AusAID/SPC TARO GENETIC RESOURCES:
CONSERVATION AND UTILISATION

A Bibliography of Taro Leaf Blight

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Introduction

This bibliography has been prepared by the Taro Genetic Resources: Conservation and Utilisation (TaroGen) project. TaroGen is an AusAID-funded regional project for taro improvement. It is implemented by the Secretariat of the Pacific Community (SPC) in collaboration with the University of the South Pacific (USP), the National Agricultural Research Institute (NARI), the International Plant Genetic Resources Institute (IPGRI), HortResearch, Queensland University of Technology (QUT) and the University of Queensland (UQ). Julia Brunt contributed to this project while working for the SPC Plant Protection Service, Suva, Fiji.

The purpose of this bibliography is to draw together publications on taro leaf blight in an effort to assist research. The bibliography updates an earlier edition (Taro leaf blight—a preliminary bibliography, by P. Walton) prepared in 1993. This edition now includes some 452 references to the literature, with abstracts where available.

Sources available to the compilers included:

AGRIS 1975—August 1995 (FAO)

CABPESTCD 1973—August 1998 (CAB International)

SPC library

IRETA library

Personal communications

Not all the papers included in this bibliography have been seen by the compilers, so there are a few incomplete references. We have also certainly missed others, especially from regions outside the Pacific and amongst the rapidly growing resources available on the World Wide Web.

We hope this bibliography will be widely used and any comments, corrections and additions are welcomed. In this way, the bibliography may be updated in future.

Please send all comments to:

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Taro leaf blight
With special reference to the Pacific Islands

Introduction

Plant diseases pose a serious threat to food security and national economies worldwide. Recent examples are the southern corn leaf blight and coffee rust epidemics of the 1970s. In the Pacific region the impact of taro leaf blight, caused by the fungus *Phytophthora colocasiae*, and the threat it poses to countries not yet affected by the disease, illustrate this point clearly. The spread of the fungus to Samoa in 1993 demonstrated once again the devastating potential of the disease when, over a period of six months, the country lost an export industry worth US$10 million per year with a similar value for domestic supplies. Events of similar catastrophe occurred in Solomon Islands 50 years earlier and caused a loss of varieties and major changes to the cropping systems.

Taro leaf blight and the causal pathogen *P. colocasiae*

To date, taro leaf blight has been recorded in a number of countries in the Pacific region, most recently in Samoa in 1993. The disease is mainly a foliar pathogen although postharvest storage rots also occur. Initial symptoms of the disease are small brown water-soaked flecks on the leaf that enlarge to form dark brown lesions, often with a yellow margin. Secondary infections lead to rapid destruction of the leaf, which may occur in 10–20 days or less in very susceptible varieties. The normal longevity of a healthy leaf is about 40 days. The disease significantly reduces the number of functional leaves and can lead to yield reductions of the magnitude of 50% (Trujillo and Aragaki, 1964; Trujillo, 1967; Jackson, 1999). Inoculum in the form of spores is spread by wind-driven rain and dew to adjacent plants and nearby plantations. The disease can also be spread on taro planting material and the fungus has been reported as remaining alive on planting tops for about three weeks after harvest (Jackson, 1999). This is the most likely source of the pathogen in new countries and the means for its rapid spread within a country, once established. Therefore, strict quarantine measures are required as a first line of defense against the disease.

In addition to corm yield losses due to the reduced leaf area in diseased plants, there is also a corm rot caused by *P. colocasiae.* This is mainly a problem when taro corms are stored for more than seven days but not in subsistence economies where corms are harvested and consumed within days.

Fortunately, *P. colocasiae* does not have a wide host range. *Xanthosoma* taro is immune. Although *Alocasia* taro can be infected by the pathogen, there is little inoculum produced and therefore little likelihood of an epidemic on this host (personal observation).

Raciborski (1900), in Java, was the first person to study taro leaf blight disease and was the first to name the causal pathogen. There is limited information on the origin of *P. colocasiae* and the magnitude of the area of origin remains to be defined (Zhang *et al.,* 1994). Ko (1979) has indicated that Asia may be the centre of origin of *P. colocasiae* given that it is the world's

centre of origin for many wild and cultivated varieties of taro. Prior to this, Trujillo (1967) had also speculated on a Southeast Asian origin for the pathogen. One of the indications of the centre of origin of a fungus such as *Phytophthora* is the existence of an A1/A2 mating type ratio of about 1:1 (Zentmyer, 1988). In order to determine if Taiwan was inside the centre of origin Ann *et al.* (1986) screened 799 isolates of *P. colocasiae.* All behaved as A2 mating types, indicating that the fungus is not indigenous to this area. Only A1 mating type has been found in India, indicating that it is not the centre of origin (Narula and Mehrotra, 1980). Evidence for an Asian origin of *P. colocasiae* has recently come from China (Zhang *et al.,* 1994), where previous reports had indicated that only the A2 mating type occurred (Ho *et al.,* 1983). Of 280 isolates of *P. colocasiae* obtained from Hainan Island, 136 were A1, 102 A2 and 42 A0 mating types. Such findings indicate that Hainan Island is inside the centre of origin of *P. colocasiae*. More recent work suggests that only mating type A2 occurs in Papua New Guinea (PNG), Hawai'i, Samoa and Guam (Fullerton *et al.,* 2000)

Based on a possible Southeast Asian origin for the pathogen, Trujillo (1967) postulated that the disease dispersed into the Pacific region by three different routes: 1. To Hawai'i via the Philippines; 2. From Taiwan to Micronesia via the Philippines; and 3. to Fiji via PNG and Solomon Islands. At that time taro leaf blight had been reported as present in Fiji but this was an obvious misidentification. The movement of taro leaf blight via PNG and Solomon Islands would appear to be a separate route and is supported by anecdotal evidence from inhabitants of these countries expressing that the disease only appeared after the Western Pacific Campaign of World War II (Oliver, 1973).

Ooka (1990) speculates that movement on the northern route went from Java to Taiwan, where Sawada reported the disease in 1911. From Taiwan it is believed to have moved to Japan and then to Hawai'i where it arrived in 1920 (Carpenter, 1920). The disease was first recorded in the Philippines in 1916 and movement to Micronesia probably occurred from there. The disease was recorded in Guam in 1918 (Weston, 1918).

History of taro leaf blight in the Pacific Islands

There has been little documentation of the impact of taro leaf blight as it has spread from country to country in the Pacific. What has been documented covers mainly Papua New Guinea. What is known is that wherever it has occurred in the region, many growers have been forced to abandon taro and rely on other root crops (Jackson, 1996).

The earliest records for the appearance of the disease in the Pacific Islands are for Guam (1918) and Hawai'i (1920), which precede the appearance of the disease in the more southern Solomon Islands and PNG by a couple of decades. Prior to the arrival of taro leaf blight in Hawai'i there were approximately 350 different varieties of taro in the country. Few have survived the disease and today the number of Hawaiian taros is less than 40 (Trujillo, 1996). In Guam, where the disease has been present for a longer period than Hawai'i, the disease is considered unimportant today (Wall, 1996). Recent interviews among farmers in Guam have highlighted that there may be as many as 23 varieties of taro on Guam but most are recent introductions with only six predating the arrival of taro leaf blight (Manner, 1991). The relatively few traditional taro varieties is believed to be a consequence of the disease (Wall, 1996).

In Micronesia the disease seems to have been brought in during the Japanese occupation of Chuuk and Pohnpei and taro cultivation appears to be declining rapidly. Taro leaf blight has contributed to significant changes in dietary patterns and cropping systems in Micronesia where earlier this century cassava became the staple instead of taro (Barrau, 1961; Jackson, 1996). On Pohnpei, the majority of the taro varieties that existed before the arrival of the Japanese are gone (Trujillo, 1996) and leaf blight has been responsible for the serious decline in taro as a crop plant (Santos, 1993; Raynor and Silbanus, 1993). On Pohnpei, taro now ranks behind yams, banana, imported rice and breadfruit as a staple crop (Primo, 1993; Raynor and Silbanus, 1993). Despite heavy rainfall and the long time presence of leaf blight in Pohnpei, farmers are still managing to produce taro. Wall (1996) reports that this is a result of the disease having selected more resistant taro varieties and the incorporation of sanitation and traditional mixed cropping systems for the management of the disease.

Taro leaf blight is believed to have contributed to the decline in taro production and its displacement in some areas by sweet potato in PNG. It is thought that the disease spread to PNG from Southeast Asia through Indonesia during the WWII (Kokoa, 1996). In Bougainville, *P. colocasiae* was first reported around the close of the war (Connell, 1978). It was the firm belief of the local population that the disease was not present before then. The impact of the disease in some areas was devastating and throughout lowland Bougainville taro was almost wiped out. It has been reported that the epidemic of taro leaf blight on Bougainville resulted in the deaths of about 3000 people (Putter, 1993) and in most areas sweet potato replaced taro as the main staple. The real impact of the blight is difficult to accurately assess. At the time of the appearance of the disease the Japanese were pillaging many of the local taro gardens. As a result, there was a serious lack of planting materials. Many people fled their villages and numerous cases of starvation and malnutrition occurred. It is difficult to distinguish the impact of the disease, if any, from these events. It is possible that the impact of the disease was delayed for a few years following the Japanese occupation. At the close of WWII people returned to village life. As the Japanese had taken most of the planting material people turned to many of the early maturing sweet potato varieties that existed in the now disbanded Japanese gardens to fill the interim. Later, when taro planting material did become available, it was wiped out again by the blight providing yet another setback for farmers. Unfortunately, the coincidence of the spread of taro leaf blight in Bougainville with WWII makes it difficult to attribute any given change solely to the effects of leaf blight (Packard, 1975).

The disease continues to spread in PNG and in 1976 a severe epidemic occurred on the island of Manus and in 1988 the disease occurred in Milne Bay for the first time, destroying the crop (Jackson, 1996).

In Solomon Islands it is also difficult to determine the impact that taro leaf blight had on taro production and cropping patterns in the country. Taro leaf blight first appeared in the Shortland Islands in 1946 (Liloqula *et al.,* 1996) and within the next few years had spread to most of the provinces as a result of the increased movement of people and produce in the post war years. What is known is that taro cultivation declined quite drastically in Solomon Islands at this time being replaced by sweet potato, which was a later arrival in the country. Whether the introduction of sweet potato alone or combined with the effects of taro leaf blight are the reasons for the decline in taro are difficult to ascertain.

The impact of taro leaf blight in Samoa

The most recent introduction of the disease was to the Samoan islands in 1993. Taro leaf blight was first detected in the Western District highlands of Tutuila Island, American Samoa on 15 June 1993. The disease has severely constrained taro production in the country (Gurr, 1996). Within a year of the introduction of the disease it had caused over 95% reduction in the supply of taro to the public market. In less than one month taro leaf blight was diagnosed and confirmed in Samoa. It was first observed on the the island of Upolu at Aufaga Aleipata and two days later from Saanapu and adjacent districts of Alafou, Samusu, Utufaalalafa, Malaela, and Lepa. The crop at this time was highly uniform and genetically vulnerable. The disease spread rapidly throughout the country severely affecting all local varieties, but was most severe on taro variety *Niue*, which was unfortunate as this was the variety of choice for commercial production because of its quality and taste.

It is believed that the rapid spread of the disease was encouraged by the movement of infected planting materials around the two main islands, Upolu and Savai'i. At this time there was a major replanting of taro underway in the aftermath of Cyclone Val and anything up to 10,000 plants could be planted by a single farmer in a one week period (Semisi, 1996). Various factors contributed to the rapid spread of the disease in Samoa. The area planted with taro *Niue* at the time was extremely large and effectively ensured a monocrop situation comprising a highly susceptible variety. There was a continuous and abundant source of taro for the disease because of the practice of many farmers to interplant on old plantations and stagger their cultivation. Combined with the movement of planting material and the ideal weather conditions that exist in Samoa for the disease, it is not surprising that the disease reached epidemic proportions.

