Pest Management Guidelines

Taro Diseases: A Guide for Field Identification

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Figures referred to in this document are unavailable at this time.

INTRODUCTION

This booklet is designed as a quick guide for identifying taro diseases. It is intended for field use by agricultural technicians and taro producers. The text gives brief descriptions of some of the principal taro diseases, their causal agents, and their symptoms. Color photographs illustrate diseased plants.
The text is divided into two main parts: infectious diseases of taro with biotic causal agents (fungi, bacteria, nematodes, and viruses) and noninfectious or abiotic problems of taro. Among these disease classes, fungal diseases of taro are the most economically significant. Hard rot, a disease without a known cause, may be responsible for large yield losses in some areas. Others, while not now economically significant, have the potential to become so.
A discussion of taro pests in Hawai'i is also included.

DISEASES CAUSED BY BIOTIC AGENTS

Fungal Diseases
Phytophthora Leaf Blight (Figure 1) Phytophthora colocasiae Rac.
Epidemics of leaf blight may occur throughout the year during rainy or overcast weather. When night temperatures are between 20 to 22°C and temperatures during the day are from 25 to 28°C, entire fields may be blighted in 5 to 7 days.
The early stages of the disease are characterized by small, circular, water-soaked lesions 1 to 2 cm in diameter, generally dark brown or purple . A clear, amber fluid exudes from the center of the lesion. This liquid turns bright yellow or dark purple when it dries . The lesions rapidly enlarge and take on a zonate appearance. The zonation is the result of the temperature-related growth response of the fungus, with rapid growth during the warm days followed by slow growth during the cooler nights. The sporangia (fungal spores) appear as white fuzz on both sides of the leaf. The ring of sporangia is particularly prominent in the morning before the leaves dry.
After initial establishment, lesion expansion is rapid until the leaf is entirely colonized and collapses. Under severe conditions, the fungus destroys the leaf petiole as well as the lamina and enters the corm, causing a firm, cream to brownish rot, with little or no odor. In the corm, the difference between healthy and diseased tissue is well defined.
Non-systemic or systemic fungicides applied on a regular basis are known to control leaf blight, if the environment is not conducive to disease development and the inoculum level is low. However, there are no fungicides cleared by the Environmental Protection Agency (EPA) for use on taro in the U.S.A.
Increasing the interplant distance and removing diseased and dead leaves from the field will reduce the rate

of disease spread.

Figure 1. Phytophthora leaf blight.
Figure 2. Corm rot caused by Pythium.

Pythium Rot (Soft Rot, Pala, Palahi) (Figures 2 and 3) Pythium aphanidermatum Fitzpatrick, P. graminicola Subramaniam, P. splendens Braun, P. irregulare Buisman, P. myriotylum Drechsler, P. carolinianum Matthews, P. ultimum Trow.
Pythium root and corm rots are probably the most widely distributed diseases of the crop. Warm and stagnant water in the paddies of wetland taro as well as poor field sanitation have been suggested as important factors contributing to the high incidence of soft rot.
The normally firm flesh of the corm is transformed into a soft, mushy, often malodorous mass. In wetland culture, the root system is destroyed except for a small fringe near the apex of the corm. Diseased plants become stunted, with leaf stalks shortened and leaf blades curled and crinkled, yellowish, and spotted. When the main corm dies, the lateral cormels develop roots and remain clustered around the cavity left by the disintegration of the main corm. The skin of the diseased corm usually remains intact until the corm interior has disintegrated completely. When the corm is cut open, there is usually a sharp line of demarcation between the healthy and diseased tissue. Diseased plants are easily removed from the soil by hand. Newly planted huli may be killed before they are able to produce leaves or may be severely stunted.
Selecting disease-free huli and harvesting the crop on time are major methods of limiting loss to soft rot. Water temperatures exceeding 27°C in the paddies favors the pathogen. A few taro varieties, such as Kai Kea, Kai Uliuli, and Lehua Maoli, have limited resistance to Pythium rots. Although several fungicides control Pythium, none are currently cleared in the U.S.

Figure 3. External symptoms of Pythium rot.

