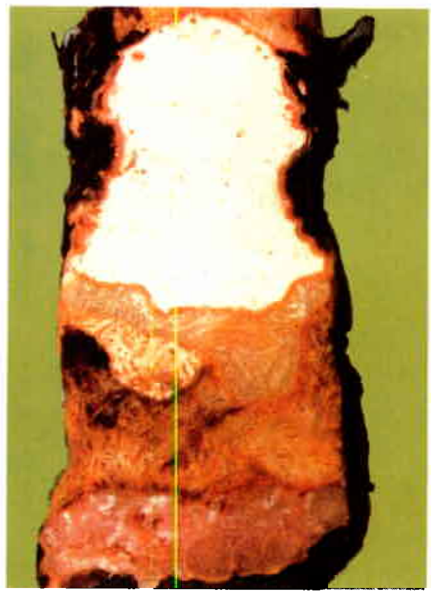
Advisory leaflet **20**
1985

SOUTH PACIFIC COMMISSION

PYTHIUM ROTS OF TARO

Left: *Wilted plant affected by root rot disease.*



Right: *Corm with areas of rot caused by different species of* Pythium

PYTHIUM root and corm rot diseases of taro *(Colocasia esculenta)* are widespread in the SPC region and occur in irrigated (wetland) crops as well as those grown under rainfed (dryland) conditions. Many different *Pythium* species have been found in diseased plants. Some appear to attack only roots, others, corms, while some species cause rots of both these organs. The following species have frequently been recovered from diseased plants: *P. aphanidermatum*, *P. carolinianum*, *P. graminicolum*, *P. irregulare*, *P. middletonii*, *P. myriotylum*, *P. splendens* and *P. vexans*.

Root and corm rot diseases have been reported to be locally severe in Cook Islands, French Polynesia, Hawaii, the Republic of Palau, Solomon Islands, Vanuatu, and Western Samoa. It is likely that similar problems occur in other countries of the region, but they have not been reported. An essentially similar disease also occurs on *Xanthosoma sagittifolium* associated with *P. myriotylum* in Papua New Guinea, and with the same fungus and *P. irregulare* in Vanuatu. *Alocasia macrorrhiza* is also affected by root rot disease in Western Samoa caused by *P. myriotylum*.

SYMPTOMS

The first sign of the disease, on plants grown in both dry and wetland situations, is a slowing of leaf production. This is due to restriction of water movement to the leaves as roots are attacked. On young plants, root decay is followed by rot of the corm piece of the planting sett. Leaves collapse and the plant dies. On older, established plants, outer leaves wilt and die prematurely (see front cover, left). The leaf blades of the two or three remaining leaves are crinkled, slightly rolled or curled inwards, their colour is an unhealthy greyish blue-green and the margins are pale yellow. Plants remain stunted, new leaf production is slow and so the corms are small.

Infected plants are more easily pulled from the soil than those that are healthy. Inspection of the roots at an early stage of attack shows that decay is mostly restricted to the small lateral roots; these are either absent, or only short darkened stubs remain. At their junction with main roots, 1-2 mm oval zones of rot are often present and indicate sites of infection. As decay proceeds, extensive browning and rotting of the entire root system occurs (Fig. 1). In extreme cases only a fringe of healthy roots remains at the top of the corm.

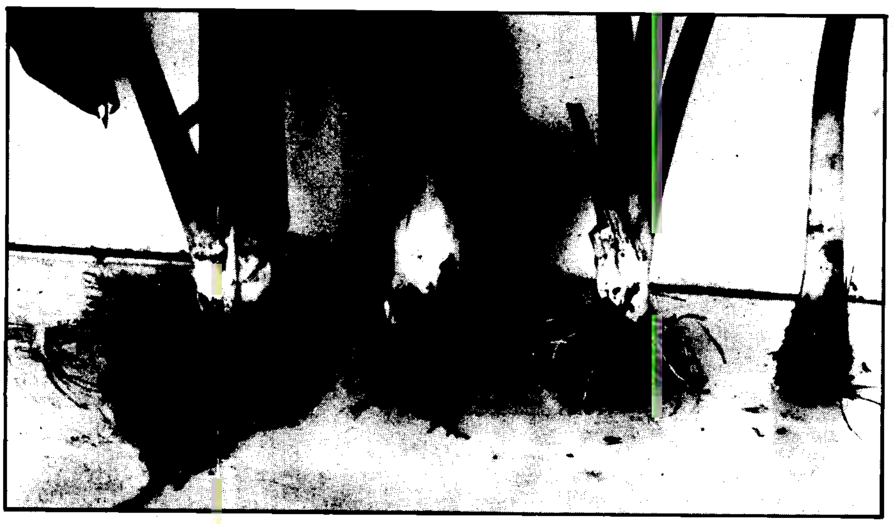


Fig. 1: *Roots with various stages of destruction by* P. myriotylum.

