



Banana Bunchy Top Virus

Banana bunchy top virus (BBTV) is one of the most serious diseases of banana. Once established, it is extremely difficult to eradicate or manage. BBTV is widespread in Southeast Asia, the Philippines, Taiwan, most of the South Pacific islands, and parts of India and Africa. BBTV does not occur in Central or South America. In Hawaii, BBTV was first observed in 1989 and is now widely established on Oahu. In 1995 it was discovered in the Kona area of the island of Hawaii, and in 1997 it was found on the island of Kauai.

The virus is spread from plant to plant by aphids and from place to place by people transporting planting materials obtained from infected plants. There is no cure for BBTV. Some banana varieties, like the Cavendish types, are more readily infected with the virus, but no variety of banana is resistant. Banana plants that show symptoms rarely bear fruit, and because they are reservoirs of the virus, they must be destroyed. BBTV is a serious threat to Hawaii's banana industry and to the productivity of banana plantings in home gardens.

Symptoms of BBTV

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) (Figure 1). 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. 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 (Figure 2). The short hooks point down along the midrib toward the petiole. They can best be seen by back-lighting the leaf against the sky.

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.

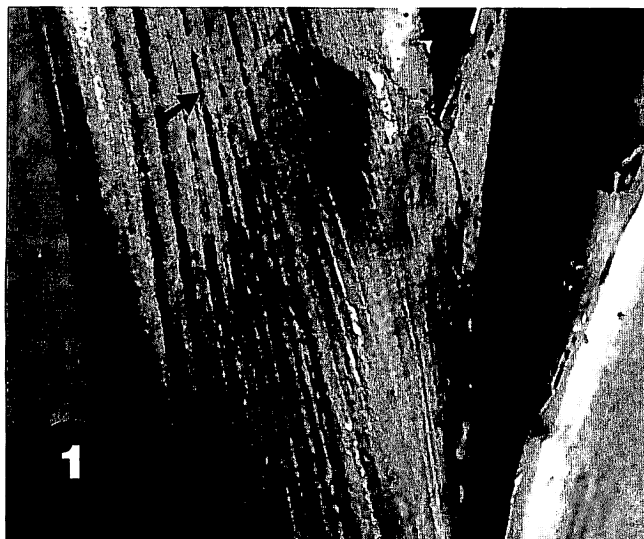
The keikis (suckers) that develop after a "mother" plant has been infected with BBTV are usually severely stunted, with leaves that do not expand normally and remain bunched at the top of the pseudostem. These leaves are stiff and erect, are shorter and narrower than normal leaves, and have chlorotic edges (Figure 3). Keikis with these symptoms will not produce fruit.

Disease spread and development

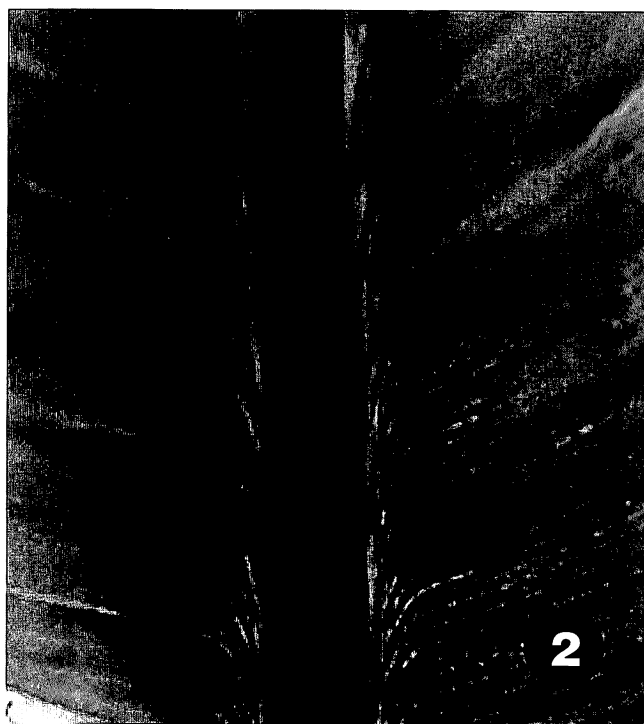
Banana bunchy top virus is spread by the banana aphid, which acquires the virus after at least four (but usually about 18) hours of feeding on an infected plant (Figures 4 and 5). The aphid can retain the virus through its adult life, for a period of 15–20 days. During this time, the aphid can transmit the virus to a healthy banana plant by feeding on it, possibly for as little as 15 minutes but more typically for about two hours. Disease symptoms usually appear about a month after infection.

Control of BBTV

The most important factors in controlling banana bunchy top virus are killing the aphid vector (disease carrier) and rogueing (removing and destroying) infected banana plants. By killing the aphids on the banana plant, dispersal of virus-carrying aphids to nearby, healthy banana plants is avoided. Since the only host of BBTV is banana, rogueing infected trees reduces spread of the virus by reducing the opportunity for aphids to acquire the virus or for people to obtain and transport infected suckers or planting material.



An early symptom of BBTV infection is "Morse code streaking" on the leaf stem (petiole).



The "hooking" symptom of BBTV, where the veins of the leaf blade extend into the normally clear area along the leaf midrib and point down toward the base of the leaf.

Control methods used are likely to vary depending on whether you are a homeowner or a commercial banana grower. Commercial growers may prefer to use pesticides and are usually knowledgeable about their proper use, while homeowners may prefer not to use pesticides.