Phyllosticta Leaf Spot (Figure 4) Phyllosticta colocasiophila Weedon.
Cloudy, rainy weather for 2 to 3 weeks accompanied by cool winds is conducive to infection and disease development. The disease is limited by hot days and dry, cool nights.
The spots on the leaves vary from 8 mm to 25 mm or more and are oval or irregular in shape. The young spots are buff to reddish brown. Older spots are dark brown with a chlorotic region surrounding the lesion. The centers of the infected area frequently rot out to produce a shot-hole-type lesion. Phyllosticta spots generally resemble those caused by Phytophthora colocasiae, except for the absence of sporangia produced on Phytophthora lesions.
Phyllosticta spot generally is not severe enough to warrant control measures. Field sanitation reduces disease levels.

Figure 4. Phyllosticta leaf spot.

Cladosporium Leaf Spot (Figure 5) Cladosporium colocasiae Sawada.
Cladosporium colocasiae causes a relatively innocuous disease common on both wetland and upland taro and occurs mainly on the older leaves. On the upper leaf surface, the spot appears as a diffuse, light yellow to copper area. On the lower leaf surface, the spots are dark
brown due to superficial hyphae, sporophores, and conidia of the fungus. The lesions are generally ?5 to 10 mm in diameter.
Control measures are generally not needed for this disease.

Sclerotium or Southern Blight (Figure 6) Sclerotium rolfsii Sacc.; Sexual stage: Athelia rolfsii (Curzi) Tu and Kimbrough syn. Pellicularia rolfsii Curzi and West; Corticium rofsii Curzi.
Sclerotium blight is generally a problem of dryland taro, although wetland taro is frequently infected. This disease appears to be one of overmature corms and plant stress. Sclerotia abundantly produced on infected

corms persist in the soil, causing serious outbreaks of the disease in warm, wet weather after a significant dry spell. They also float on the water of paddies, infest the dead petioles of taro when the opportunity presents itself, and subsequently invade the corm and produce a rot in the field and in storage under some conditions. Affected plants are usually stunted and the corms are rotted at the base, where abundant sclerotia of the pathogen develop. The sclerotia are small, almost spherical, lemon yellow to dark brown bodies resembling cabbage seeds. The rotted tissue is ocher to brown and soft with a tendency to stringiness. A dense, white mycelium may cover the tissue. In wetland culture, the rot frequently starts at the waterline on the corm rather than at its base.

Some control in dryland taro is obtained by burying plant debris through deep plowing. The soil should be tested to insure adequate calcium levels for taro production. Growers should avoid using huli for new fields from infected plants or infested fields. Short term protection of mature corms in wetland taro can be achieved by raising the water level in the paddy. Submerging the fungal growth on the corm surface will kill the fungus but internal infections will persist.

Black Rot (Figure 7) Ceratocystis fimbriata Ellis and Halst.

Ceratocystis fimbriata causes a soft, dark to charcoal black rot with a fragrant banana odor, starting from natural or mechanical wounds in corms.

Do not use huli from infected plants or infested fields. No chemicals are registered for control of this disease in the U.S.

Rhizopus Rot (Figure 8) Rhizopus stolonifer Sacc.

Rhizopus rot is generally a postharvest problem in cleaning and packing areas. It is a white- to cream-colored soft rot ranging in consistency from cheesy to watery with a slight yeasty odor. The skin of the corm generally remains intact until the rot is very advanced. External development of mycelium is sparse; however, sporulation is extensive at breaks in the skin and at wounds resulting from the removal of cormels, covering these areas with a black, powdery layer.

Sanitation in the cleaning and packing areas is important for disease prevention by airborne spores of R. stolonifer. Daily removal of debris and disinfection of machinery and work surfaces reduce infection levels. Rinsing the cleaned corms well with running, clean water; dipping them into a 10-percent solution of liquid bleach for a minute; air drying; and storing the corms in a cool, clean area will also reduce losses.

Figure 5. Cladosporium leaf spot.

