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Improvements in Taro Culture and Reduction in Disease Levels

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Pocket rot of taro continues to be a major problem in most wetland taro fields. In greenhouse tests, this corm disease was recently reproduced for the first time by inoculating clean, healthy taro plants with a new *Phytophthora* species.

Phytophthora is a microorganism that causes diseases in many plants. It was originally classified as a fungus, but it has been shown to be related to algae and is now classified in the biological kingdom Stramenopila. Pesticides, including metalaxyl, can control diseases caused by *Phytophthora*, but none of these are registered for use in wetland taro fields. Also, several populations of *Phytophthora colocasiae*, the cause of leaf blight, have been found to be resistant to metalaxyl. The origin of these resistant strains is unknown.

Even without the use of pesticides, however, growers can improve their crops. The following recommended practices for taro cultivation take advantage of the biology of the taro plant, the pathogens' growth requirements, and the natural ecosystem in the wetland *lo'i* (paddy), which helps to control diseases.

Use clean *huli*

Always plant fields with clean *huli* (starter plants). The presence of disease in *huli* is a problem that begins a few months before the taro crop is harvested. When the amount of leaf blight in the crop is high, the taro plant is weakened and small rots are likely to be found on the upper part of the *huli* corm. Leaf blight—large rotted sections of the taro leaf—is very common during wet weather. As the weeks pass, the corm grows and the small rots move slightly lower on the corm. The rots are not easy to find and often form under the corm's skin, with no sign of disease on its surface.

A field that has had low levels of leaf rot for at least a month or two before harvest is generally healthy and ideal for collection of healthy *huli*. Unfortunately, fields often must be harvested during wet periods, when rotting leaves are common and small rots on *huli* are widespread. In this situation, the grower must take extra time to carefully check each *huli* for any sign of rots. At times the hidden rot is exposed when the *huli* is harvested, and these rots should be trimmed off. Trimming the skin of the *huli* corm also exposes these hidden rots, and rotted *huli* can be further trimmed or discarded if severely diseased (Figures 1, 2, 3, and 4).

Many growers are aware of these small rots on the *huli*. Infected *huli* should not be planted, for if they are used, disease is also being planted. In large field trials conducted on Oahu, when *huli* were checked before planting, and all *huli* were healthy, there was almost 100 percent establishment of *huli* into plants. As few as 5 plants per 1000 were lost. However, when *huli* quality is poor, more than half of the plants will die.

Growers must train and encourage their employees to save only healthy *huli*. In large operations, we have observed differences among *huli* gathered by employees—some excel in selecting only healthy *huli*, while others are less diligent and include many diseased *huli* for planting.

Care of the *huli* is extremely important

Huli should be planted the day after they are harvested, or at most the second day after. They should be kept in the shade in a dry location. Every day that the *huli* remains unplanted, it uses more of its stored food and water to keep living and therefore depletes its reserves. After a week, the *huli* is seriously weakened and will take a

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longer time to produce a vigorous plant, and it may not root well for many weeks. Some growers place unused *huli* in water to store them until the field is ready. This allows the *huli* to begin growing, and thus a location receiving some sunlight is best. These *huli* with roots must be transplanted carefully to reduce root damage.

Watch for attacks by other pathogens

Other fungi also attack *huli*. *Sclerotium rolfsii* causes a pink rot with lots of white, thread-like growth (Figure 5). This fungus enters the plants through wounds. High humidity is needed for infection, so *huli* should not be packed in boxes or bags that prevent air movement. Laundry baskets are generally good for keeping *huli* for one or two days. Lay the *huli* in the basket with all the corm sections at one end.

Keep pathogen levels low in the *loi*

Pathogens such as *Phytophthora* compete poorly with other microorganisms in the environment. This means that taro pathogens survive poorly in the *lo‘i* without taro plants. Although in the absence of taro they might last for a short time by feeding on dead weeds, they are generally unable to compete with other microbes, including other (beneficial) fungi, protozoans, nematodes, and bacteria. Within its host (that is, the taro plant), the pathogen is the only microorganism that can feed on the living plant tissue. Thus, inside the host, it thrives.

