Quarantines and sanitation programs to protect entire regions are the best defense.

### Control

At present, there is no cure for PRV. The only control is prevention by early identification and elimination of infected trees in and around the orchard.

The Hawaii Department of Agriculture Plant Pest Control Branch has assigned personnel to

identify and destroy PRV-infected papaya trees and advise removal of alternate host plants. If you suspect a tree is infected with the virus, please call the experts.

It is imperative that neither PRV-infected papaya nor cucurbits be transported into "virus-free" commercial production areas such as the Puna district. Alternate hosts of PRV should not be grown close to papaya orchards. Growers in Puna who start an orchard by transplants should grow their seedlings in the Puna area and not transport their plants from Hilo. Any transport

of papaya seedlings increases the risk of introducing the virus into new areas and should be avoided. Seeds do not harbor the virus and can be safely transported from one place to another. Direct seeding is the recommended method of establishing new plantings, to minimize the risk of PRV.

The authors thank M. Isherwood and W. I. Kobayashi of the Hawaii Department of Agriculture and D. Ullman of CTAHR for their cooperation and suggestions on this publication.

#### **DISCLAIMER**

Reference to a company or product name does not imply approval or recommendation of the product by the College of Tropical Agriculture and Human Resources, University of Hawaii, or the United States Department of Agriculture to the exclusion of others that may be suitable.

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U. S. Department of Agriculture. Noel P. Kefford, Director and Dean, Cooperative Extension Service, College of Tropical Agriculture and Human Resources, University of Hawaii at Manoa, Honolulu, Hawaii 96822. An Equal Opportunity Employer providing programs and services to the citizens of Hawaii without regard to race, color, national origin, or sex.

12/89