Cooperative Extension Service
College of Tropical Agriculture and Human Resources
University of Hawai'i at Mānoa

Banana Bunchy Top: Detailed Signs and Symptoms

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May 2004

Photo credits: The following individuals contributed photographs for this document: Scot Nelson, Russell Messing, Randall Hamasaki, Douglas Gaskill, Wayne Nishijima, Mark Wright.

This document provides detailed and high-quality images and symptom descriptions for banana bunchy top disease (BBTD). The disease is caused by the banana bunchy top virus (BBTV). The virus is vectored by the banana aphid (*Pentalonia nigronervosa*).

The purpose of this article is to enhance one's ability to recognize bunchy top and the aphid vector. This document supplements the information in PD-12 ("*Banana Bunchy Top Virus*"), which is available at http://www2.ctahr.hawaii.edu/oc/freepubs/pdf/PD-12.pdf, and the article about the banana aphid, which is available online at the CTAHR *Crop Knowledge Master* website http://www.extento.hawaii.edu/kbase/crop/Type/pentalon.htm.

Contents:

Banana Bunchy Top Symptoms

(Adapted from UH-CTAHR Cooperative Extension PD-12, *Banana Bunchy Top Virus*):

Keikis: The keikis (suckers) which develop after a "mother" plant has been infected with BBTV are usually severely stunted, with leaves that do not expand normally and remain bunched at the top of the pseudostem. These leaves are stiff and erect, are shorter and narrower than normal leaves, and have chlorotic edges. Keikis with these symptoms will not bear fruit.

Maturing plants: On mature plants infected with BBTV, new leaves emerge with difficulty, are narrower than normal, are wavy rather than flat, and have yellow (chlorotic) leaf margins. They appear to be "bunched" at the top of the plant, the symptom for which this disease is named. Severely infected banana plants usually will not fruit, but if fruit is produced, the banana hands and fingers are likely to be distorted and twisted.

Subtle disease symptoms: Some symptoms require close inspection to in order to see them. The ability to detect these symptoms enables earlier removal of diseased plants. These symptoms are referred to as "Morse Code Streaking" and "Green J-Hooks."

Morse code streaking. The initial symptoms of banana bunchy top virus consist of dark green streaks in the veins of lower portions of the leaf midrib and the leaf stem (petiole). The streaks also occur, but are less prominent, in the veins of the leaf blade (lamina). This symptom is sometimes referred to as "Morse code streaking" because the streaks are irregular and resemble a series of "dots" and "dashes." Rubbing away the waxy white coating that covers the petiole or midrib makes it easier to see the streaking.

Green J-hooks. Also, dark green, hook-like extensions of the leaf lamina veins can be seen in the narrow, light-green zone between the midrib and the lamina. The short hooks point down along the midrib toward the petiole. They can best be seen by back-lighting the leaf against the sky.

The banana aphid (*Pentalonia nigronervosa*): Adults

Adult banana aphids are small to medium-sized aphids (1/25 to 1/12 inch), shiny, reddish to dark brown or almost black. They have six-segmented antennae that are as long as the body. Adults start producing young aphids one day after reaching maturity. They can give birth to 4 aphids per day with an average production of 14 offspring per female (adapted text from *Crop Knowledge Master*).

The banana aphid (*Pentalonia nigronervosa*): Alates

Alate banana aphids have prominent, dark (brown or black) wing veins. Winged adults often develop after 7 to 10 generations of wingless individuals. Dispersing winged adults establish new colonies on other new host plants. Although they are not strong fliers, they may be carried considerable distances by light winds. Flight activity peaks between 9:00 to 11:00 AM and 5:00 PM to dusk (from *Crop Knowledge Master*).

The banana aphid (*Pentalonia nigronervosa*): Colonies

Colonies of the banana aphid feed on tender foliage of the young banana leaves and leaf sheaths. Small colonies occasionally occur on the leaf blade. Ants are associated with the banana aphid. The ants feed on the honeydew secreted by the aphid and, in turn, establish new aphid colonies and ward off natural enemies. The aphids in this image are magnified in size (text adapted from *Crop Knowledge Master*).

The banana aphid (*Pentalonia nigronervosa*): Colonies on cigar leaf

A colony of banana aphids may be found and observed with the naked eye on a banana "cigar leaf" (the youngest, unfurled leaf). Banana aphids are often associated with tender plant tissues or young plants (keikis).

The banana aphid (*Pentalonia nigronervosa*): Colonies under leaf sheath

A colony of banana aphids was hiding under a leaf sheath which was pulled away from a banana pseudostem to reveal them. A dead, long-legged ant is shown above. Like some other ant species, the long-legged ant is associated with the banana aphid. The ants feed on the honeydew secreted by the aphid and, in turn, help establish new aphid colonies and help ward off natural enemies of the aphids. To kill these aphids with some insecticide sprays is very difficult, because the spray must drench behind leaf sheaths and reach into the protected area to kill aphids where the leaf sheath and the petiole attach to the banana pseudostem.