Many pathogens produce spores with thickened walls that enable them to survive over periods without taro plants. The new *Phytophthora* is an example of a pathogen that produces these spores with thickened walls (Figure 6). Similar observations have been made of other pathogens, although their ability to survive without the host varies.

Sclerotium rolfsii is a common pathogen in wetland taro fields. This fungus produces tiny spores the size of mustard seeds that survive in the *lo‘i* (Figure 7). After the taro harvest, this pathogen quickly attacks wounds on remaining plants. Thus bits and pieces of taro left in the paddy are rapidly infected, and within a few days millions of spores are produced. Growers who cut soft rots and discard the trimmings and “junk” taro into the *lo‘i* during harvest are providing food for these pathogens. During the period when the soil is dried, the pieces of taro left in the *lo‘i* are infected and consumed by *Sclerotium* and other pathogens. The infected taro pieces eventually crumble, and thousands of fungal spores are left in the soil. Therefore, complete removal of the old taro crop is recommended, especially in fields with *Sclerotium rolfsii*. Levels of pathogenic *Pythium* also increase when crop residues are left in the *lo‘i*.

Growers who diligently remove taro from the field after harvest have less disease incidence. Some growers pile this material away from the paddy in an area that does not drain into any other paddy. Removal of host

Figure 1. Cross-section cut reveals small rot on a *huli*.

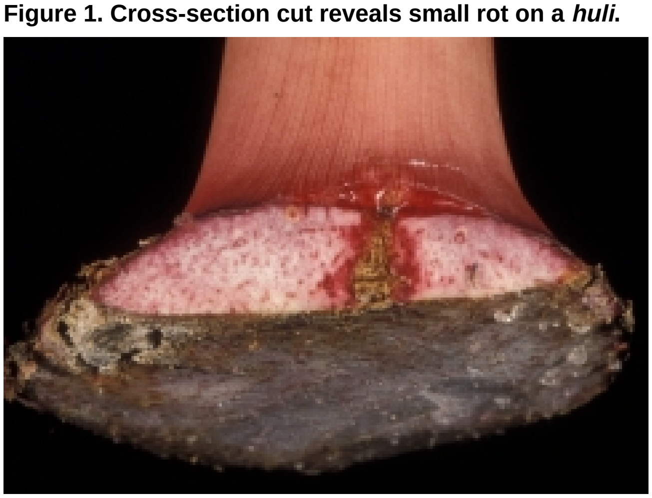

Figure 2. These *huli* have been scrubbed with a brush, exposing small rots.

Figure 3. A small pocket rot on the cormel, or *'ohā*.

Figure 4. Light colored rot in a *huli* corm.

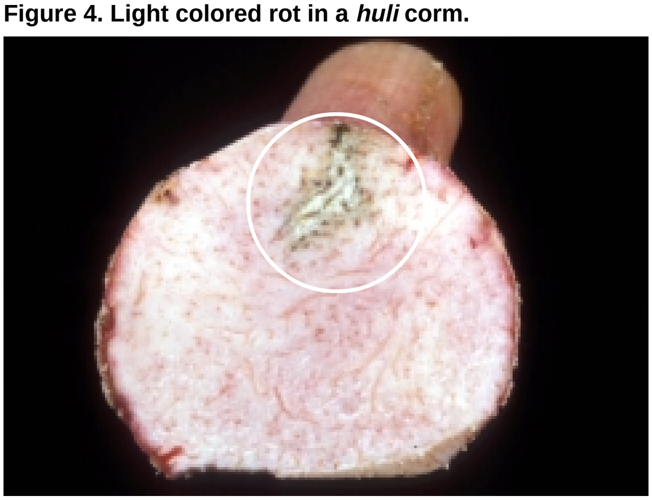

Figure 5. *Sclerotium* infection causes pink rot with white, thread-like growths.