Taro in Samoa is the traditionally favoured root crop and was considered an essential component of an everyday meal. Although this popularity is based on dietary and cultural factors, taro is also favoured for its considerable productivity in the fertile and high rainfall environment. Prior to the disease outbreak taro was the major export earner in the country and over 90% of households in Samoa were growing the crop (Ward and Ashcroft, 1998). In the twelve-month period prior to the outbreak of taro leaf blight 180,191 kg of taro were brought for sale at the local market. In the twelve-month period subsequent to the outbreak of the disease 59,212 kg were brought in for sale. Seventy-five per cent of this volume was brought in during the first three months of the twelve-month period when the impact of the disease was still to be realised (Chan, 1996). Paulson and Rogers (1997) report that supplies of taro on the local market in June 1994 were only 1% of the supplies that were available in June the previous year. The massive losses due to the disease had a similar impact on the export of taro. The first three months of 1994 saw only 60,000 kg of taro exported which was valued at about WS$56,000 (Chan, 1996). This represents about 0.5% of the 1993 export figure.

One of the initial responses of the Samoan Government to the disease was to encourage diversification of other crops, helping to explore alternative commercial agricultural enterprises (Semisi, 1996; Jackson, 1996). The government also provided assistance through the supply and distribution of planting material. Farmers quickly diversified into a range of other staple crops and bananas and *taamu* (*Alocasia macrorhiza*) replaced taro as the main staple.

Management of taro leaf blight

The recent outbreak of taro leaf blight in Samoa provides a good overview of the measures that have been used in an attempt to manage the disease.

Initial efforts to minimise the disease

Early efforts to contain taro leaf blight in Samoa included a spraying programme of infected plantings with the fungicides Ridomil MZ and Manzate. Staff from the Ministry of Agriculture, Forestry, Fisheries and Meteorology (MAFFM) carried out routine fungicide spraying of infected plantations. Later, fungicides were supplied free to farmers through village *pulenuu* (village mayors) and application equipment was made available at subsidised prices at the local Agricultural Store (Chan, 1996). At the completion of this initial spraying campaign over WST$600,000 had been spent.

In conjunction with fungicide spraying, quarantine efforts to minimise the movement of planting material, leaves and soil on the island of Upolu and between islands were enforced together with a public awareness campaign to inform farmers and the general public. This included information on disease symptoms, epidemiology and disease control. The campaign utilised radio, television, videos and print media including leaflets and newspaper.

These three actions had minimal effect on the spread of the disease. Unseasonal wet weather in the months following the introduction of the disease into Samoa and the fact that planting material was still being routinely moved meant the disease spread rapidly. By the end of 1993 the disease had spread to most of Savai'i and farmers were beginning to diversify with alternative crops.

Cultural control

Various cultural methods have been recommended for the control of taro leaf blight. Removal of infected leaves has been effective during the early stages of disease development in a number of countries. Wide spacing of plants has been reported to reduce disease severity but this appears to have a negligible effect when conditions favour disease development. Other cultural methods that have been recommended include delaying planting on the same land for a minimum of three weeks, avoiding plantings close to older infected ones and preventing the carryover of corms or suckers which can harbour the pathogen from one crop to the next (Jackson, 1999). Preliminary findings have indicated that fertilizer treatment may also help the plant cope with leaf blight (Tilialo *et al., 1996).* Trials in Samoa to investigate the effect of planting time, intercropping, the role of fertilisation on the incidence and severity of the disease and the effect of leaf removal have been inconclusive (Chan, 1997).

Chemical control

Jackson (1996) reports that the disease can be controlled by spraying copper fungicides. Copper oxychloride applied at a rate of 4.5 kg per 100 litres of water per hectare gave good control of the disease in Solomon Islands. Early trial work in Samoa concentrated on trials of Ridomil MZ, Manzate and phosphorous acid (Foschek). Pot experiments demonstrated the superiority of phosphorous acid over Ridomil MZ. Further experiments comparing phosphorous acid formulations (Foschek, Agri-Fos 400 and Foli-R-Fos) found no differences

in terms of disease control (Chan, 1997). In Samoa, a recommendation for fungicide spraying was made for Foschek, alternated with Manzate to minimise resistance problems but the costs were prohibitive for the majority of farmers.

Resistant varieties

Most farmers who traditionally grow taro cannot afford the extra costs required for fungicides and labour involved in leaf removal and spraying. Alternative sustainable strategies for the management of the disease are needed. The use of resistant varieties is one such strategy. Given the susceptibility of local taro varieties to leaf blight in Samoa and the impact that the disease has had on varietal diversity, Samoa initiated a programme to screen and evaluate exotic taros. Of those varieties screened in the field *PSB-G2, Pwetepwet, Pastora* and *Toantal* were found to be more resistant to leaf blight. *Pwetepwet, Pastora* and *Toantal* originated from the Federated States of Micronesia (FSM) and were obtained from the Tissue Culture Unit at Alafua Campus, USP. *PSB-G2* was received from the Philippine Seed Board in 1994.

These four varieties were further multiplied and evaluated in trials at USP–Alafua during 1996–1998. A preliminary trial demonstrated that disease severity recorded for each variety was not significantly different. *Pastora* produced the largest corms followed by *PSB-G2, Pwetepwet* and *Toantal* (Hunter and Pouono, 1998). Samoans prefer dry, firm-textured taro and therefore, per cent dry weight is one measure of eating quality. Dry matter content of corms was highest for *PSB-G2* (37%) and taste tests at USP-Alafua demonstrated that both *Toantal* and *PSB-G2* were most preferred. MAFFM taste tests also rated *PSB-G2* highest followed by *Toantal* (Chan, 1997). Acceptibility of PSB-G2 (known locally as taro *Fili*) in Samoa has been high and a recent impact assessment carried out among farmers on the multiplication, performance and use of the variety confirms that it is performing well (Iosefa and Rogers, 1999). Additional varieties collected from Palau have shown good levels of resistance against taro leaf blight in Samoa. Indications are that farmers in Samoa are adopting a diversity of varieties from the FSM, Palau and the Philippines.

Taro Genetic Resources: Conservation and Utilisation (TaroGen) — a regional approach to taro improvement

The impact of taro leaf blight, the subsequent loss of taro genetic resources, and the continuing vulnerability of other Pacific Island countries to the disease was the major impetus behind the development of the Taro Genetic Resources: Conservation and Utilisation (TaroGen) regional project. In recognition of the urgency of the problem, three regional meetings to discuss disease control, loss of genetic resources and ways to prevent further spread of the disease were held in the region between 1993 and 1995. Outcomes from these meetings contributed to the formulation of the TaroGen project. The project is implemented by the Secretariat of the Pacific Community (SPC) and funded by the Australian Government. The project represents a collaboration with the International Plant Genetic Resources Institute, National Agricultural Research Institute and the University of the South Pacific and is working with national programmes to develop a regional strategy for taro genetic resource conservation and crop improvement. A unit has been established within SPC to provide the expertise required in conservation, plant breeding and project management. The project is designed to assist Pacific Island countries in the collection and conservation of taro

germplasm and in the use of the genetic resources in plant improvement programmes with an overall goal of improving food security and rural incomes in Pacific Island countries.

One of the main components of TaroGen is to provide farmers in Pacific Island countries with taro varieties that have improved resistance to taro leaf blight. To achieve this the project supports breeding programmes in PNG and Samoa based on durable resistance. Breeding of more resistant varieties together with the introduction of resistant varieties is the most sustainable approach to managing the disease. Improved taro with good resistance to taro leaf blight and quality is now available in Samoa and PNG. In Samoa, the project partners, USP and MAFFM, have been very successful in developing a strong partnership between growers, researchers and extension staff. This partnership is ensuring that improved taro is readily available to farmers. Growers in Samoa have access to improved taro from both the USP and MAFFM programmes after only two years of the project. This approach has created considerable interest in PNG where a similar farmer participatory approach is now under consideration. TaroGen plans to make these improved lines, and other resistant varieties, available to farmers in other Pacific Island countries.

Conclusions

The recent introduction of taro leaf blight into Samoa illustrates clearly the devastation that taro leaf blight can cause and highlights the vulnerability of isolated taro populations that for years evolved in the absence of the disease. Unfortunately, other countries in the Pacific are in a similar position to that of Samoa before the blight. In Fiji production is dominated by *Niue*, which was the dominant cultivar in Samoa at the time of the blight's arrival. This represents a situation of severe genetic vulnerability and a rerun of the Samoan epidemic could happen anytime. Fortunately, those countries most at risk now have the opportunity to benefit from the outputs from the TaroGen breeding programme. Improved taro with good resistance to taro leaf blight can provide these countries with the opportunity to minimise the impact of the disease.

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   The major outcomes of a study conducted by M. W. K. Saurara in Upolu, Samoa, on farmers' attitudes to taro leaf blight control are reported. 30% of farmers now use a fungicide spray (Forschek, a phosphorous acid-based product) to control the disease, some at double the recommended rate to improve results. Cultural control, by removing infected leaves or parts of leaves, was generally not popular, as corm yields are reduced. This latter method is mainly used by small holders.

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   The use of tolerant cultivars to overcome taro leaf blight in Samoa is discussed. Micronesian varieties Pwetepwet, Pastora, Toantal and the Philippine variety PSB-G2 have shown good tolerance to taro leaf blight in trials at Alafua. Consumers in Samoa, however, still prefer the taste and cooking quality of the local variety, Niue (now called Samoa).

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The use of chemicals and wrapping in polythene bags to control postharvest decay of taro corms, including that caused by *Phytophthora colocasiae*, is reported.

28. Anon. (1998). Proceedings of the Taro Breeding Workshop. Suva, Fiji Islands, 26–28 August 1998. (21 pp.). Noumea, New Caledonia: Secretariat of the Pacific Community. AusAID/SPC Taro Genetic Resources: Conservation and Utilisation.

29. Anon. (1999). Proceedings of the Taro Collecting Strategy for Pacific Islands Workshop. Lae, Papua New Guinea, 7–11 December 1998. (21 pp.). Noumea, New Caledonia: Secretariat of the Pacific Community. AusAID/SPC Taro Genetic Resources: Conservation and Utilisation.

30. Anon. (1998). Proceedings of the Taro Planning Workshop. (20 pp.). Noumea, New Caledonia: AusAID/SPC Taro Genetic Resources: Conservation and Utilisation, Secretariat of the Pacific Community.

31. Anon. (1996). Root crops research and development. Taro. In Ministry of Agriculture, Forestry, Fisheries and Meteorology Annual Report July 1996–June 1997 (Research Division) (pp. 26–29). Apia, Samoa.

In this section results of trials on taro breeding for resistance to taro leaf blight and evaluation of varieties selected for resistance to taro leaf blight; growth characteristics, yield, level of adoption by farmers, and taste are reported.

32. Anon. (1996). Root crops research and development. Taro. In Ministry of Agriculture, Forestry, Fisheries and Meteorology Annual Report July 1995–June 1996 (Research Division) (pp. 20–22). Apia, Samoa.

    In this section of the report results of trials on taro breeding for resistance to taro leaf blight, evaluation of varieties selected for resistance to taro leaf blight, growth characteristics, yield, level of adoption by farmers and taste, and the effects of off-season planting on the incidence of taro leaf blight are reported.

33. Anon. (1999). Taro Genetic Resources Committee Meeting. Lae, Papua New Guinea, March 1999. (21 pp.). Noumea, New Caledonia: Secretariat of the Pacific Community. AusAID/SPC Taro Genetic Resources: Conservation and Utilisation.

34. Anon. (1999). Taro Genetic Resources Committee Meeting. Suva, Fiji Islands, October 1999. Noumea, New Caledonia: Secretariat of the Pacific Community. AusAID/SPC Taro Genetic Resources: Conservation and Utilisation.

35. Anon. (1977). Taro pathology. In Report of the plant pathologist for 1975 and 1976 (pp. 2–21). Dodo Creek, Solomon Islands: Solomon Islands, Ministry of Agriculture and Lands.

    Research into taro leaf blight is reported, including yield loss, chemical control, storage decay studies. Infection of taro petioles by *Phytophthora colocasiae* after harvest was also investigated.

36. Anon. (1993). Togafitiga o le faamai lega o talo, unnumbered. Apia, Western Samoa: Ministry of Agriculture, Fisheries, Forestry and Meteorology. Leaflet no. 26. In Samoan.

    Information is given on the cultural and chemical control of taro leaf blight for farmers.