Homeowner methods for aphid control

Aphids can be killed by spraying them with soapy water, and some insecticidal soaps are legally registered as pesticides. Insecticidal soaps have the advantage of being relatively non-toxic to people, birds, and other animals. The spray solution should be directed to the places where the aphids are most likely to be hiding or feeding. This includes the leaf petioles and the "pockets" where the petioles separate from the pseudostem. In particular, aphids can be found feeding on young suckers and down inside the whorl of the latest, unfurled leaf. After spraying the aphids, do not disturb the plant until the next day.



Young banana plants showing advanced symptoms of BBTV, including yellowed leaf margins and narrow, stiff, erect leaves "bunched" together at the top of the stem.



Aphids congregate and feed on the unfurled leaves of young banana plants.

Several commercial insecticidal soaps are registered for use in Hawaii. Consult your local garden shop for suitable products. In many situations, home-mixed soap sprays may be as effective as the commercial products, but they may contain additives toxic to plants. In addition, these home remedies are not legally registered as pesticides.

If the infected plant is tall and it is difficult to reach the upper petioles and unfurled leaf with the spray, it may be necessary to carefully cut and lower the plant to reach those parts. Cut a notch about $\frac{1}{3}$ into the pseudostem, preferably on the side it is leaning toward, if that is a clear path to lower the plant. Then, carefully cut a slit with a sawing motion opposite and a few inches above the notch, until the plant starts to lean. If this is done carefully, the stem will not crash to the ground, thereby disburasing the aphids, but rather it will come down gradually to where it can be grabbed, steadied, and helped to descend. Spray for aphid control immediately, and then leave the plant undisturbed for about a day.



Aphids and ants, which tend them, on the petiole and lamina of the underside of a young banana plant leaf.

Banana aphids also feed on heliconia and flowering ginger. Although these plants do not harbor the virus, they should also be sprayed to control aphids on them when they are in the vicinity of banana plants. This would help reduce aphid populations in the area.

Homeowner methods for removing infected plants

Banana plants infected with BBTv should be destroyed after killing the aphids. The main corm and any keikis arising from it must be dug up to prevent regrowth. If the infected plant is in a mat (group or clump of plants), the entire mat should be destroyed, even if only a single sucker is infected. The parts of the corm with potential to regrow should be disposed of in such a way that they cannot regrow. Effective methods include incineration, burial in a landfill, thorough chopping and drying, and allowing them to rot in black plastic bags.

Commercial-grower methods for aphid control and rogueing

For control of aphids on banana plants, Prentox Diazinon AG500 has been approved for use in Hawaii on plants that are not fruiting (SLN no. HI-900007, EPA reg. no. 655-459). Diazinon kills aphids on contact but has no residual effect on aphids.

Aphids on heliconia and flowering ginger in the vicinity of banana plants can be controlled with systemic insecticides approved for such use. No systemic insecticide is approved for use on banana against aphids.

Infected banana plants can be killed with the systemic herbicide glyphosate. Roundup Ultra™ (SLN no. HI-960005, EPA reg. no. 524-475) is approved for use in Hawaii on banana; follow label directions.

Even if only a single sucker in a mat is infected, the entire mat must be destroyed. If regrowth occurs from the rogued plants or mat, both aphid control and rogueing must be repeated until the plants are completely killed.

Anyone using diazinon or glyphosate in a BBTv control program in banana must have a copy of the Special Local Need pesticide label covering the use in their possession at the time of application. These labels can be obtained from the pesticide retailer or the Hawaii Department of Agriculture, Pesticides Branch.

Caution: Pesticide use is governed by state and federal regulations. Read the pesticide label to ensure that the intended use is included on it, and follow all label directions.

Establishing new plantings

Banana growers establishing new commercial plantings should use extreme care in selecting or obtaining suckers and corms to establish new fields. "Seed" materials should be obtained from BBTv-free areas. Tissue-cultured plantlets should be derived from mother plants that have been "indexed" for BBTv and grown in insect-proof screenhouses.

Homeowners wishing to plant bananas should seek reasonable assurance that the keikis are virus-free. There is no certification program in Hawaii to ensure that banana plants being sold are free of BBTv. After planting bananas, examine them frequently for signs of virus infection.

Plant quarantine

Hawaii law prohibits importation of banana planting materials into the state without permit and a one-year quarantine period. A local quarantine has also been imposed by the Hawaii Department of Agriculture prohibiting movement of banana plants and plant parts (except fruits) from Oahu and Kona to any other islands, and this quarantine may be extended to include Kauai. To reduce the risk of introducing BBTv to new areas, shipping banana planting materials between any of the Hawaiian islands is not recommended. Also, when heliconia or flowering ginger plants, cut flowers, or propagules are shipped between islands, precautions should be taken to ensure that they are free of the banana aphid.

Controlling banana bunchy top virus where it is established and keeping it out of virus-free areas is everybody's business. If your plants are infected, your neighbor's likely will soon be too, and vice versa.

For further advice on BBTv identification and control, contact your local Cooperative Extension Service office, or the CTAHR Plant Disease Clinic (Oahu: 956-8053, Hilo: 959-9155), or the Hawaii Department of Agriculture, Pest Control Branch (Oahu: 973-9538, Hilo: 974-4143, Kona: 323-4565, Wailuku: 873-3555, Lihue: 274-3069).

Revised by Stephen A. Ferreira¹, Eduardo E. Trujillo¹, and Desmond Y. Ogata² from an earlier version titled "Bunchy Top Disease of Bananas," Commodity Fact Sheet BAN-4(A), 1989. Nilton Matayoshi and Myron Isherwood, Hawaii Department of Agriculture, provided comment.
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