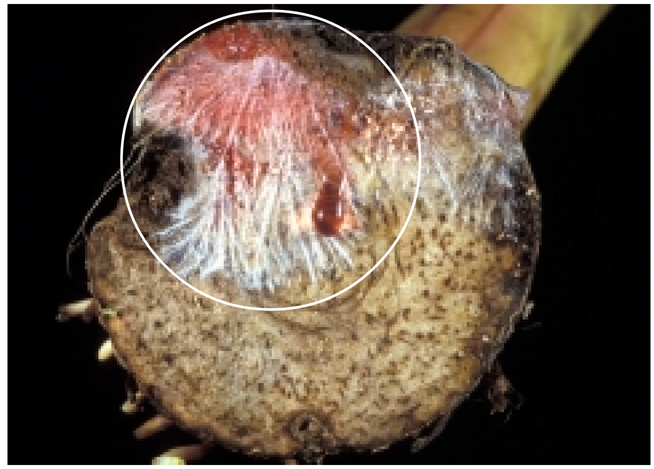

Figure 6. Thick-walled *Phytophthora* spore (microscopic).

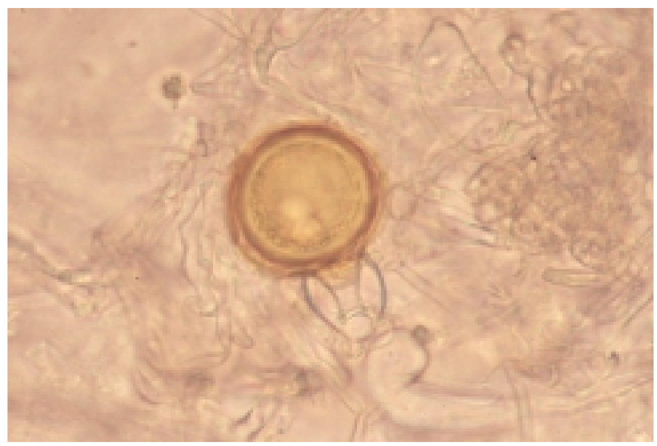

Figure 7. *Sclerotium* survival structures (these ones were produced in laboratory culture) are commonly present on rotted taro corms (edge of a dime indicates size).

tissue that is required for pathogen survival breaks the disease cycle. It is a difficult task to remove the taro scraps, but it is an excellent practice in the overall management of disease.

Fallow, composting, and cover crops

An alternative to removal of taro rubbish is effective composting of the crop residues in the soil before replanting. After harvest, the *lo'i* is drained and the soil is plowed to incorporate the remaining crop residues. Addition of compost aids decomposition of the crop residues and also adds some nitrogen to the *lo'i*. The *lo'i* should be kept dry for at least two to three months. The longer the dry period, the fewer the number of surviving spores. Allowing this fallow period is an ideal practice that provides precious time for the ecosystem of the *lo'i* to return to a balance; however, growers may have difficulty waiting three months to plant the next crop. Failure to allow time for the *lo'i* to regain its beneficial microorganisms will leave high levels of pathogens in the soil.

An alternative is to grow a leguminous cover crop for a few weeks in the dry paddy after the taro is harvested. The crop should be cut and plowed into the soil before its seeds form. This adds organic matter and nitrogen to the soil, and pathogen levels will decrease due to competition and microparasitism from beneficial microorganisms as the cover crop decomposes.

Apply the correct level of nitrogen

In preliminary tests, a high level of fertilizer nitrogen (600 lb/acre/crop) has been associated with more taro leaf blight. Such excessive levels of nitrogen promote soft leaves that are more susceptible to invasion by *Phytophthora*.

Summary

Growers following these recommendations for taro cultivation will likely have reduced corm disease. CTAHR research to determine new approaches to control fungal pathogens in the *lo'i* is continuing. Field tests to determine the advantages of cover crops in rotation with wetland taro need to be done. Because leaf blight is a related disease, control of this problem also needs to be addressed, and research in this area is progressing.

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