37. Arentz, F. (1986). A key to *Phytophthora* species found in Papua New Guinea with notes on their distribution and morphology. Papua New Guinea Journal of Agriculture, Forestry and Fisheries **34**(1–4), 9–18.

    A simple key is given for the most common *Phytophthora* species found in the soils of Papua New Guinea. Species listed are *P. cinnamomi*, *P. colocasiae*, *P. cryptogea*, *P. heveae*, *P. katsurae*, *P. megasperma* var. *sojae*, *P. nicotianae* var. *nicotianae*, *P. nicotianae* var. *parasitica*, *P. palmivora* and a *Phytophthora* species placed nearest *P. cryptogea*. *Peronophythora litchii* has been included because of its close resemblance to *Phytophthora*. All isolations held at Bulolo are listed, together with notes on their morphology.

38. Arura, M., & Thistleton, B. M. (1986). Crop protection problems in Papua New Guinea and the requirements for solving them. In UNDP/FAO/GTZ/IRETA

Regional Crop Protection Workshop. Apia, Western Samoa, 8–12 September 1986. (pp. 39–65). UNDP.

Taro leaf blight is considered in this paper on pests and diseases of various crops in Papua New Guinea. Future needs are identified as crop loss assessment studies and evaluation and economics of alternative (to metalaxyl) chemicals for control.

39. Ashok Aggarwal, Gurinderjit Kaur, & Mehrotra, R. S. (1987). Activity of some antibiotics against *Phytophthora colocasiae* incitant of leaf blight of *Colocasia esculenta*. Journal of the Indian Botanical Society **66**(3–4), 301–304.

When 8 antibiotics were tested against the pathogen, ledermycin proved the most inhibitive *in vivo* and *in vitro*, followed by terramycin [oxytetracycline], resteclin (tetracycline hydrochloride) and agrimycin-100.

40. Ashok Aggarwal, Gurinderjit Kaur, & Mehrotra, R. S. (1986). Effect of certain metabolic inhibitors on growth and respiration of *Phytophthora colocasiae* Racib. Indian Botanical Reporter **5**(2), 119–122.

In laboratory tests sodium azide, mercuric chloride, sodium fluoroacetate, sodium malonate, methylene blue and sodium fluoride inhibited respiration and mycelial growth of *P. colocasiae* on *Colocasia esculenta*.

41. Ashok Aggarwal, Kamlesh, & Mehrotra, R. S. (1993). Control of taro blight and corm rot caused by *Phytophthora colocasiae* homeopathic drugs. Plant Disease Research **8**(2), 94–101.

The effect of 4 homeopathic drugs (Kali iodide (potassium iodide), Arsenicum album (arsenic oxide), Blatta orientalis (an extract of cockroach) and extract of *Thuja occidentalis*) on the mycelial growth, sporangial production, pectolytic and cellulolytic enzyme production and control of *P. colocasiae* on taro (*Colocasia esculenta*) was investigated. All 4 drugs inhibited mycelial growth, but the percentage inhibition varied with different drug potencies. Max. inhibition (50–90%) was obtained by Kali iodide and Arsenicum album at all 3 potencies (3, 30 and 200) and by Blatta orientalis and *T. occidentalis* at potencies of 30 and 200. The effect on sporulation also varied with potency, with max. inhibition caused by each drug at a potency of 200, and by a potency of 30 for Arsenicum album. Kali iodide resulted in the greatest decrease in pectolytic and celluloytic activity, followed by Arsenicum, *Thuja* and Blatta. The occurrence of disease was reduced by 45–59% compared with an untreated control when taro leaves were treated with Kali iodide or Arsenicum album (both at 200 potencies) prior to inoculation with *P. colocasiae.*

42. Ashok Aggarwal, & Mehrotra, R. S. (1987). Control of *Phytophthora* leaf blight of taro (*Colocasia esculenta*) by fungicides and roguing. Phytoparasitica **15**(5), 299–305.

In *in vitro* tests Demosan 65W (chloroneb) was the most effective of 6 fungicides in inhibiting mycelial growth of *P. colocasiae*, followed by Difolatan 80W (captafol), Fytolan (copper oxychloride), Apron 35F (metalaxyl), Topsin-M 50W (thiophanate-methyl) and Dithane Z-78 75W (zineb). In field trials excellent control was obtained with chloroneb and captafol, good control with metalaxyl, fair control with copper oxychloride and poor control with thiophanate-methyl and zineb. Roguing of infected leaves did not eradicate the pathogen but may delay the start of epiphytotics.

43. Ashok Aggarwal, & Mehrotra, R. S. (1988). Effect of antibiotics on growth, enzyme activity and respiration of *Phytophthora colocasiae*. Plant Disease Research **3**(1), 37–42.

    Details are given of the *in vitro* effects of 7 antibiotics on this pathogen of *Colocasia esculenta*. Ledermycin had the greatest effect on respiration and growth, while all the antibiotics had significant effects on the activities of transeliminases, hydrolases and cellulases.

44. Ashok Aggarwal, & Mehrotra, R. S. (1986). The effect of certain carbohydrates and amino acids on growth and respiration of *Phytophthora colocasiae*. Plant Disease Research **1**(1–2), 11–15.

    The effects of 9 carbohydrates and 20 amino acids on respiration and mycelial growth of an isolate from *Colocasia esculenta* are tabulated and the results discussed.

45. Ashok Aggarwal, & Mehrotra, R. S. (1988). Effect of systemic and non-systemic fungicides on mycelial growth and respiration of *Phytophthora colocasiae*. Indian Phytopathology **41**(4), 590–593.

    The effect of 11 fungicides (Ridomil-25 WP (metalaxyl), Apron 350 FW (metalaxyl), Topsin-M (thiophanate-methyl), Cuman L (ziram), Dithane-M 45 (mancozeb), Dithane-Z 78 (zineb), Difolatan-80-W (captafol), Blitox (copper oxychloride), Benlate (benomyl), Bavistin (carbendazim) and Fytolan (copper oxychloride)) at 5, 50 and 500 p.p.m. on *P. colocasiae* mycelial growth and respiration rate was investigated. All the fungicides inhibited the fungus. The results suggest a correlation between mycelial growth inhibition and respiration rate inhibition. All the fungicides which inhibited mycelial growth also significantly inhibited respiration rate. None of the fungicides tested stimulated respiration or mycelial growth.

46. Ashok Aggarwal, & Mehrotra, R. S. (1988). Effects of various fungicides on mycelial growth, sporangial production, enzyme activity and control of *Phytophthora* leaf blight of *Colocasia esculenta* L. Acta Phytopathologica Et Entomologica Hungarica **23**(3–4), 401–414.

    Studies on the effects of 23 fungicides on *P. colocasiae* revealed that Apron 350 FW (metalaxyl), Blitox (copper oxychloride), Blimex, Cuman-L (ziram), Demosan 65W (chloroneb), Dexon (fenaminosulf), Difolatan 80 W

(captafol), Fytolan, Hexaferb, Kitazin (S-benzyl O,O-diethyl phosphorothioate), Milton, Ridomil 25 WP (metalaxyl) and Syllit (dodine) all gave 100% inhibition at different concentrations. All fungicides had some effect on sporangial formation. The effects of 8 fungicides on pectolytic and cellulolytic enzyme activity were also observed. All inhibited the enzymes to some degree with metalaxyl (as Ridomil 25 WP followed by Apron 350 FW) being the most effective. It was also the most effective at 200 parts per million of 8 fungicides tested in field conditions.

47. Ashok Aggarwal, & Mehrotra, R. S. (1986). Pectolytic and cellulolytic enzymes produced by *Phytophthora colocasiae, P. parasitica* var. *piperina in vitro and in vivo.* Indian Journal of Plant Pathology **4**(1), 74–77.

    P. colocasiae and *P. parasitica* var. *piperina* [*P. nicotianae* var. *parasitica*] produced pectolytic (PME, PG, PMTE and PMG) and cellulolytic (Cx) enzymes under conditions of different C sources in liquid medium and detached leaves of *Colocasia esculenta* and *Piper betle*. Pectin methylesterase (PME) activity was not detected in the isolates *in vivo*. Pectolytic enzymes produced by these fungi were of a constitutive rather than adaptive nature. These results indicate that PG, PMG and PMTE enzymes play a decisive role in the pathogenesis of *P. colocasiae* on *C. esculenta* and *P. nicotianae* var. *parasitica* on *Piper betle*.

48. Ashok Aggarwal, & Mehrotra, R. S. (1987). The role of phenolic substances in leaf blight of *Colocasia esculenta* caused by *Phytophthora colocasiae*. Journal of the Indian Botanical Society **66**(3–4), 272–274.

    Alterations in phenolic compounds in *Colocasia* due to *P. colocasiae* infection are reported. Total phenols, orthodihydric phenols and flavonols markedly increased as a result of infection. Eleven phenols were detected in the infected plants as against 7 in healthy plants. Each stage of infection was characterized by an addition of a new phenol (4 in all, U1–U4). A close correlation existed between the phenolic acids produced by the pathogen *in vitro* and those in the infected plant. The implication of the occurrence of new phenols and further accumulation of the already existing phenols, as a result of infection, on disease development is discussed.

49. Ashok Aggarwal, & Mehrotra, R. S. (1988). Studies on transeliminases in *Phytophthora colocasiae*: inhibitory effects of plant growth regulators, phenolics and fungicides. Indian Journal of Plant Pathology **6**(2), 158–163.

    All the growth regulators tested (IAA, IBA, GA, K, 2,3,4-T) and 10 and 100 p.p.m. checked the production of polygalacturonate transeliminase and pectin methyl transeliminase by this pathogen of *Colocasia esculenta*, but none could completely prevent it. Ferulic acid, m-hydroxybenzaldehyde, phloroglucinol and vanillin at 10, 50 and 100 p.p.m. were also inhibitory, as were all 6 fungicides tested, especially Apron 350 FW (metalaxyl), Ridomil 25 WP (metalaxyl) and Topsin M (thiophanate-methyl).

50. Ashok Aggarwal, Narula, K. L., Gurinderjit Kaur, & Mehrotra, R. S. (1990). *Phytophthora colocasiae* Racib.—its taxonomy, physiology, pathology and control. In S. K. Hasija, & K. S. Bilgrami (Editors), Perspectives in Mycological Research. Volume 2. (pp. 105–134). New Delhi, India.: Today & Tomorrow's Printers & Publishers. International Bioscience Series. Volume XV.

    The taxonomy, physiology, pathology and control of *Phytophthora colocasiae* , the cause of leaf and corm blight of *Colocasia esculenta*, are reviewed.

51. Ashok Bhattacharyya, & Saikia, U. N. (1996). Fungicidal management of leaf blight of *Colocasia*. International Journal of Tropical Agriculture **14**(1–4), 231–233.

    Field experiments conducted during 1990–91 at Jorhat, Assam, India, to study the effect of fungicides in controlling leaf blight caused by *Phytophthora colocasiae* in *Colocasia esculenta* revealed that 0.2% metalaxyl and mancozeb (as Ridomil MZ-72) was the most effective treatment, followed by 0.2% captafol (as Foltaf), Bordeaux mixture (1% copper sulfate and lime) and 0.25% mancozeb (as Foltaf). A significant increase in yield was recorded for all treatments over the untreated control. Bordeaux mixture gave the highest incremental cost-benefit ratio over the control (1:30.3).

52. Barrau, J. (1954). Decline in taro disease. South Pacific Commission Quarterly Bulletin **4**(2), 24.

53. Barrau, J. (1958). Subsistence agriculture in Melanesia. Bulletin, Bernie P. Bishop Museum, Hawaii (No. 219).

54. Barrau, J. (1961). Subsistence agriculture in Polynesia and Micronesia. Bulletin, Bernie P. Bishop Museum, Hawaii (No. 223).

55. Barrau, J. (1955). Taro disease in British Solomons. South Pacific Commission Quarterly Bulletin **5**(1).

56. Bergquist, R. R. (1973). Effect of fungicide rate, spray interval and timing of spray application in relation to control of *Phytophthora* leaf blight of taro. Phytophthora Newsletter (1), 6–7.

57. Bergquist, R. R. (1974). Effect of fungicide rate, spray interval, timing of spray application, and precipitation in relation to control of *Phytophthora* leaf blight of taro. Annals of Botany **38**(154), 213–221.