Root decay can lead to corm rots; this is a common feature of the disease where taro are grown in wetland cultivation or on raised beds. Rot development invariably begins at the base and sides of the corm and transforms the inside into a foul-smelling soft mass, but usually the skin is left intact until decay is almost complete. These rots vary in colour from white, yellow, through shades of grey and blue to dark purple. Often, there is a sharp boundary between decayed and healthy tissues. Rots may continue to the top of the corm and into the growing point. The plant is killed, but often the suckers remain unaffected. Other fungi and also bacteria and nematodes are invariably present in the rotting corms of wetland taro and may contribute to the disease symptoms. By contrast, where rots occur in corms of dryland taro they are predominantly caused by *Pythium* fungi among which *P. middletonii*, *P. myriotylum*, *P. splendens* and *P. vexans* are most often found. Corms may contain one or several (see front cover, right) of these fungi.

INFECTION AND SPREAD

Outbreaks of root and corm rot depend upon several factors, the most important of which are: the presence of the fungus, the susceptibility of the taro varieties, abundant soil moisture and high soil temperatures. The interaction of all these determines both the occurrence and severity of the disease.

Pythium fungi are soil inhabitants. Taro may become infected when planted in soils where *Pythium* fungi are already present. The fungus may be surviving on the roots of alternate hosts or in the trash of previous taro crops or as thick-walled resting structures (oospores), which are formed when conditions are unfavourable for fungal growth. It is also possible for infection to occur from spores borne in irrigation water. These fungi produce zoospores which swim in the water and are attracted towards chemicals that form at the root tip. The infection process begins when the zoospores settle on roots or corms and penetrate them.

Pythium fungi can also be transferred to new areas on infected vegetative planting material. They may be present in roots, the remains of leaves, or in rots present in the residual corm piece when insufficient care has been taken to 'clean' the setts at harvest.

Once the fungus is established and a susceptible variety is present, soil moisture and temperature then determine whether infection, and spread of the disease, will take place. Water is required for zoospore movement. Hence, disease spread is rapid in wetland situations (paddies, swamps and in waterlogged soils) and also in dryland areas where rainfall is high. Temperatures above 25°C are required for most *Pythium* species to grow in the soil and in infected plants; below this, little disease may result even if other factors are optimal.

EFFECT OF THE DISEASE

Crop losses due to *Pythium* infection have rarely been accurately assessed. In wetland cultivation in Hawaii, losses range from 10 to 100 per cent, with a conservative average of 25 per cent loss in paddies used continuously. Another estimate for the Republic of Palau, Hawaii, and Samoa puts the loss as up to 80 per cent, presumably for isolated outbreaks of the disease. In Cook Islands, on the islands of Atiu and Mangaia, repeated and severe occurence of *Pythium* attack has led to wetland taro cultivation being abandoned. Even less is known about the losses that occur when taro is cultivated under dryland conditions, but there are indications that damage may, in general, be less than that reported for wetland cultivation. In Western Samoa, the disease has been found present in most plantings examined, and crop losses of 2 to 6 per cent have been estimated where rainfall is over 3250 mm per annum; in localised areas, losses can be greater.

CONTROL

Once soil becomes contaminated by *Pythium* fungi, control is difficult and expensive. The best way to prevent outbreaks of root rot is to grow diseasefree planting material in uninfected soil. Ways of doing this and to control the disease in affected land are detailed below:

Inspection of planting material

Setts taken from infected land should be carefully inspected for symptoms of *Pythium* infection before planting in a new site. Outer petiole sheathing bases should be removed, as these may be contaminated with soil containing the fungus. Roots should also be removed. If rots are found on the corm piece, they should be cut out. Corm pieces with large areas of rot should not be used.

