COLLEGE OF TROPICAL AGRICULTURE AND HUMAN RESOURCES
UNIVERSITY OF HAWAI'I AT MANOA

Red Ginger Viruses in Hawai'i

A Symptom Identification Guide

Introduction

Red Ginger is host to several viral pathogens that can affect both its appearance as a landscape plant and its productivity as a floriculture crop. The purpose of this guide is to help with the identification of virus-infected red ginger plants.

There are six currently known viruses that infect red ginger. The table below reviews those viruses and their known important characteristics. The following pages will review virus symptoms with photographs for easy recognition. We will also review some known symptoms of co-infections with multiple viruses and non-virus symptoms that are often confused with virus infection.

This is meant to be an updated identification guide. For current control methods of viruses affecting red ginger, please see CTAHR Extension publication OF-53, "Preventing and Controlling Pathogens in Red Ginger (Alpinia purpurate) Cut Flower Production." In the field, detection can be difficult, so if you believe you have red ginger virus and cannot accurately identify the cause, contact your local Extension office for help.

Table 1. Known viruses, their known or assumed insect vector, whether they exist long term in the vector (Persistence), whether they are thought to cause severe decline symptoms, how often they were identified in collected symptomatic samples, and what Hawaiian islands they were identified on.

Virus	Vector	Persistence in Vector?	Severe symptoms?	Prevalence (n=79)
Alpinia Vein Clearing Virus (ApVCV)	Mealybug	Unknown	Yes, alone, and with other viruses	Found in 37% of samples
Alpinia Vein Streaking Virus (ApVSV)	Aphid	Unknown	Yes, alone, and with other viruses	Found in 26% of samples
Canna Yellow Mottle Virus (CaYMV)	Possibly Mealybug	Unknown	Sometimes, mostly with other viruses	Found in 30% of samples
Banana Bract Mosaic Virus (BBrMV)	Aphid	Non-persistent	Mostly with other viruses	Found in less than 1% of samples
Banana Streak Virus (BSV)	Possibly Mealybug	Unknown	Rarely alone, but yes with other viruses	Found in less than 1% of samples
Bean Common Mosaic Virus (BCMV)	Possibly Aphid	Non-persistent	Mostly with other viruses	Found in less than 1% of samples

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Virus Infection Symptoms

Alpinia Vein Clearing Virus (ApVCV)

ApVCV typically causes vein-clearing symptoms (Figure 1). These symptoms resemble interveinal chlorosis and cause a striped pattern on the mature and immature leaves on stems of varying maturity. This symptom is most visible on fully mature leaves of older stems. Plants can also be stunted in height between 1 to 3 feet tall.

Figure 2 represents a typical height of stunted plants infected with ApVCV. Plants infected with ApVCV can also appear healthy and do not always show symptoms. ApVCV can occasionally cause severe decline symptoms on its own, but more often causes decline when coinfecting plants with any of the listed other viruses.

Figure 1. ApVCV-infected plant. Typical vein-clearing symptoms on a somewhat healthy plant.

Figure 2. ApVCV-infected plant. Plants can become stunted to around 3 ft. when infected with ApVCV.

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Alpinia Vein Streaking Virus (ApVSV)

ApVSV can cause vein streaking symptoms that are very similar to ApVCV (Figure 3), although the symptoms are normally more pronounced with more well-defined streaks. Plants can also exhibit distorted foliage and bleaching on young leaves that in turn develop yellow and necrotic leaf edges (Figure 4). Plants infected with APVSV can also become severely stunted, like the specimen in Figure 5. The stunting is usually more severe than with ApVCV and the plant will also show symptoms of leaf deformation, along with the stunting. ApVSV can cause severe decline symptoms on its own and when coinfecting plants with other viruses.

Figure 3. (below) ApVSV-infected plant. Vein streaking symptoms associated with ApVSV.

Figure 4. (above, right) ApVSV-infected plant. Plants infected with ApVSV can also have distorted and bleached foliage.

Figure 5. (below, right) ApVSV-infected plant. Plants infected with ApVSV can become extremely stunted to around one foot tall and have severe decline symptoms.

Canna Yellow Mottle Virus (CaYMV)

CaYMV can cause streaking symptoms similar to ApVCV and ApVSV (Figure 6), but advanced indicative symptoms include leaf mottling, like those in Figure 7 and Figure 8. This mottling often looks like a spray brush pattern, as if a paint brush was flicked across the leaf. More advanced symptoms include severe stunting, yellowing, and necrosis of the leaves (Figure 9). Plants infected with CaYMV can also result in streaked colors breaking in the flowers (Figures 10, 11). CaYMV can cause severe decline symptoms on its own and when coinfecting plants with other viruses.

Figure 6. (below) CaYMV-infected plant. Plants infected with CaYMV can express symptoms similar to ApVCV and ApVSV. This figure shows a plant exhibiting common striping symptoms with more affected leaves around it.

Figure 7. (above, right) CaYMV-infected plant. Mottling patterns on the leaves like those shown here are indicative of plants infected with CaYMV.

Figure 8. (below, right) CaYMV-infected plant. Mottling on infected leaves.

Figure 9. (below) CaYMV-infected plant. Plants infected with CaYMV can have severe stunting and decline symptoms.

Figure 10. (above, right) CaYMV-infected plant. Color breaking in flowers is one symptom of CaYMV-infected plants.