    In trials at 2 sites on the windward side of Kauai, *Colocasia esculenta* was sprayed with mancozeb at 4.48, 2.24 or 1.12 kg/ha at intervals of 5, 7, 10 or 14 days. At the drier of the 2 sites rate of fungicide had no effect, while at the wetter site (0.25 cm/week more rainfall) the highest rate of fungicide was more effective than the lowest. Spraying every 5 days was significantly more effective than spraying every 14 days. Applications of fungicide at 7-day

intervals when weekly accumulated rainfall exceeded 1 cm and/or when lesion counts exceeded 1/plant, gave substantial disease control. Yields at the wetter site were 8.66 and 11.19 kg primary corms/plant with no fungicide and with 1.12 kg mancozeb/ha, respectively, and significantly higher (14.26 and 16.71 kg/plant) at the 2 highest fungicide rates. Respective yields of secondary corms were 7.85, 7.08, 8.65 and 10.78 kg/plant.

58. Bergquist, R. R. (1972). Efficacy of fungicides for control of *Phytophthora* leaf blight of taro. Annals of Botany **36**(145), 281–287.

    Results of laboratory, glasshouse and outdoor trials are reported, in which Polyram (metiram) and Dithane M-45 (mancozeb) gave very good control of *Phytophthora colocasiae* on *Colocasia esculenta* and were the least phytotoxic.

59. Bernardo, E. N. (1981). Pest resistance in plants with emphasis on root crops. In Southeast Asian and the Pacific Training Course on Root and Tuber Crops Germplasm Evaluation and Utilization (p. 251). Leyte, Philippines: College of Agriculture.

60. Bhatt, D. D. (1966). Preliminary list of plant diseases recorded in the Katmandu Valley. Journal of Science of the Tri-Chandra College Science Association **2**(1), 13–20.

61. Bourke, R. M. (1982). Agronomic field trials on food crops in Papua New Guinea 1928–1978. Technical Report DPI 82/3 . Department of Primary Industry, Papua New Guinea.

    Included in this list of agronomic field trials carried out in Papua New Guinea are fungicide and cultivar trials on taro for blight control.

62. Bourke, R. M. (1982). Root crops in Papua New Guinea. In Proceedings of the Second Papua New Guinea Food Crops Conference. Port Moresby, Papua New Guinea, 14–18 July, 1980. (pp. 51–63). Port Morseby, Papua New Guinea: Department of Primary Industry.

    The widespread occurrence of taro leaf blight in Papua New Guinea is noted.

63. Bourke, R. M. (1982). Root crops in Papua New Guinea. In 5th International Symposium on Tropical Root and Tuber Crops. Philippines, 17–21 September 1979. (pp. 121–133). Los Banos, Philippines: Philippine Council for Agriculture and Resources Research.

    The widespread occurrence of taro leaf blight in the lowlands is noted. Agronomic work undertaken is tabulated.

64. Brooks, F. (2000). List of plant diseases in American Samoa, 35 pp. American Samoa: American Samoa Community College Land Grant Program. Land Grant Technical Report No. 31.

This publication includes a brief description of the taro leaf blight epidemic in American Samoa in 1993–94.

65. Brooks, F. (2000). Pests and diseases of American Samoa: taro in American Samoa, 2 pp. American Samoa: Agriculture, Human and Natural Resources, American Samoa Community College Land Grant Program. American Samoa Community College Land Grant Program Leaflet No. 2.

    The impact of taro leaf blight on the American Samoan economy is described along with an overview of taro pests and diseases.

66. Butler, E. J., & Bisby, G. R. (1931). The fungi of India, 237 pp. Imperial Council of Agricultural Research and Science Monograph No. 1.

67. Butler, E. J., Bisby, G. R., & Vasudeva, R. S. (1960). The fungi of India, 552 pp. India: Indian Council of Agricultural Research.

68. Butler, E. J., & Kulkarni, G. S. (1913). *Colocasia* blight caused by *Phytophthora colocasiae* Rac. Memoirs of the Department of Agriculture in India, Botanic Series **5**(4), 233–261.

69. CAB INTERNATIONAL. (2000). Crop Protection Compendium Global Module. Wallingford, UK: CAB INTERNATIONAL.

    This CD contains updated datasheets on taro and *Phytophthora colocasiae*, with information on biology, control and geographic distribution.

70. CAB INTERNATIONAL. (1998). Crop Protection Compendium Module 1. Wallingford, UK: CAB INTERNATIONAL.

    This CD contains datasheets on taro and *Phytophthora colocasiae*, with information on biology, control and geographic distribution.

71. CAB INTERNATIONAL. (1997). Distribution maps of plant diseases. (April–October), unnumbered.

    This set includes a map for *Phytophthora colocasiae* (Map no. 466). This is the 3rd edition of this map for this pathogen.

72. Cable, W. J. (1977). Report of a field study on taro research in the South Pacific. In Regional Meeting on the Production of Root Crops. Suva, Fiji, 24–29 October 1975. (pp. 94–99). Noumea, New Caledonia: South Pacific Commission. SPC Technical Document No. 174.

    In this review, taro leaf blight in the region is discussed. Control measures are outlined.

73. Carpenter, C. W. (1920). Report of the plant pathologist. Hawaii Agricultural Experiment Station Report 1919 (pp. 49–54). Hawaii, USA.

74. Castellani, E. (1939). Considerazioni fitopatologiche sull'Africa orientale italiana. [Phytopathological studies in Italian East Africa]. Agricoltura Colon , 486–492.

75. Chan, E. (1996). The impact of taro leaf blight on the Samoan economy and agricultural activity, 8 pp. Western Samoa Farming Systems Project, Ministry of Agriculture, Forestry, Fisheries and Meteorology, Unpublished report.

    The outbreak of taro leaf blight in Samoa is discussed. The government reaction to the disease, the effect on the pattern of food production and consumption and the effect on Samoa's economy are considered.

76. Chan, E. (1997). A summary of trials carried out in the taro leaf blight control program 1996–1997, 33 pp. Western Samoa Farming Systems Project, Ministry of Agriculture, Forestry, Fisheries and Meteorology, Unpublished report.

77. Chan, E., Milne, M., & Fleming, E. (1998). The causes and consequences of taro leaf blight in Samoa and the implications for trade patterns in taro in the South Pacific region. Tropical Agriculture (Trinidad) **75(**1), 93–98.

    The impact of taro leaf blight on taro production in Samoa after the outbreak of the disease in 1993 and steps taken by the Ministry of Agriculture, Fisheries, Forestry and Meteorology, including input subsidies, development of resistant varieties and food crop diversification are discussed. The implications of taro leaf blight for the Samoan economy and for taro trade and domestic prices in the Pacific region are also considered.

78. Chandra, S. (1984). Conclusions and recommendations for research and development in edible aroids. In S. Chandra (Editor), Edible Aroids (pp. 237–242). Oxford, UK: Clarendon Press.

    The main areas of needed future research and development for edible aroids are identified as: agronomy and production systems; germplasm and breeding; diseases and pests; and storage, utilization and marketing. *Phytophthora colocasiae* is identified as an important disease and the importance of collecting resistant germplasm is stressed.

79. Chaudhary, R. G., & Mathura Rai. (1988). A note on the varietal screening of taro to *Phytophthora* blight. Haryana Journal of Horticultural Sciences **17**(3–4), 278–279.

    In tests carried out in Arunachal Pradesh, India, 23 varieties of taro (*Colocasia esculenta*) were screened for resistance to *P. colocasiae*. Results showed that 5 varieties were immune and 1 was moderately resistant.

80. Cho, J. J., & Michelmore, R. W. (1996). Genetic analysis of *Phytophthora* leaf blight resistance in taro using molecular markers. In The Second Taro Symposium. Proceedings of an International Meeting. Faculty of Agriculture,

Cenderawasih University, Manokwari, Indonesia, 23–24 November 1994. (pp. 58–61).

Molecular techniques to accelerate the breeding of taro with resistance to blight are described. The technology can be used to tag genes associated with blight resistance. Breeding strategies using RAPD markers and PCR are described.

81. Chowdhury, S. (1944). Some fungi from Assam, I. Indian Journal of Agricultural Sciences , 230–233.

82. Cifferi, R. (1955). Preliminary list of noteworthy diseases of cultivated plants in continental eastern China. Plant Disease Reporter **39**(10), 785–792.

83. Clarke, W. C. (1973). A change of subsistence staple in prehistoric New Guinea. International Symposium on Tropical Root Crops. Ibadan, Nigeria, 1973.

84. Clarkson, D. (1981). Taro blight. Harvest (Papua New Guinea) **7**(2), 87. Plant pathology note: no. 9.

85. Clarkson, D., & Moles, D. J. (1984). Effects of four fungicides on the growth of *Phytophthora colocasiae*. Papua New Guinea Journal of Agriculture, Forestry and Fisheries **33**(1–2), 51–53.

    The efficiency of four fungicides in controlling *Phytophthora colocasiae* was investigated *in vitro* and *in vivo*. Du-ter and Ridomil were gave excellent control of fungal development but the phytotoxicity of Du-ter rendered it unsuitable for use on taro. Cuprox and Aliette were found to be less effective.

86. Cole, J. S. (1996). Isolation of *Phytophthora colocasiae* into pure culture. Taro Leaf Blight Seminar. Proceedings. Alafua, Western Samoa, 22–26 November, 1993. (pp. 83–85). Noumea, New Caledonia: South Pacific Commission. Unpublished.

    The use of selective medium, selecting agents (Pimaricin, Penicillin-G and PCNB (Pentachloronitrobenzene)), isolation of the pathogen from plant material and baiting techniques for *Phytophthora colocasiae* are described.

87. Connell, J. (1978). The death of taro: local response to a change of subsistence crops in the Northern Solomon Islands. Mankind (No. 11), 445–452.

    The outbreak of taro leaf blight on Bougainville after the 2nd World War, its spread in the Solomon Islands and the local response to the disease are discussed.

88. Coursey, D. G., & Booth, R. H. (1977). Contributions of post-harvest biotechnology to trade in tropical crops. In Regional Meeting on the Production of Root Crops. Suva, Fiji, 24–29 October 1975. (pp. 100–105). Noumea, New Caledonia: South Pacific Commission. SPC Technical Paper No. 174.

Although the storage of taro is minimal, the role of *Phytophthora colocasiae* in postharvest decay of taro is discussed.

89. Coursey, D. G., Jackson, G. V. H., & Pena, R. S. d. l. (1979). Working group report: handling and storage. In D. L. Plucknett (Editor), Small-scale Processing and Storage of Tropical Root Crops (pp. 15–25). Boulder, Colorado, USA: Westview Press. Westview Tropical Agriculture Series, No. 1.

    In this chapter, preharvest (removal of infected leaves 2 weeks before harvest) and packaging and handling techniques to reduce damage caused by *Phytophthora colocasiae*, and other diseases are discussed.

90. Cox, P. G. (1986). Taro leaf blight, 15 pp. Lae, Papua New Guinea: Department of Agriculture and Livestock, Bubia Agricultural Research Centre. Seminar paper presented at Bubia Agricultural Research Centre, Lae, Papua New Guinea, 5 November 1986.

    Research on taro leaf blight at DPI Crops Research is outlined. Experiments on chemical control using metalaxyl, the effect of taro leaf blight on leaf number, the effect of dose rate on the chemical control of taro leaf blight, the effect of application frequency on chemical control and the effect of leaf number on varietal reaction to taro leaf blight are described.

91. Cox, P. G., & Kasimani, C. (1988). Control of taro leaf blight using metalaxyl. Tropical Pest Management **34**(1), 81–84.

    Metalaxyl with copper (as 0.3% Ridomil plus 72 w.p.) gives excellent control of taro (*Colocasia esculenta*) leaf blight (*Phytophthora colocasiae*) when applied at 2-week intervals using a knapsack sprayer. It is concluded that this is useful for taro research and suggests a way to control the disease in subsistence food gardens in Papua New Guinea, which may be preferable both to the development and introduction of elite cultivars and to attempts at cultural control.

92. Cox, P. G., & Kasimani, C. (1990). Control of taro leaf blight using metalaxyl: effect of dose rate and application frequency. Papua New Guinea Journal of Agriculture, Forestry and Fisheries **35**(1–4), 49–55.