Basidiomycete Dry Rot (Unidentified basidiomycete)

A few dryland taro specimens with a rot associated with a basidiomycete have been collected on Kaua'i since 1980. The frequency of this rot has recently increased in the Kawaihau district on Kaua'i. The rot is dry to semi-dry, yellowish white to gray, begins at the lower perimeter of the corm at about the soil line, and advances into the corm. In general, a well-defined border of brown amorphous material separates the healthy and rotted tissues. Rots extend 10 to 20 mm into the corm. Depending on variety, a pink to red color extends from this border a few millimeters into the sound tissue. The rotted tissue may be spongy and dry or doughy with little or no odor. As time progresses, the fungus invades beyond the demarcation line and consumes the entire corm, killing the apical point. Generally the disease originates on the oldest corm. The pathogen then infects the suckers and kills the entire hill.

Mycelial strands grow along roots and plant debris and spread to other hills. Black plastic mulch appears to favor pathogen spread. Mushroom-like fruiting structures are sometimes found on infected corms.

Based on disease severity, some resistance to this disease has been observed in the taro germplasm collection maintained at the Kaua'i Branch Station, College of Tropical Agriculture. Two very susceptible varieties are Ulaula Kumu and Ulaula Poni.

Figure 9. Dasheen mosaic virus symptoms.

Viral Disease
Dasheen Mosaic (Figure 9) Dasheen mosaic virus
Dasheen mosaic virus is a flexuous rod 750 nm in length. It is a stylet-borne virus carried by aphids (Myzus persicae Sulzer, Aphis craccivora Koch., A. gossypii Glov.). The foliar symptoms include a dispersed and veinal mosaic pattern on the leaves.
Leaf distortion is generally mild to moderate. Plants generally become asymptomatic 3 to 4 months after initial symptom expression. Symptom expression seems to be more pronounced during the cooler months of the year in Hawai'i. The quality of the corm is not affected.
No varieties are immune to this virus, although Lehua Maoli appears to be more tolerant than others in the field. While chemical control of insect vectors is highly desirable, no insecticide is registered for wetland taro in the U.S.

Bacterial Disease
Bacterial Soft Rot (Figure 10) Erwinia carotovora [L. R. Jones] Holland; E. chrysanthemi Burkholder, McFadden, and Dimock.
Bacterial soft rot is a foul-smelling, watery, soft rot ranging in color from white to dark blue. Wounds and bruises caused by the feeding of insects and other animals and those inflicted at harvest are the most common infection courts for this disease. Free water is required for invasion by the bacteria.
Growers need to rely on cultural practices to control bacterial diseases. These include use of clean huli from disease-free fields and quick removal of diseased plants to prevent pathogen spread.

Figure 10. Bacterial soft rot. Note large central rot on the lower section of the corm. E. E. Trujillo photo.

Disease Caused by Nematodes
Root-knot Nematodes (Figure 11)
While several nematode species are commonly reported on taro, little work has been done on the effect of these invertebrates on taro growth or yield. The following nematodes have been reported on taro or dasheen: Pratylenchus sp.; Helicotylenchus sp.; H. dihystera (Cobb) Sher; Rotylenchulus reniformis; Meloidogyne sp.;

M. incognita (Kofoid-White) Chitwood; M. javanica (Treub) Chitwood; Longidorus sylphus Thorne; Tylenchorhynchus sp., Pratylenchus sp., and Aphelenchoides sp.
Root-knot nematodes (Meloidogyne spp.) damage dryland taro when the crop is planted in infested soils. Galls on the root and swelling and malformations on the corm are characteristic of attack by this nematode. Severe attacks will result in chlorotic and stunted plants.
Although several fumigants effectively reduce the populations of nematodes, none are registered for taro in the U.S. No host resistance has been identified.