Drainage and irrigation

Stagnant water conditions favour the development of disease in wetland cultivation and should be avoided by improving the circulation of the irrigation water before planting. Dryland taro crops should not be grown in land liable to flooding, or where drainage is poor.

Roguing diseased plants

Control of isolated outbreaks in plantings can be attempted by removing diseased plants. Care should be taken to remove as much of the decayed roots and corm as possible. In the Republic of Palau, the traditional method is to remove diseased plants together with soil from around the roots. Where the disease is especially severe, all the adjacent taro of the same age are also removed, even those that appear healthy. Afterwards the soil is cultivated and all weeds and plant debris buried deeply. The decomposition of plant material, together with aeration of soil that occurs during cultivation, is likely to stimulate the development of a microbial population antagonistic to the root and corm rot pathogens.

Fallow period

Land where *Pythium* rots are a problem should not be planted with taro for at least 5 years during which time population levels of the fungi can be expected to decline. Where land is scarce, and long fallow periods are not practical, the land should be used for crops that are less susceptible to *Pythium* rots.

Alternative crops

In Hawaii, no more than two successive taro crops are recommended where *Pythium* rots are a problem. Following harvest of the second crop, the land should be ploughed and cultivated at frequent intervals for 3–4 months and then used to grow vegetables. Where *Pythium* is a problem in swamp pits, and neither vegetable production nor lengthy fallows are acceptable solutions, alternating taro production with the giant swamp taro, *Cyrtosperma chamissonis*, may be advantageous. This plant has resistance to *Pythium* rots.

Fertilisers

The use of fertilisers to promote vigorous plant growth is an important additional factor in the control programme. In Hawaii, for instance, phosphorus is considered to be intimately related to resistance to root and corm rot. It is likely that plant resistance is increased in well-nourished plants. Healthy plants are more able to withstand and outgrow damage caused by *Pythium* attack.

Resistant varieties

No varieties are reported to be immune to the disease, but resistant varieties have been reported from Cook Islands (vars. Tiitii and Veo, in particular, but there may be others), Hawaii (vars. Kai Kea, Kai Uliuli, Piko Uaua and Lehua Maoli), Fiji (Kurokece, Sisiwa, Vavai Dina), French Polynesia (vars. Rapa and Veo), Solomon Islands (var. Oga) and Western Samoa (vars. Tusi Tusi [probably identical to var. Veo in Cook Islands], Talo Vale, Pule Mu and Pula Sama Sama). Local resistant varieties should be used where available. There are serious quarantine risks involved in importing taro varieties. If countries wish to test those varieties present elsewhere in the region, they should first consult the SPC Plant Protection Officer for advice on how this can be done.

Chemical control

The use of fungicides to control *Pythium* diseases can only be recommended for crops grown commercially because of the high price of the chemicals. Where they are used they should be integrated into pest management strategies which include the control measures given above.

1. Soil treatments

The severity of root and corm rot can be reduced by incorporation of captan (50 per cent w.p., 112 kg/ha) into the soil before planting. The systemic fungicides metalaxyl (Ridomil) and aluminium tris phosphonate (Aliette) may prove useful but have not been tested locally.

2. Sett treatments

Setts should be dipped in a suspension of captan (4 g/l) or placed in Ridomil (1 g/l) or Aliette (2.5 g/l) for ½-1 hour before planting. This method also provides setts with a few days' protection from *Pythium* infection after they have been planted.

POST-HARVEST CORM ROT

Post-harvest rots caused by *Pythium* fungi are common in Cook Islands, Fiji, Solomon Islands, and Western Samoa, and losses of up to 20 per cent within 10 days have been reported. Some rots begin before harvest. Others form only after harvest when the *Pythium* fungi already present on the corm surface invade the internal tissues through wounds made as leaves are detached. In either case, rots develop rapidly. This is especially so when caused by *P. splendens* (Fig. 2), a species commonly associated with corm decay.

Control of post-harvest rots can be achieved by placing corms in polythene bags after they have been cleaned of soil and main leaves and suckers have been removed. Excellent control has also been achieved in tests in Cook Islands when taro for export to New Zealand were dipped in a mixture of benomyl (Benlate, 2 g/l) and Ridomil (1 g/l) and packed in plastic-lined cardboard boxes. □

Fig. 2: *Post-harvest corm decay by* P. splendens. *A white, dry rot at the base with a discoloured area above the rot margin. After storage for 4 days.*

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