    Metalaxyl (as Ridomil plus 72 WP) was applied to taro (*Colocasia esculenta*) cultivar K264 using a knapsack sprayer to control leaf blight (*Phytophthora colocasiae*). The efficacy of 3 dose rates (0.1, 0.2 and 0.3%) applied at 2-week intervals (experiment 1) and 3 application frequencies (2, 5 and 7 times) using 0.3% metalaxyl (experiment 2) was investigated. In experiment 1, analysis of variance showed a significant increase in corm weight in all plots treated with metalaxyl ($P<0.001$) but no difference in yield between treatments. In the second experiment, treated plots again showed a significant increase in corm yield: 5 applications of metalaxyl at 3-week intervals resulted in an increase of almost 50%.

93. Cox, P. G., & Kasimani, C. (1987). Effect of blight on leaf area duration, leaf number and marginal unit leaf rate of taro, 15 pp. Kerevat, Papua New Guinea: Department of Agriculture and Livestock, Lowlands Agricultural Experiment Station.

    Leaf blight substantially reduces both the leaf area duration and the marginal unit leaf rate of taro. Leaf number is the principal component of leaf area duration affected by blight. Use of effective leaf area does not correct for differences in the unit leaf rate. A model is presented which explains this in terms of the division of labour along the plant axis. The implications of variation in the rate of yield accumulation for the control of taro leaf blight in farmers' gardens are discussed. Two disease indices are proposed: (1) percentage loss of leaf number (for the comparison of different varieties); and (2) percentage of growing period affected by blight (for the comparison of different disease progress curves).

94. Cox, P. G., & Kasimani, C. (1990). Effect of taro leaf blight on leaf number. Papua New Guinea Journal of Agriculture, Forestry and Fisheries **35**(1–4), 43–48.

    Setts of taro (*Colocasia esculenta*) cultivar K264 were planted in a randomized complete block design with 5 replicates of 4 treatments: plants inoculated with *Phytophthora colocasiae* at 78, 105 or 133 d after planting or uninoculated in control plots. The number of leaves declined following inoculation, reaching an equilibrium after 3–6 weeks. Leaf number was then similar in all inoculated plants. The number of older leaves was reduced by the blight, but the rate of leaf production was unaffected. Yield from all inoculated plants was significantly reduced ($P<0.01$) but there was no significant difference between inoculated plots.

95. Cox, P. G., & Kasimani, C. (1987). Effect on leaf number on varietal reaction to taro leaf blight, 12 pp. Lae, Papua New Guinea: Department of Agriculture and Livestock, Bubia Agricultural Research Centre.

    Leaf blight reduces the cumulative leaf number of taro. A plant with more leaves suffers a greater proportional loss of leaf number in the presence of blight, and a correspondingly greater proportional loss in mean corm weight. It is concluded that this has implications for the design of improved taro cultivars.

96. Das, S. R. (1997). Field efficacy of fungicides for the control of leaf blight disease of taro. Journal of Mycology and Plant Pathology **27**(3), 337–338.

    Field experiments were conducted at the Orissa University of Agriculture and Technology, Bhubaneswar, Orissa, India, for the 3 successive kharif seasons of 1991–93 to test the efficacy of copper oxychloride, mancozeb, metalaxyl, captafol, ziram and Bordeaux mixture against leaf blight disease (*Phytophthora colocasiae*) of taro (*Colocasia esculenta* var. *antiquorum*). The local variety, Telia, was used as a test crop. Fungicides were sprayed when disease symptoms first appeared and repeated twice at 14-day intervals.

Leaf blight severity and marketable corm yield were recorded for each treatment. All fungicides significantly reduced leaf blight intensity and increased corm yields in comparison with the untreated control. Metalaxyl + mancozeb gave significantly more effective disease control than the other fungicides followed by mancozeb and Bordeaux mixture. Mancozeb recorded the highest corm yield (95.6 q/ha). It is concluded that leaf blight of taro can be effectively managed by giving 3 sprays of metalaxyl + mancozeb or mancozeb alone starting at the onset of the disease and repeating at fortnightly intervals.

97. Dayrit, R., & Phillip, J. (1987). Comparative performance of eight dryland taro varieties on Pohnpei, Federated States of Micronesia, 4 pp. Kolonia, Federated States of Micronesia: AES/CTAS.

98. Delp, C., Hunter, D. G., & Pouono, K. (1999). USP Taro Breeders Club: an innovative and participatory approach to improving taro in Samoa. IRETA's South Pacific Agricultural News .

    The Taro Breeders Club initiated at the University of the South Pacific in Samoa in 1999 is described.

99. Deshmukh, M. J., & Chhibber, K. N. (1960). Field resistance to blight *Phytophthora colocasiae* Rac. in *Colocasia esculenta* Schott. Current Science (Bangalore) **29**(8), 320–321.

    The progress of taro leaf blight in the field resistant cultivar, Ahina, and susceptible Patna Local was compared. Fewer sporangia of the fungus were produced on the resistant cultivar and the disease progressed at a much slower rate. The reaction on the resistant cultivar was much more severe. It is concluded that the observed field resistance is a weak hypersensitive reaction.

100. Dey, T. K., Ali, M. S., Bhuiyan, M. K. R., & Siddique, A. M. (1993). Screening of *Colocasia esculenta* (L.) Schott lines to leaf blight. Journal of Root Crops **19**(1), 62–65.

    A total of 38 *C. esculenta* lines were evaluated for susceptibility to leaf blight, caused by *Phytophthora colocasiae.*

101. Dey, T. K., Ali, M. S., Chowdhury, N., & Siddique, M. A. (1991). Vegetative growth and sporangial production in *Phytophthora colocasiae* Racib. Journal of Root Crops **17**(2), 142–146.

    The influence of agar media, temperature and liquid substrates on vegetative growth and sporangial production of *P. colocasiae* was investigated. Oat meal agar with yeast extract and V-8 juice agar gave maximum vegetative growth and mycelial density. Highest vegetative growth and mycelial density was recorded at 25 +/- 1 C. Rain water was the best liquid substrate for sporangial production followed by charcoal water at 20 +/- 1 C.

102. Dingley, J. M., Fullerton, R. A., & McKenzie, E. H. C. (1981). Records of fungi, bacteria, algae and angiosperms pathogenic on plants in Cook Islands, Fiji, Kiribati, Niue, Tonga, Tuvalu, and Western Samoa. SPEC/UNDP/FAO Survey of Agricultural Pests and Diseases, Technical Report No. 2.

    The distribution of *Phytophthora colocasiae* in the Pacific region is given as Solomon Islands, Papua New Guinea and Hawaii (page 136). Reports for Fiji and Western Samoa are cited, but it is concluded that these reports need confirmation.

103. Erari, D. K. (1994). Penggunaan beberapa mikroorganisme saprofit dan fungisida Metalaxyl untuk pengendalian penyakit hawar daun talas (*Phytophthora colocasiae*). [The use of several saprophytic microorganisms and metalaxyl fungicide to control taro leaf blight (*Phytophthora colocasiae*)]. Unpublished report of the Faculty of Postgraduate Studies, Bogor Agricultural Institute.

104. Erari, D. K. (1985). Penilaian ketahanan beberapa klon talas asal Manokwari terhadap serangan penyakit bercak daun talas (*Phytophthora colocasiae*). [The evaluation of several taro clones from Manokwari to taro leaf blight (*Phytophthora colocasiae*)]. Unpublished report of the Faculty of Agriculture UNCEN, Manokwarai.

105. Erwin, D. C. (1983). Variability within and among species of *Phytophthora.* D. C. Erwin, S. Bartnicki-Garcia, & P. H. Tsao (Editors), *Phytophthora*: its Biology, Taxonomy, Ecology, and Pathology (pp. 149–165). St Paul, Minnesota, USA: APS Press (American Phytopathological Society).

    Phytophthora colocasiae is considered in this discussion on variability within and among species of *Phytophthora*.

106. Erwin, D. C., & Ribeiro, O. K. (1996). *Phytophthora colocasiae*. *Phytophthora* Diseases Worldwide (pp. 299–300). USA: APS Press (American Phytopathological Society).

    The fungus is described and its taxonomy discussed.

107. Esgrerra, N. M. (1981). Status of integrated pest management on root crops in the Philippines. In Southeast Asian and the Pacific Training Course on Root and Tuber Crops Germplasm Evaluation and Utilization (pp. 264–312). Leyte, Philippines: Visayos State College of Agriculture.

108. Ezumah, H. C., & Plucknett, D. L. (1981). Cultural studies on taro, *Colocasia esculenta* (L.) Schott. Journal of Root Crops **7**, 41–52.

109. FAO. (1998). Global Plant and Pest Information System.

    Also available via the Internet at http://pppis.fao.org. This CD is a snap shot of the database taken in July 1998. Data is updated regularly in the internet version and CDs pressed periodically. The database contains information on *Phytophthora colocasiae* and the text of a thesis on 'Phenology and

epidemiology of *Phytophthora colocasiae* Racib. on taro in the East West Province, Papua New Guinea' by Putter, C. A. J.

110. FAO. (1963). Host list of fungi etc. recorded in the South East Asia and Pacific region. *Colocasia antiquorum*—taro; *Dioscorea* spp.—yam; *Manihot utilissima*—cassava. Technical Document FAO Plant Protection Commission .

111. FAO. (1963). Quarterly report for October–December 1962 of the Plant Protection Committee for the South East Asia and Pacific Region. Bangkok, Thailand: FAO.

112. Ferentinos, L. (1993). Proceedings of the Sustainable Taro Culture for the Pacific Conference. University of Hawaii, 24–25 September 1992. (140 pp.). Honolulu, Hawaii: Hawaii Institute of Tropical Agriculture and Human Resources. HITAHR Research and Extension Series No. 140.

    Several papers concern taro leaf blight and have been noticed separately in this bibliography.

113. Firman, I. D. (1975). *Phytophthora* and *Pythium* species and the diseases caused by them in the area of the South Pacific Commission. Fiji Agricultural Journal **37**, 1–8.

114. Firman, I. D. (1982). Review of major diseases of crops in the South Pacific. In Sub-Regional Training Course on Methods of Controlling Diseases, Insects and Pests of Plants in the South Pacific (pp. 39–46). Tonga: GTZ/USAID/CICP/MAFF.

115. Fonoti, P., Hunter, D. G., & Delp, C. (2001). Improving traditional farming systems through plant breeding. In Proceedings of the Regional Workshop on the Improvement and Development of Traditional Farming Systems for South Pacific Countries. IRETA, University of the South Pacific, Alafua Campus, Samoa, 18–22 October 1999.

116. Fonoti, P., Hunter, D. G., Singh, D., Okpul, T., Delp, C., Pouono, K., & Sivan, P. (1999). Breeding for resistance to taro leaf blight in the South Pacific. In Proceedings of the 12th Biennial Australasian Plant Pathology Society Conference. Canberra, Australia, 27–30 September 1999. (p. 248).

117. Fullerton, B., Hunter, D. G., & Jackson, G. (1998). Phytophthora colocasiae: the pathogen and its epidemiology. In Proceedings of the Taro Breeding Workshop. Suva, Fiji Islands, 26–28 August 1988. (pp. 8–9). Noumea, New Caledonia: AusAID/SPC Taro Genetic Resources: Conservation and Utilisation, Secretariat of the Pacific Community.

118. Fullerton, R. A. (1995). SPC/DAL/Unitech Taro Seminar II, Lae, Papua New Guinea. Report to the New Zealand Ministry of Foreign Affairs and Trade, 55 pp.

Auckland, New Zealand: HortResearch. HortResearch Client Report No. 95/239.

In this report the Taro Seminar II meeting held in Lae, 26–30 June 1995 is analysed. The major focus on taro leaf blight is noted and details of work in progress on chemical control and breeding for resistance are summarised. Recommendations included the need for a continuation of the breeding programme, sourcing resistant material, exposure of resistant lines to other strains of the pathogen and conservation of genetic resources. The paper 'Breeding for resistance to taro leaf blight—a pathologist's perspective' presented by R.A. Fullerton at the meeting is appended.