Disease of Uncertain Cause
Hard Rot ("Guava Seed," Kalakoa) (Figure 12)
Taro hard rot, also called "guava seed" or kalakoa, is of unknown etiology and only reported from Hawai'i, where it may cause losses of up to 100 percent. Damage caused to feeder roots and large roots by Pythium spp. may be responsible for the problem. Hard rot incidence is high when the occurrence of Pythium corm rot is low and vice versa. It has also been reported that the use of planting material from infected corms increases the disease incidence in the subsequent crop.
The disease destroys the vascular system of the corm, starting with the root traces and working progressively inward. A healthy corm has a smooth skin. The skin of a diseased corm, on the other hand, is barklike, 3 to 6 mm thick, deeply furrowed, crumbly, and coarse.
Affected areas of the corm are woody and appear dull. They are filled with walled-off vascular elements tan to reddish brown in color, very much like the seed cavity of a cross-sectioned guava (Psidium guajava), thus giving the disease its local name "guava seed." In advanced stages of hard rot, all that remains of the corm is

a hardened, dark brown to black skeleton framework. Damage to roots by high-salt concentration, whether through intrusion by salt water in paddies lying near sea level or induced by the application of commercial fertilizers, may account for the stratification of the affected areas and the general limiting of the damage to the lower third of the corm.

Figure 13. Loliloli. Arrows indicate affected areas.

ABIOTIC DISEASE OR NONINFECTIOUS PROBLEMS

Physiological Problem
Loliloli (Figure 13)
Loliloli is a disorder of corms characterized by deficiency or absence of starch. While the normal corm is firm, crisp, and resilient to the touch, loliloli taro is soft and spongy, and water exudes when affected parts are squeezed. Any action that encourages resumption of vegetative growth in mature taro is likely to result in loliloli taro.

Toxicity: Herbicide Problem
Glyphosate (Figure 14)
Glyphosate (isopropylamine salt of N--(phosphonomethyl) glycine, Roundup) damage is evidenced by interveinal chlorosis and distortion of the laminae of emerging leaves. A high dosage of the chemical will produce shoestringing in the newly emerging leaves and will kill the plant. Taro is very sensitive to this compound and all contact with the chemical should be avoided. Spraying drift control with thickening agents such as Airdrop and spraying application during windless morning hours are precautions well taken when using glyphosate near taro.

Nutritional Imbalance
Lime-induced Chlorosis (Figure 15)
High pH of calcareous soils may induce iron deficiency in taro. Lime-induced chlorosis appears first between the veins of the youngest leaves. The leaves turn from yellowish green to a bleached yellow and the plant may be stunted. This is a problem in alkaline or calcareous soils. Foliar application of an aqueous solution of 0.5 to 1.0 percent ferric sulfate, ferrous carbonate, or iron chelates, repeated as necessary, will correct the condition.

PESTS OF TARO IN HAWAI'I

Mole Cricket (Gryllotalpa africana Palisot De Beauvois)
The mole cricket tunnels in the dikes surrounding taro paddies causing leaks in the banks. Damage caused by these insects is generally limited. No insecticide is cleared for use in wetland taro to control this pest.

Root Aphid (Pemphigus sp.)
This aphid is a serious pest of dryland taro. Feeding activities injure developing roots and can cause plant death. This aphid is restricted to dryland taro on the island of Hawai'i. Consequently, no taro should be transported to any other island unless they are in tissue cultured flasks. Tissue cultured taro established in pots are subject to infestation and cannot be moved to other taro growing areas from the Big Island. Only one aphid is needed to initiate a new colony. Once introduction and establishment occurs, this insect is impossible to eradicate.

Crayfish (Procambraus clarkii Girard)
This crustacean tunnels in the dikes around paddy taro and sometimes causes extensive leaks in the banks and paddy bottom. While paradichlorobenzene will kill them, no pesticide is currently cleared by the EPA for crayfish control in taro. Physical removal by trapping will reduce numbers. Some wading birds and bull frogs

feed on crayfish. If your paddies are free of crayfish, make every effort to prevent introduction.

Apple Snail (Pomacea canaliculata Lamarck)
Snails cause considerable damage to taro by feeding on all parts of the plant. Wounds on the plant resulting from feeding activities provide excellent infection courts for pathogens. The apple snail is a major problem of wetland taro on Kaua'i, Maui, Hawai'i, and O'ahu. Apple snails grow to 7.5 cm (3 inches) in diameter and are voracious feeders.
Avoid transporting taro from paddies infested with apple snails. Hand picking the snails from taro patches and destroying their eggs are the only means of controlling the snails on Kaua'i. Cayuga ducks are used on Maui where no native Koloa ducks are present. While some chemical and biological controls are being researched, none are close to approval by the EPA for use.

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