PEST ADVISORY LEAFLET No. 47

Plant Protection Service
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Integrated Management of Kava Dieback Disease

Kava dieback disease is the most serious problem affecting kava production. For over 50 years, the cause of kava dieback disease remained unknown until a virus called Cucumber mosaic virus (CMV) was found to play a significant role. CMV is probably present on most Pacific Islands and has been found in dieback-affected kava plants in Fiji, Tonga, Samoa, Vanuatu, Hawai'i and the Cook Islands.

However, the relationship between kava dieback and CMV is not a simple one. Kava dieback may come and go at one location and may be much more severe in some places than in others. This is thought to be because dieback results from a complex of interactions of kava with environmental, agronomic or other stresses, with CMV at the centre. The exact factors involved probably vary in different places and at different times, but one thing is certain: if there is no CMV, there is no dieback. This Pest Advisory Leaflet therefore focuses on control of CMV and correct kava growing practices.

Fig. 1

SYMPTOMS OF KAVA DIEBACK

Diseased kava plants 'melt down' and die from a rapidly spreading black soft rot of the stems with the disease moving quickly from plant to plant (Fig. 1). Some or all of the stems rot and die back to the stem base and cycles of dieback followed by regrowth are common (Fig. 2). Usually, these eventually kill the plant.

Leaf symptoms

Symptoms of virus infection can usually be seen on the leaves before the stem rots. Young expanding leaves show patches of yellow against a green background. The patches have a sharply defined boundary. This mosaic symptom usually appears together with crinkling, blistering, or puckering along the leaf veins. Two or even all three of these other leaf symptoms may occur together (Fig. 3). On older leaves, the mosaic patches become yellow blotches because the leaf has expanded. Occasionally, general yellowing of the leaves, with dead and brown leaf edges, is the only symptom seen before stems rot. Very occasionally, infected kava plants wilt.

Fig. 2. Regrowth following dieback.

Fig. 3. First signs to look for on leaves: (a) mosaic, (b) mosaic plus crinkled leaf and (c) mosaic plus pucker.

Fig. 4. First sign of rot inside stems showing leaf symptoms.

Fig. 5. Stem rot from the tip.

Stem rot symptoms

The first signs of rot can often be seen inside stems of plants showing leaf symptoms (Fig. 4), but there may be no other outward signs of the disease. Dieback first becomes visible on the outside of the stem as a black soft rot either at the tip, stem branches, or nodes. As the rot spreads, the stems either rot back from the tip to the base (Fig. 5) or collapse in the middle (Fig. 6). Stems usually disintegrate completely.

Confusion about dieback symptoms

If the only visible damage is a small number of stems that died some time ago remaining on the plant like long dry sticks (Fig. 7) it is unlikely they were killed by dieback disease. There are many other conditions that can occasionally kill off a few kava stems. There is only one disease that is devastating, fast spreading, and results in a dramatic 'melt down' effect: dieback disease.

Fig. 6. Rot midway up a kava stem.

DISEASE TRANSMISSION AND SPREAD

CMV is spread from plant to plant by aphids. When aphids feed on leaves infected with CMV, they pick up the virus on their mouthparts. When they move to another susceptible host plant and feed again, the aphids transmit the virus to the new plant. The virus then multiplies and spreads within that plant. CMV is a non-persistent virus. This means that aphids pick up and transmit CMV in a few minutes, they remain infectious for only a few hours, and they lose the virus if they feed on a non-host plant.

Dieback disease usually starts in a low number of plants in a kava planting. These primary infections start either from infected planting material, or from incoming flying aphids that have picked up the virus elsewhere. These primary infections spread to become larger patches of diseased plants. This secondary spread is caused by aphids moving between plants. Patches of dieback can expand very quickly when conditions are favourable.

Fig. 7. Kava stems killed by causes other than dieback remain on the plant as long dry sticks.

DISEASE MANAGEMENT

Controlling CMV is not easy. As yet, no suitable disease-resistant varieties of kava have been found. There are no chemical sprays available which kill the virus in infected plants. Using insecticides to kill the aphids that spread the disease from plant to plant does not give effective control either. CMV is an especially challenging virus because it is very common and has an extremely broad host range, infecting over 1,200 plant species. However, recent research in Fiji offers new hope with findings showing that infected kava plants restrict movement of the virus within themselves. This means that usually only some stems contain the virus at any one time and most new growth is free of the virus.

There is no single, simple answer for kava farmers. Therefore, the key factors known about the disease have been combined into an 'integrated disease management package'. This package takes advantage of the two main weaknesses of CMV in kava:

1. The virus is unable to completely infect and spread through all parts of the kava plant.
2. When the aphids that spread CMV feed on non-host plants, the virus is easily lost from their mouthparts.