119. Fullerton, R. A., Tyson, J., Hunter, D. G., & Fonoti, P. (2000). Plant Pathology Progress Report. In Taro Genetic Resources Committee Meeting. Lae, Papua New Guinea, 18 April 2000.

    The development of laboratory and field screening techniques for taro blight are described. Additional information is provided on determination of *P. colocasiae* mating type from different Pacific countries.

120. Galloway, L. D. (1936). Report of the Imperial Mycologist. Science Report of the Agricultural Research Institute, Pusa. (pp. 120–136).

121. Gendua, M. A., & Johnston, M. (1996). The performance of taro (*Colocasia esculenta*) seedlings grown to maturity. In The Second Taro Symposium. Proceedings of an International Meeting. Faculty of Agriculture, Cenderawasih University, Manokwari, Indonesia, 23–24 November 1994. (pp. 79–82).

    Taro seedlings showed greater variation in their reaction to *Phytophthora colocasiae* than their parents. It is concluded that selection within seedling populations offers much potential.

122. Ghani, F. D. (1980). The status of Keladi China *Colocasia esculenta* (L.) Schott cultivation in Peninsula Malaysia. In International Symposium on Taro and Cocoyam. Visayas State College of Agriculture, Baybay, Leyte, Philippines, 24–25 September, 1979. (pp. 35–54). Stockholm, Sweden: International Foundation for Science. Provisional Report (International Foundation for Science) No. 5.

    In this account of taro growing in Malaysia, taro leaf blight is reported as sometime occurring during wet weather. When it occurs, it is serious causing decay of the petioles and the corms.

123. Ghosh, S. K., & Das, N. (1996). Physiology of sporangial germination of *Phytophthora colocasiae* Racib. *in vitro*. Advances in Plant Sciences **9**(1), 107–110.

Sporangia of *P. colocasiae*, the cause of leaf blight and corm rot of taro (*Colocasia esculenta*), were harvested from 10 day old cultures grown in oat + yeast extract + thiamine medium. The mode of sporangial germination was investigated in both distilled and tap water at various temp. (10–30 C) and incubation durations. Both direct and indirect germination of sporangia took place. At 10ø, indirect germination began within 15 min and 100% germination took place after 2 h, while at 30ø it started after 30 min and only 18% of sporangia germinated indirectly after 2 h. Direct germination occurred up to 6.1% at 30ø after 3 h and even after 24 h but at 10ø no direct germination was observed.

124. Ghosh, S. K., & Sitansu Pan . (1989). A comprehensive account of the fungal diseases of *Colocasia esculenta* (L.) Schott. Indian Journal of Mycological Research **27**(2), 107–119.

This review covers the distribution, symptoms, epidemiology, aetiology, perennation, hosts, losses caused by and control measures for leaf blight (*Phytophthora colocasiae*), dry rot (*Fusarium* [*solani* var.] *coeruleum* and *F. solani*), and the root and corm rots caused by *Pythium* spp.

125. Ghosh, S. K., & Sitansu Pan. (1991). Control of leaf blight of taro (*Colocasia esculenta* (L.) Schott) caused by *Phytophthora colocasiae* Racib. through fungicides and selection of variety. Journal of Mycopathological Research **29**(2), 133–140.

Spraying with Ridomil MZ 72 WP [metalaxyl] at 3 kg/ha at intervals of 15 d was highly effective in controlling the disease under field conditions, and gave max. net financial return. This fungicide was equally effective against *P. colocasiae in vitro*. Of 11 cultivars screened under natural epiphytotics, Burdwan local was the best for commercial cultivation in this agroclimatic zone.

126. Ghosh, S. K., & Sitansu Pan. (1994). Pectolytic and cellulolytic enzyme activity by 3 isolates of *Phytophthora colocasiae* Racib. with graded virulence. Mysore Journal of Agricultural Sciences **28**(1), 47–51.

The involvement of cell wall degrading enzymes in the pathogenesis of *P. colocasiae* on *Colocasia esculenta* was investigated using 3 isolates of the pathogen with high, medium and low virulence. In *in vitro* experiments using culture filtrates, production of polygalacturonase (PG), pectin methyl esterase (PME) and polymethyltranseliminase (PMTE) was greatest for the isolate with high virulence; no polymethylgalacturonase (PMG) activity was determined. In further *in vivo* tests on detached leaves, PMTE, PMG and PG activity was highest for the most virulent isolate; no PME activity was determined.

127. Giri, D., Banerjee, K., Laha, S. K., & Khatua, D. C. (1989). Some diseases of horticultural and field crops. Environment and Ecology **7**(4), 821–825.

Amongst the diseases detected during surveys undertaken in the kharif and rabi seasons of 1981 in West Bengal, India, leaf blight (*Phytophthora colocasiae*) of *Colocasia nymphaeifolia* was recorded for the first time in India.

128. Gollifer, D. E. (1971). Preliminary observations on the performance of cultivars of taro (*Colocasia esculenta* L.) in the British Solomon Islands with notes on the incidence of taro leaf blight (*Phytophthora colocasiae* Rac.) and other diseases. In Tropical root and tuber crops tomorrow. Volume 2. Proceedings of the Second International Symposium on Tropical Root and Tuber Crops. Honolulu, Hawaii, 23–30 August 1970. (pp. 56–60). Honolulu, Hawaii, USA: University of Hawaii.

    All cultivars surveyed were infected by *Phytophthora colocasiae.* The effect of the disease on yield has not been measured in the Solomons.

129. Gollifer, D. E. (1972). Taros *Colocasia esculenta* L. Annual Report 1971, British Solomon Islands Protectorate, Department of Agriculture, Dala Experimental Station (pp. 38–45). Honiara, Solomon Islands: Department of Agriculture.

    Results of cultivar, fungicide and yield loss trials are reported.

130. Gollifer, D. E., & Brown, J. F. (1974). *Phytophthora* leaf blight of *Colocasia esculenta* in the British Solomon Islands. Papua New Guinea Agricultural Journal **25**(1–2), 6–11.

    Leaf blight, caused by *P. colocasiae*, is the most widespread disease of this crop on the larger volcanic islands. None of the 181 local cultivars tested was immune or highly resistant to the fungus. A small proportion, however, did not show high levels of disease. Cu fungicides as foliar sprays, although giving poor control, resulted in yield increases of up to 25%.

131. Gollifer, D. E., Jackson, G. V. H., & Newhook, F. J. (1980). Survival of inoculum of the leaf blight fungus *Phytophthora colocasiae* infecting taro, *Colocasia esculenta* in the Solomon Islands. Annals of Applied Biology **94**(3), 379–390.

    The fungus was isolated by baiting with detergent-treated taro leaf discs placed on water slurries of soil, on suspensions of macerated leaf lesions or on washings from petioles of harvested plants. Inoculum on detached leaf lesions or in soil remained viable for only a few days, and that on petiole bases (used for vegetative propagation) for 2 days if stored dry, but for 14 days if planted in the field immediately. Artificial augmentation of surface inoculum with naturally produced sporangia extended the period of inoculum detectability. Incubation of inoculated tops under high humidity led to active infection and sporulation on petioles, especially the cut ends. Of several aroids tested only *Alocasia macrorrhiza* proved susceptible but it has not been found naturally infected. Thus perennation between crops is effected by short-lived, surface propagules and possibly by mycelium within petiole

lesions. Reduction of the former and prevention of the latter might be achieved by dry storage of tops (used for propagation) for 2–3 weeks.

132. Gomez, E. T. (1925). Blight of gabi (*Phytophthora colocasiae* Rac.) in the Philippines. Philippine Agriculturist **14**, 429–440.

    The importance, distribution, symptoms, causal organism, environmental factors affecting the disease and control measures of gabi (*Colocasia esculenta*) blight in the Philippines are discussed.

133. Gomez-Moreno, M. L. (1942). Araceas de Fernando Poo. [Araceae of Fernando Poo]. Ann Agic Terr Esp Golfo Guinea , 7–37.

134. Goswami, B. K., Zahid, M. I., & Haq, M. O. (1993). Screening of *Colocasia esculenta* germplasm to *Phytophthora* leaf blight. Bangladesh Journal of Plant Pathology **9**(1–2), 21–24.

Among 50 lines tested by inoculation in the field during 1987–89, 2 were highly resistant to *P. colocasiae*, 5 resistant, 12 moderately resistant and the rest moderately to highly susceptible.

135. Greenough, D. R. (1996). Taro leaf blight research programme for American Samoa. Taro Leaf Blight Seminar. Proceedings. Alafua, Western Samoa, 22–26 November, 1993. (pp. 87–88). Noumea, New Caledonia: South Pacific Commission. Unpublished.

    Variable results have been achieved with Ridomil in the control of taro leaf blight in American Samoa. Research needs were identified as: chemical control studies with Ridomil, Ridomil/Aliette and calcium hypochlorite and integrated management studies including variety and fertility trials. Progress of this research is briefly described.

136. Greenough, D. R., & Trujillo, E. E. (1996). Effects of nitrogen, calcium, and/or potassium nutrition on the resistance and/or susceptibility of Polynesian taros, *Colocasia esculenta*, to the taro leaf blight, caused by the fungus *Phytophthora colocasiae*. In ADAP Project Report (pp. 19–25).

    The objectives and progress and major accomplishments in the project are reported. Results of field trials in Hawaii, American Samoa and Guam are reported.

137. Greenough, D., Fa'aumu, S., & Tilialo, R. (1994). Effect of three concentrations of Ridomil 2E on the incidence of taro leaf blight (*Phytophthora colocasiae*) in American Samoa. Phytopathology **84**(10), 1115. Abstract of a paper presented at the APS Annual Meeting, Albuquerque, New Mexico, 6–10 August, 1994.

    The epidemic of taro leaf blight in American Samoa starting in June 1993 is described. Chemical and cultural control measures were initiated. Ridomil 2E at 3, 5 and 7 fluid ounces/2 gallons water were applied as a soil drench, 2 and

4 months after planting. The highest concentration gave the best control, with only some phytotoxicity observed.

138. Gregory, P. H. (1983). Some major epidemics caused by *Phytophthora*. D. C. Erwin, S. Bartnicki-Garcia, & P. H. Tsao (Editors), *Phytophthora*: its Biology, Taxonomy, Ecology, and Pathology (pp. 271–278). St Paul, Minnesota, USA: APS Press (American Phytopathological Society).

    Five examples are discussed including the epidemiology of *Phytophthora colocasiae* on taro.

139. Guarino, L., & Jackson, G. V. H. (1986). Describing and documenting root crops in the South Pacific, 141 pp. Suva, Fiji: FAO/SPC. RAS/83/001 Field Document No. 12.

    The presence of *Phytophthora colocasiae* in the region and the breeding for resistance in Papua New Guinea and Solomon Islands is noted.

140. Gunua, T. G. (1997). Foliar diseases of taro in the wahgi valley of the Western highlands province of Papua New Guinea. Papua New Guinea Journal of Agriculture, Forestry and Fisheries **40**(1–2), 22–26.

    Foliar diseases of taro (*Colocasia esculenta*) in 3 areas of the Wahgi Valley in the Western Highlands of Papua New Guinea were investigated. Taro leaf blight (*Phytophthora colocasiae*) was not found at any of the sites.

141. Gurr, P. (1996). The taro leaf blight situation in American Samoa. Taro Leaf Blight Seminar. Proceedings. Alafua, Western Samoa, 22–26 November, 1993. (pp. 35–38). Noumea, New Caledonia: South Pacific Commission. Unpublished.

    The detection of the taro leaf blight epidemic in American Samoa in 1993, its spread and measures taken to control the disease are outlined. Successes and problems with chemical control using the copper based fungicide (Paranoias), Ridomil 2E and calcium hypochlorite are discussed.

142. Hicks, P. G. (1967). Resistance of *Colocasia esculenta* to leaf blight caused by *Phytophthora colocasiae*. Papua New Guinea Agricultural Journal **19**(1), 1–4.

    Seven of the clones tested were weakly to moderately resistant.

143. Hill, D. S., & Waller, J. M. (1990). Taro. In Pests and Diseases of Tropical Crops Field Handbook .

144. Hill, V. (1995). In worlds of our own: different ways of seeing and the small-holder taro grower in Western Samoa. Unpublished doctoral dissertation, Victoria University, Wellington, New Zealand.