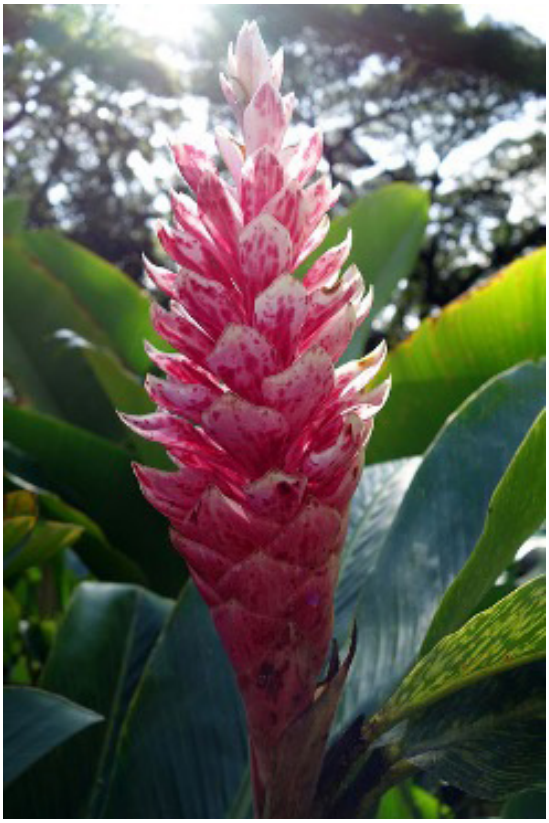
Figure 11. (below, right) CaYMV-infected plant. Color breaking symptoms, along with foliar symptoms.

Banana Bract Mosaic Virus (BBrMV)

BBrMV causes mosaic-like patterns on the leaves (Figure 12). These mosaic patterns vary from dark to light to chlorotic spots most visible on mature leaves. The leaves on BBrMV infected plants can turn yellow and necrotic on the leaf edges. BBrMV also causes color breaking on the flowers, which can be differentiated from CaYMV by the noticeable mosaic-like splotches on the bracts (Figure 13). BBrMV was not found commonly in symptomatic plants and presents severe decline symptoms mostly when co-infecting plants with other viruses.

Figure 12. (below) BBrMV-infected plant. Mosaic patterns typical of BBrMV-infected plants.

Figure 13. (right) BBrMV-infected plant. Color breaking can occur in BBrMV-infected plants.



Bean Common Mosaic Virus (BCMV) and Banana Streak Virus (BSV)

Not enough samples of these viruses have been collected to confidently describe the symptoms (see Table 1). These viruses are rarely found in symptomatic ginger plants and are considered low risk for ginger decline and red ginger production.

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Mixed Infection Symptoms

Coinfections of multiple viruses in the same plant were commonly identified during sampling. These coinfections cause variable and inconsistent symptoms, making field identification difficult.

Coinfections with two or more of the viruses ApVCV, ApVSV, and CaYMV

All samples collected that had coinfections and tested positive for ApVCV, ApVSV, and CaYMV displayed severe decline symptoms, including severe stunting (Figure 14). Coinfections, which tested positive for ApVCV and CaYMV, also displayed severe stunting symptoms (Figure 15). Both of these plants show indicative decline symptoms from coinfection with two or more of these viruses. Extreme stunting occurs, along with yellowing and necrosis of whole stems normally beginning at leaf tips and edges.

Figure 14. ApVCV-, ApVSV-, and CaYMV-infected plant. Mixed infections of these three viruses cause severe decline symptoms.

Figure 15. ApVCV- and CaYMV-infected plants. Mixed infections of these two viruses cause severe decline symptoms.

Coinfections of BBrMV with one of the following Viruses: ApVCV, ApVSV, CaYMV

Plants that tested positive for BBrMV coinfecting with one of the more common viruses (ApVCV, ApVSV, CaYMV) expressed symptoms similar to BBrMV infections (Figure 16). Leaf symptoms included mosaic patterns and chlorotic discoloration, and flowers expressed color breaking, however, plants and flowers were not always stunted (Figure 17). Coinfections of one other virus with just BBrMV usually did not have as significant stunting as coinfections between the three most common viruses (ApVCV, ApVSV, and CaYMV).

Figure 16. BBrMV-, ApVCV-, ApVSV-infected plant. Mosaic symptoms and color breaking.

Figure 17. BBrMV- and ApVSV-infected plant. A combination of vein streaking and mosaic symptoms.

Diseases Confused for Virus Infections

One common disease often confused for viral symptoms is a fungal leaf spot that often occurs in gingers, especially in plants weakened by viruses. The fungal leaf spots continuously tested positive for the fungal pathogen *Nigrospora sp.*, and samples inoculated with *Nigrospora sp.* caused similar lesions on leaves, although pathogenicity was not fully proven. The leaf spot symptoms in Figures 18 and 19 are not viral symptoms but are thought to be caused by the fungal pathogen *Nigrospora sp.*or another unidentified fungal pathogen. Plants that have these symptoms may be infected with viruses, but these symptoms do not necesarily mean they are virus infected.

Figure 18. Nigrospora-infected plant. This close-up image shows symptoms of fungal leaf spots assumingly caused by Nigrospora sp. or another fungal pathogen. Pathogenicity has not been proven. This is not a symptom of virus infection, but can occur on virus infected plants.

Figure 19 Nigrospora-infected plant. This plant level image shows what a plant may look like when infected with leaf spot fungal pathogens. This is not a symptom of virus infection, but can occur on virus infected plants.

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