BBTV disease symptoms:
Advanced symptoms on small plants

These are the **most conspicuous symptoms** of BBTD, and indicate an advanced stage of the disease within a given area.

The **keikis** (suckers) which develop after a mother plant has been infected with BBTV are usually severely stunted, with leaves that do not expand normally and remain bunched at the top of the pseudostem. These leaves are stiff and erect, are shorter and narrower than normal leaves, and have chlorotic (yellow) and wavy edges. Note that the mother plant in this photograph (with dead leaves hanging down) died some time ago and was not harvested.

BBTV disease symptoms:
Advanced symptoms on small plants (continued)

A small, isolated **young plant** is depicted with severe BBTD symptoms (erect, bunched, yellow leaves). The plant was found growing in a vacant lot with no other banana plants within many meters. This suggests an advanced stage of disease in the area; all pre-existing mother plants in the adjacent vicinity have perhaps died. Leaves are stiff, erect, have some yellow leaf margins, and are bunched.

BBTV disease symptoms:
Advanced symptoms on small plants (continued)

Leaf abnormalities (leaf distortion, marginal leaf yellowing, interveinal yellowing, stiffness, erectness, small size, J-hooks, Morse code) in the youngest, emerging leaf are typical of banana bunchy top. Examining the most newly emerging leaf for symptoms is the most reliable way to diagnose BBTD visually.

BBTV disease symptoms:
Advanced symptoms on large plants

When severely diseased, large or mature banana plants with BBTV infection can exhibit symptoms which resemble very closely the **obviously bunchy symptoms** commonly seen on the young or small plants in advanced stages of the disease.

BBTV disease symptoms:
Advanced symptoms on large plants (continued)

A larger plant with **somewhat less obvious bunching symptom** than the plant shown on page 11. Usually, the "bunchy" symptom on larger plants is not as dramatic as on small plants or keikis. These less dramatic symptoms indicate that a plant was probably not infected at an early growth stage, but after it had matured somewhat.

BBTV disease symptoms:
Subtle symptoms on large plants

Relatively mature banana plant with more **subtle symptoms** of BBTD. The leaf bunching is not as pronounced and the leaf yellowing is not as intense, but the leaves are somewhat erect.

To verify the disease, one must take a closer look at the petioles and leaves to see the Morse code and green J-hooking symptoms (see images of this plant on pages 14 and 17).

BBTV disease symptoms:
Leaf symptoms (Morse code, Green hooks)

Banana leaf showing **Morse code** (dot/dash) symptoms in leaf veins (red arrow), from plant shown on page 13. The symptom is best observed by holding up the banana leaf between your eyes and a source of light (i.e., the sun). Some green hooks are visible along the left-hand side of the leaf midrib in this image.

BBTV disease symptoms :
Leaf symptoms (Morse code, Green J-hooks)

BBTV-infected banana leaf showing distinct **green J-hook**s symptom along the leaf midrib (red arrow).

BBTV disease symptoms :
Leaf symptoms (Morse code, Green J-hooks)

Diseased, with green J-hooks and Morse code

Healthy, without green J-hooks and Morse code

Healthy banana leaves do not have Morse code symptoms or green J-hooks.

BBTV disease symptoms:
Petiole symptoms (Morse code)

(Left) **Morse code** streaking on petiole of large, BBTV-infected plant (red arrow).
(Right) Adjacent plant without BBTV has **no Morse code** streaking on petioles (white arrow).

BBTV disease symptoms: petiole symptoms (Morse code)

Severe **Morse code streaking** symptoms (red arrow) on banana leaf petioles. Note the green "dot and dash" striping along the veins.

BBTV disease symptoms:
Flower symptoms (Morse code)

The **Morse code** symptoms on a banana inflorescence (red arrow) indicate a relatively late infection for this plant. Most plants with severe BBTV infections will not flower or bear fruit, or fruits may be deformed by the effects of BBTD disease.

Note: *This symptom is very similar to a disease which is caused by another banana virus, cucumber mosaic cucumovirus (CMV), shown on page 21).*

Submitting banana leaf samples for BBTV virus testing

Select the midrib of the third leaf from the top of a suspect banana plant. This tissue, according to CTAHR ADSC (College of Tropical Agriculture and Human Resources Agricultural Diagnostic Service Center), is the best tissue to submit as it contains high viral titer (large amount of virus).

Preferably, submit fresh tissue that has not been allowed to sit in a hot car or decompose. Submit the sample to your local Cooperative Extension Service Office.

The current BBTV test is an ELISA method (enzyme-linked immunosorbent assay). Current cost to the consumer is $5.00 per individual ample.

Cucumber Mosaic Cucumovirus (CMV) symptoms

Typical flower and leaf symptoms for bananas infected with cucumber mosaic cucumovirus (**CMV**). Top: flower deformity and streaking. Middle: Leaf streaking. Bottom: interveinal chlorosis (yellowing). This disease **may be confused with BBTV**. CMV has a very wide host range, but is not considered an economically significant disease of bananas in Hawaii.

Literature Cited

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