145. Ho, H. H. (1992). Keys to the species of *Phytophthora* in Taiwan. Plant Protection Bulletin (Taiwan) **1**(2), 104–109.

A dichotomous key and a synoptic key for the identification of the 23 *Phytophthora* species recognized in Taiwan are presented.

146. Ho, H. H. (1981). Synoptic keys to the species of *Phytophthora* in Taiwan. Mycologia **73**(4), 705–714.

Three synoptic keys are presented to facilitate identification of plant pathogenic *Phytophthora* species in culture.

147. Ho, H. H., & Chang, H. S. (1992). A re-evaluation of *Phytophthora* species described by K. Sawada in Taiwan. **43**, 297–316.

The taxonomic status of all 23 species of *Phytophthora* described by K. Sawada in Taiwan is reviewed, based on a study of available dried plant specimens, type/authentic cultures and the original publications. Sawada's findings of *P. colocasiae* on taro are confirmed.

148. Ho, H. H., Hu, Y. N., Zhuang, W. Y., & Liang, Z. R. (1983). Mating types of heterothallic species of *Phytophthora* in China. I. Acta Mycologica Sinica **2**(3), 187–191.

Each of 38 isolates of 7 heterothallic *Phytophthora* spp. was grown in dual culture with known A1 and A2 strains. There was no correlation between mating types and hosts or geographical distribution.

149. Ho, H. H., Liang, Z. Y., Zhuang, W. Y., & Yu, Y. N. (1984). *Phytophthora* spp. from rubber tree plantations in Yunnan Province in China. Mycopathologia **86**, 121–124.

150. Ho, P. K., & Ramsden, L. (1998). Mechanisms of taro resistance to leaf blight. Tropical Agriculture (Trinidad) **75**(1), 39–44.

Five cultivars of taro and 2 other related aroids were screened for the induction of pathogenesis-related (PR) proteins in response to infection by *Phytophthora colocasiae.* Extracellular fluid from infected leaves was tested for PR protein expression by SDS-PAGE analysis and activity gels were used to measure the activity of the known PR proteins, beta-1,3-glucanase, proteinase inhibitors and peroxidase). Infected plants showed increased levels of PR proteins but this did not correlate with resistance in the most susceptible cultivars. Despite high levels of some PR proteins, infection still occurred in these cultivars. Successful resistance in other plants was more closely linked to the pattern of expression of proteinase inhibitors which appear to be an important defence strategy in taro in related aroids.

151. Hohl, H. R. (1975). Level of nutritional complexity in *Phytophthora*: lipids, nitrogen sources and growth factors. Phytopathologische Zeitschrift **84**(1), 18–33.

In a medium (P-1L) that supported good vegetative growth of all 24 test strains, representing 16 *Phytophthora* spp., the single most effective additives were lecithin and linoleic acid, which were generally superior to sterols.

152. Hohl, H. R. (1975). Levels of nutritional complexity in *Phytophthora*: lipids, nitrogen sources and growth factors. Phytophthora Newsletter (No. 3), 12.

    A medium containing lecithin and linoleic acid was devised which supported good vegetative growth of 24 strains representing 16 *Phytophthora* spp. These strains were divided into 4 levels of nutritional complexity on the basis of the results.

153. Hohl, H. R. (1983). Nutrition of *Phytophthora.* D. C. Erwin, S. Bartnicki-Garcia, & P. H. Tsao (Editors), *Phytophthora*: its Biology, Taxonomy, Ecology, and Pathology (pp. 41–54). St Paul, Minnesota, USA: APS Press (American Phytopathological Society).

    The nutritional aspects of vegetative growth of *Phytophthora* species is reviewed, including several references to *P. colocasiae*.

154. Holliday, P. (1980). *Phytophthora colocasiae.* In Fungus diseases of tropical crops. (pp. 348–349). Cambridge, UK.: Cambridge University Press.

    A description of the fungus is given and symptoms of the disease and its control are briefly discussed.

155. Houtondji, A., Palay, L., & Messiaen, C. M. Recherches sur l'activite eventuelle de quelques nematicides vis a vis de champignons phytopathogenes du sol (chou caraobe). [Investigations on the possible antifungal activity of some nematicides (tannia plant)]. In Congres sur la protection de la sante humaine et des cultures en milieu tropical: nouvelles strategies de protection integree des cultures et de lutte contre les vecteurs de maladies, regions tropicales et subtropicales. Marseille, France, 2–4 July 1986. (pp. 301–304). In French.

156. Hunter, D. G., & Delp, C. (1999). Breeders club helps save taro. The University of the South Pacific Bulletin **32**, 2.

157. Hunter, D. G., & Delp, C. (2000). Taro returning to Samoa. IRETA's South Pacific Agricultural News **17**, 4–5.

158. Hunter, D. G., Delp, C., Iosefa, T., & Fonoti, P. (2000). Improving taro production in Samoa through breeding and selection. In 12th Symposium of the International Society for Tropical Root Crops. Tsukuba, Japan, 10–16 September 2000.

159. Hunter, D. G., Delp, C., Iosefa, T., & Metai, A. (2000). Samoan taro growers are battling taro leaf blight, *Phytophthora colocasiae*. In 1st Asian Conference on Plant Pathology. Beijing, China, 25–28 August 2000. (p. 335).

    This poster presented at the conference is available on page 335 of the 3rd circular/program.

160. Hunter, D. G., & Fonoti, P. (2000). Taro leaf blight—tackling the problem as partners. FOCUS (July), 18.

Two initiatives in Samoa, a taro breeders club and a taro improvement project, are described in this short article.

161. Hunter, D. G., Iosefa, T., Delp, C. J., & Fonoti, P. (2000). Beyond taro leaf blight: a participatory approach for plant breeding and selection for taro improvement in Samoa. In Proceedings of the International Symposium on Participatory Plant Breeding and Participatory Plant Genetic Resource Enhancement. Pokhara, Nepal, 1–5 May 2000. Cali, Colombia: CGIAR Systemwide Program on Participatory Research and Gender Analysis for Technoloy Development and Institutional Development, Centro Internacional de Agricultura Tropical.

    This paper documents the arrival and impact of taro leaf blight on the Samoan economy and initial attempts to try and contain the spread of the disease. The article focuses on the need for breeding for resistance as the most sustainable approach for management of the disease and compares conventional and participatory methods.

162. Hunter, D., & Pouono, K. (1998). Evaluation of exotic taro cultivars for resistance to taro leaf blight, yield and quality in Samoa. Journal of South Pacific Agriculture **5**(2), 39–43.

    Four taro cultivars (Pwetepwet, PSB-G2, Pastora and Toantal) were screened and evaluated in trials at the University of the South Pacific Alafua Campus, Samoa, for their resistance to taro leaf blight, and for their yield and eating quality. Disease severity levels were not significantly different for any of the cultivars studied. Corm yields were highest for Pastora, followed by PSB-G2, Pwetepwet and Toantal. Toantal and PSB-G2 rated highest for taste and dry weight.

163. Hunter, D., Pouono, K., & Semisi, S. (1998). The impact of taro leaf blight in the Pacific Islands with special reference to Samoa. Journal of South Pacific Agriculture **5**(2), 44–56.

    An account of *Phytophthora colocasiae* on taro in the Pacific Islands, especially Samoa, is given and control methods discussed.

164. Hunter, D., Sivan, P., Pouono, K., & Amosa, F. (1998). Taro leaf blight and its management in Samoa. 7th International Congress on Plant Pathology. Edinburgh, UK, 10–14 August 1998.

    An abstract of this paper is available electronically on the webpage at www.bspp.org.uk/icpp98/abstracts/4.7/8.html and also in the printed proceedings of the congress. The impact of taro leaf blight in Samoa, its cultural control, screening of exotic taro cultivars, breeding, chemical control and future work are discussed.

165. Hunter, J. E., & Kunimoto, R. K. (1974). Dispersal of *Phytophthora palmivora* sporangia by wind-blown rain. Phytopathology **64**(2), 202–206.

In this paper on the dispersal of spores of *P. palmivora*, reference is made to some unpublished work of the authors on *P. colocasiae*. In a pilot study with the taro pathogen, sporangia were not released into moving air under drying conditions, but were readily released by rain-splashing.

166. Iosefa, T., & Rogers, S. (1999). The multiplication, growth and use of introduced taro cultivars in Samoa. Report of an impact assessment carried out during August to November, 1998. Suva, Fiji Islands: Pacific Regional Agricultural Programme Project 1—Farming Systems in Low Lands.

    Information on the performance of TLB-resistant cultivars in Samoa is given.

167. Irwin, S. V., Kaufusi, P., Banks, K., Pena, R. d. l., & Cho, J. J. (1998). Molecular characterization of taro (*Colocasia esculenta*) using RAPD markers. Euphytica **99**, 183–189.

168. Ivancic, A. (1996). Breeding for resistance to taro diseases in Solomon Islands. In Seminar on Pacific Plant Pathology in the 1990s. Suva, Fiji Islands, 5–7 September 1991. (pp. 17–18). Noumea, New Caledonia: South Pacific Community.

    A brief overview of taro leaf blight in the Solomon Islands (as well as other pests) and breeding for resistance are given.

169. Ivancic, A., Kokoa, P., Gunua, T., & Darie, A. (1996). Breeding approach on testing for resistance to taro leaf blight. In The Second Taro Symposium. Proceedings of an International Meeting. Faculty of Agriculture, Cenderawasih University, Manokwari, Indonesia, 23–24 November 1994. (pp. 93–96).

    Resistance to taro leaf blight was studied under screenhouse, nursery and field conditions, and in special ‘water beds’. The density of plants, temperature and humidity appeared to be the most important factors influencing infection and spread of the fungus. Plants growing in extremely hot and humid plastic cages showed higher susceptibility than those growing under normal conditions. Of all the methods, only that using water beds allowed the detection of different levels of resistance and susceptibility to *P. colocasiae*.

170. Ivancic, A., Kokoa, P., Simin, A., & Gunua, T. (1996). Mendelian studies of resistance to taro leaf blight. In The Second Taro Symposium. Proceedings of an International Meeting. Faculty of Agriculture, Cenderawasih University, Manokwari, Indonesia, 23–24 November 1994. (pp. 97–100).

    Self-pollination and crossing between taro varieties indicated that the majority of Papua New Guinea genotypes are heterozygous for resistance to taro leaf blight. The most frequent ratios in segregating populations resulting from crosses resistant X resistant and resistant X susceptible was 3:1, 9:7 and

7:9. It is concluded that it is likely that more than one gene controls resistance to taro leaf blight.

171. Ivancic, A., Kokoa, P., Simin, A., & Gunua, T. (1995). Resistance to *Phytophthora colocasiae* Racib. in taro *Colocasia esculenta* (L.) Schott: a genetic study of segregating populations. Journal of South Pacific Agriculture **2**(2), 17–21.

Populations analysed in this study were developed from three groups of crosses: (a) resistant X resistant; (b) resistant X susceptible; and (c) susceptible X susceptible. The most frequent segregation ratios (resistant:susceptible) were 3:1, 9:7, 7:9 and 13:3, suggesting that the number of genes controlling resistance to *P. colocasiae* in taro may be relatively low. The appearance of resistant genotypes in populations resulting from crosses between two (partially) susceptible genotypes indicates that minor genes associated with partial resistance may be involved.

172. Ivancic, A., & Okpul, T. (1996). A new mutation of taro (*Colocasia esculenta*) observed at Bubia Agricultural Research Centre. Papua New Guinea Journal of Agriculture, Forestry and Fisheries **39**(2), 6–9.

An unusual mutant of taro was discovered in the cycle-2 population of the recurrent selection programme at the Bubia Agricultural Research Centre, Papua New Guinea. The mutant plant developed a thin elongated stem (about 95 cm long). The stem had several nodes, each carrying 1 leaf. The leaf size decreased with distance from the corm top. The stem was filled with soft, aerated spongy tissue. Side stems were thin and relatively long, growing from lower nodes of the main stem and the corm top. Their structure was similar to that of the main stem. The plant had a normal corm. It was susceptible to *Phytophthora* leaf blight and did not flower. Authors' summary.