The integrated kava dieback disease management package

1. Choosing a good planting location

Dieback is worst in large plantings of kava grown on fully cleared land, especially if grown in monoculture. Dieback is much less of a problem when kava is grown in the traditional way; that is, in small, isolated plantings among natural vegetation and below a tree canopy. This is because most trees and many other natural plants are not hosts for the disease, so they act as a buffer zone, protecting the kava from incoming CMV. The more distance between the plantings, the better this works. The canopy of non-host trees above the kava acts as an extra barrier to CMV coming in from above. However, kava plantings must still be rotated to avoid build-up of soil-borne diseases.

2. Enhancing kava's natural ability to fight dieback

Kava seems to be less likely to develop dieback if it is growing vigorously. For this reason, growers should do everything possible to promote good growth. Kava should only be planted in the right kinds of soils: well-drained, fertile and high in organic matter. It also needs high humidity, and low light levels to really grow well. Intercrops and tree canopy cover help provide close, humid conditions and reduce excessive sunlight and drying winds.

3. Smart cropping: using natural barriers to reduce the spread of the disease

Kava is best intercropped in the early stages of growth. Planting non-host plants between kava plants will reduce the spread of CMV within plots because they act as a barrier to CMV movement between kava plants.

Intercrops to avoid

Other hosts of CMV should not be grown with kava. Crops that are well-known hosts of CMV include most cucurbits such as pumpkin and watermelon; many solanaceous plants including tomato, tobacco, capsicum, chili and eggplant; many legumes such as peanuts and snakebean; and passionfruit and pineapple. The leguminous shade tree, *Erythrina* sp. is a CMV host; other fast-growing legume shade trees may also be hosts.

Good intercrops

Only a few Pacific Island crops are not known to be hosts of CMV in other parts of the world. These crops include the two aroids related to true taro, Xanthosoma sp. and Alocasia macrorhiza, coconut, citrus, cassava, sugarcane, and tapa/masi. Some common Pacific crops are reported to become infected with CMV in other regions, but studies in Fiji show they are non-hosts, or only very occasional hosts, of the strains of CMV that cause dieback in kava. They are therefore also likely to be good kava intercrops. These crops are taro *(Colocasia esculenta),* banana (occasional host only), papaya, yam and sweet potato.

Weed hosts

Many common broad-leaved weeds are hosts to CMV. Important weed hosts that are very common on some islands are mile-a-minute *(Mikania micrantha)* and *Commelina* spp.

4. Start with healthy plants

Cultural control measures will not work if infected cuttings are used to start new plantings. Growers must use only uninfected planting material. The best choice of planting material is virus-indexed tissue culture plants. The second best choice is stems cut from plants growing in regions or on islands where the disease is not known or is uncommon. If these options are not possible, disease-free stems for propagation should be carefully selected from infected regions. CMV will not be present in every kava stem in places where dieback is a problem, but it will be in some and it is not always possible to tell which stems are infected. Plants showing the leaf or stem symptoms described above and those with stems that appear to have rotted back some time before must not be used. This is because some of the other apparently healthy looking stems will have virus in them. When CMV is spreading in kava plots, the virus may be present in plants before they start to show symptoms. For this reason, kava plantings that contain active disease 'hot spots' should be avoided.

5. Actions to slow spread of the disease from plant to plant if it appears

Destroying whole plants is a well-known method of slowing within-plot spread of plant virus diseases. This is called roguing. As kava plants get older, each plant becomes more valuable, so a less destructive process is better for kava crops. Because CMV is not present in all parts of infected kava plants, removing diseased stems as soon as they appear will greatly reduce the spread of CMV from plant to plant.

Plants must be examined regularly for early signs of dieback disease on leaves or stems (see photos). Remove any stem showing these signs by breaking it off at the first node (do not cut it with a knife as the knife may carry the virus afterwards). Immediately put the stem together with all its leaves in a plastic bag, or empty rice sack, fertiliser bag or similar type of bag. Then take the bag away from the other kava plants and destroy the stem (by burning it or burying it deep in soil). This will ensure that aphids on the stem or leaves are also removed and killed and cannot carry the disease to healthy plants nearby. The broken stem surface should be covered or painted to prevent rotting if wet conditions follow.

Plant inspection and roguing must be done at least once a week when dieback is spreading through the crop. When plants are less than one year old, the virus may often be more widespread inside the plant, so it is better to uproot the whole plant and remove it in the same way as diseased stems. If a nursery stock of young plants is kept ready, each rogued plant can be replaced with a healthy one.

SUMMARY OF CONTROL RECOMMENDATIONS

- Use traditional kava growing practices: grow kava in small, well-separated plantings among natural vegetation and below a tree canopy.
- Grow only on good soils, with intercrops and shade to ensure plants are strong and grow vigorously.
- Intercrop kava plants with crops that are non-hosts or only very occasional hosts of CMV.
- Use only very low risk planting material cut from healthy looking plants, preferably obtained from regions known to be free of dieback disease.
- Walk through the crop regularly, looking for early signs of disease. Break off, bag and destroy infected stems by burning or burying them as soon as they are discovered.

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