173. Ivancic, A., Simin, A., Ososo, E., & Okpul, T. (1995). Wild taro (*Colocasia esculenta* (L.) Schott.) populations in Papua New Guinea. Papua New Guinea Journal of Agriculture, Forestry and Fisheries **38**(1), 31–45.

Wild taro populations were evaluated for breeding purposes in several locations of Papua New Guinea. All evaluated populations were found to be susceptible to taro leaf blight (*Phytophthora colocasiae*) and the Alomae-Bobone virus complex. Absence of taro leaf symptoms was mainly due to isolation of the population (the pathogen did not reach the population). Flowering ability was relatively high. At least a few plants were found to be flowering in each population. The analysis of quantitative variation indicates that there was relatively high uniformity in leaf dimensions and number of lamina veins within populations. Relatively low variation of measured quantitative characteristics and uniformity in qualitative traits indicate that seed propagation may be extremely rare and that at least some PNG wild taro populations may consist of a single clone. It is concluded that in breeding, wild taro genotypes can be used as sources of genes for the improvement of flowering ability, environmental adaptability (for swampy or dry land conditions), growth vigour and earliness.

174. Jackson, G. V. H. (1996). Brief summary of situation in the region and comments on available assistance for long-term regional projects on taro leaf blight control. Taro Leaf Blight Seminar. Proceedings. Alafua, Western Samoa, 22–26 November, 1993. (pp. 71–74). Noumea, New Caledonia: South Pacific Commission. Unpublished.

    The impact of taro leaf blight in the Pacific Islands is described. The need for government action, the role of donors and inter-governmental agencies, control of the disease in Western Samoa, assistance for the region, infrastructure support and breeding for taro leaf blight resistance are discussed.

175. Jackson, G. V. H. (1980). Diseases and pests of taro, 51 pp. Noumea, New Caledonia: South Pacific Commission.

    This handbook contains a section on taro leaf blight and includes information on distribution, symptoms, spread, effect on yield and control of the disease.

176. Jackson, G. V. H. (1990). Pathogen-free Pacific taro. FAO Plant Protection Bulletin **38**(3), 145–150.

    The availability of 59 varieties and 8 breeders' lines of taro, 3 varieties of giant taro and a single tannia as pathogen-tested tissue cultures, or as suckers from indexed plants grown in quarantine, is reported. Some varieties have resistance to *Phytophthora colocasiae*.

177. Jackson, G. V. H. (1986). Preliminary results from surveys of plant diseases in the Federated States of Micronesia and Palau. In UNDP/FAO/GTZ/IRETA Regional Crop Protection Workshop. Apia, Western Samoa, 8–12 September, 1986. (106–113 .). Suva, Fiji: UNDP.

    Preliminary results of surveys for plant diseases in the Federated States of Micronesia and Palau are presented and pathogens of major quarantine importance (including *Phytophthora colocasiae* on taro) are identified.

178. Jackson, G. V. H. (1996). Strategies for taro leaf blight research in the region. Taro Leaf Blight Seminar. Proceedings. Alafua, Western Samoa, 22–26 November, 1993. (pp. 95–100). Noumea, New Caledonia: South Pacific Commission. Unpublished.

    The research strategies of the countries and territories in the region are discussed based on their different needs. The varying needs of countries are identified as those where outbreaks are recent (American and Western Samoa), where outbreaks are long-established (Solomon Islands and Papua New Guinea) and those countries still free of taro leaf blight. Research needed in the first two categories is outlined and contingency plans, emergency response groups, quarantine surveillance and community awareness campaigns highlighted as necessary for the third. The need for a regional approach to the disease is also flagged to prevent further spread.

179. Jackson, G. V. H. (1977). Taro leaf blight. Advisory Leaflet, South Pacific Commission (No. 3), 4 pp.

The disease of *Colocasia esculenta* caused by *Phytophthora colocasiae* is described and recommendations are given for its control.

180. Jackson, G. V. H. (1999). Taro leaf blight. Pest Advisory Leaflet (No. 3), 2 pp. Published by the Plant Protection Service of the Secretariat of the Pacific Community.

In this 2nd edition of this leaflet the symptoms, effect of the disease, infection and spread, control and quarantine precautions for this disease are outlined.

181. Jackson, G. V. H. (1997). Taro leaf blight control strategies. (p. 20 pp.). Second consultancy mission for Western Samoa Farming Systems Project.

In this consultancy report commissioned by International Development Support Services on behalf of the Western Samoa Farming Systems Project, MAFFM (Ministry of Agriculture, Forestry, Fisheries and Meteorology), a review of the breeding and varietal selection work carried out at Nu'u Crops Development Centre and the University of the South Pacific since the last visit (1996) is presented. Demonstration of methods of evaluating seedlings for taro leaf blight resistance in the nursery and field and the formulation of a programme for multiplying introduced varieties for farmer evaluation are also reported. Recommendations for the programme are made.

182. Jackson, G. V. H. (1996). Taro leaf blight control strategies. First consultancy Mission Report. Western Samoa Farming Systems Project, 46 pp. Samoa: Ministry of Agriculture Fisheries, Forests and Meteorology Western Samoa.

In this consultancy report commissioned by International Development Support Services on behalf of the Western Samoa Farming Systems Project, MAFFM (Ministry of Agriculture, Forestry, Fisheries and Meteorology); strategies to overcome taro leaf blight since its first outbreak in 1993 in Samoa are considered. The existing taro leaf blight programme was evaluated and some recommendations made for future research. A protocol for varietal selection and breeding is proposed.

183. Jackson, G. V. H., & Breen, J. (1985). Collecting, describing and evaluating field crops. Suva, Fiji.: UNDP/FAO. RAS/83/001 Field Document No. 8.

Included in this publication are guidelines for assessing taro leaf blight in the field.

184. Jackson, G. V. H., & Firman, I. D. (1984). Guidelines for the movement of taro and other aroids within the Pacific. In S. Chandra (Editor), Edible Aroids (pp. 194–211). Oxford, UK: Clarendon Press.

Hazards (including taro leaf blight) in the movement of germplasm of taro and other edible aroids within the Pacific region are detailed and techniques for safe transfer discussed. It is concluded that direct importation of vegetative material should be avoided in favour of transfer through intermediate quarantine outside the region, or as tissue cultured plants derived from shoot tips.

185. Jackson, G. V. H., & Gollifer, D. E. (1975). Disease and pest problems of taro (*Colocasia esculenta* L. Schott) in the British Solomon Islands. PANS **21**(1), 45–53.

More than 200 local varieties were screened for resistance to *Phytophthora colocasiae.* Of these only Abumae has shown promise. However, the taste and texture of this variety are unacceptable.

186. Jackson, G. V. H., & Gollifer, D. E. (1975). Storage rots of taro (*Colocasia esculenta*) in the British Solomon Islands. Annals of Applied Biology **80** (2), 217–230.

Several fungicides chosen for their ability to control the pathogens previously isolated from stored cocoyam corms failed to prevent severe rotting. This result led to a reappraisal of the organisms involved in the initial stages of decay. Isolations made from stored corms during the first 5 days showed that *Phytophthora colocasiae* and *Pythium splendens* were the dominant fungi in the rots. Later *Botryodiplodia theobromae* rapidly colonized the corms to complete the decay. Attempts to reduce losses by leaving petiole bases, cormels and roots attached only succeeded in delaying infection by a few days. Corms placed in soil in well-drained pits stored relatively well up to 4 weeks without impaired taste. Fungal rots were completely eliminated in corms stored in the soil, but bacterial rots caused by *Erwinia chrysanthemi* were responsible for some decay.

187. Jackson, G. V. H., & Gollifer, D. E. (1977). Studies on the taro leaf blight fungus *Phytophthora colocasiae* in the Solomon Islands. In Regional Meeting on the Production of Root Crops. Suva, Fiji, 24–29 October 1975. (pp. 107–110). Noumea, New Caledonia: South Pacific Commission. SPC Technical Paper No. 174.

Phytophthora colocasiae has become a limiting factor on taro (*Colocasia esculenta*) production and has caused an increasing dependence upon sweet potato (*Ipomoea batatas*). The fungus attacks both leaves and corms. However, corm-rots caused by *P. colocasiae* do not develop in the field, but extensive infection occurs after harvest. Within 5 days corms are often completely decayed. Control measures, using fungicides and screening for resistant varieties, are discussed.

188. Jackson, G. V. H., Gollifer, D. E., & Newhook, F. J. (1980). Studies on the taro leaf blight fungus *Phytophthora colocasiae* in Solomon Islands: control by fungicides and spacing. Annals of Applied Biology **96**(1), 1–10.

In trials in 1972–4, mist blower application of 2.25 kg copper oxychloride/ha gave effective control of *P. colocasiae* and increased main plant and sucker plant corm yields to 10.74 and 2.79 t/ha respectively compared with 6.78 t and 1.88 t in untreated controls. Mancozeb did not control the disease or increase corm yields. Phytotoxicity from captafol nullified any potential gain in yield from disease control. Leaf removal from healthy plants to maintain 4 leaves/plant for 90 days to simulate roguing of leaves for disease control caused no yield loss. Regular roguing of diseased leaves over the same period in plots affected by a severe epiphytotic did not eradicate the pathogen. Disease increased rapidly after roguing ceased and corm yields were greatly decreased. Attempts to decrease the effect of *P. colocasiae* by wider than traditional spacing (76 X 76 cm) were unsuccessful. Plants free from competition normally had 6–7 leaves but this number was decreased by severe disease to 3–4, the same number as was borne by plants under the competitive conditions of closer than traditional spacing. Main corm yields increased with increasing plant density irrespective of the presence of *P. colocasiae.*

189. Jackson, G. V. H., Gollifer, D. E., Pinegar, J. A., & Newhook, F. J. (1979). The use of fungicides against post-harvest decay in stored taro in the Solomon Islands. In D. L. Plucknett (Editor), Small-scale processing and storage of tropical root crops. (pp. 130–150). Boulder, Colorado, USA: Westview Press. Westview Tropical Agriculture Series No. 1.

    The control of postharvest decay of taro, including that caused by *Phytophthora colocasiae*, is discussed. At 5 days, rots caused by *P. colocasiae*, which were the first to develop in stored corms, were controlled by most of the fungicides tested. Best results were given by captan, copper oxychloride, captafol, mancozeb, Terrazole and sodium hypochlorite. Dipping in 1% sodium hypochlorite before storage in polythene bags gave good results and may be a suitable method for village storage or where corms are being taken long distances to market.

190. Jackson, G. V. H., Gollifer, D. E., & Regional Meeting on the Production of Root Crops. (1977). Studies on the taro leaf blight fungus (*Phytophthora colocasiae*) in the Solomon Islands. Regional Meeting on the Production of Root Crops; collected papers. Conference Regionale de la Production des Plantes a Racines Alimentaires; documents de travail. Suva, Fiji, 24 Oct 1975. (pp. 107–110). Noumea, New Caledonia: South Pacific Commission.

191. Jackson, G. V. H., & Macfarlane, R. (1996). Contingency plans for the eradication of *Phytophthora colocasiae* in Pacific Island countries and territories. Taro Leaf Blight Seminar. Proceedings. Alafua, Western Samoa, 22–26 November, 1993. (pp. 101–107). Noumea, New Caledonia: South Pacific Commission. Unpublished.

    Possibilities for the eradication of taro leaf blight in the Pacific are outlined. The general principals, initial response sequence, preliminary action sequence and general response activities of contingeny action plans are itemised.

Specific strategies for the eradication of taro leaf blight are then considered. Duty statements for key personnel in an eradication campaign are given.

192. Jackson, G. V. H., & Macfarlane, R. (1992). Plant protection in atolls of the Pacific. In Workshop on Developing an Agricultural Research Programme for the Atolls. Pacific Harbour, Fiji, 19–23 November 1990. (pp. 131–145). Apia, Western Samoa: IRETA.

    Phytophthora colocasiae is identified as an important disease, which has been accidently introduced to atolls in the Pacific region. General recommendations for improving plant protection in atolls are given.

193. Jackson, G. V. H., & Pelomo, P. M. (1979). Breeding for resistance to diseases of taro, *Colocasia esculenta*, in Solomon Islands, 8 pp. Honiara, Solomon Islands: Ministry of Agriculture and Lands, Dodo Creek Research Station.

194. Jackson, G. V. H., & Pelomo, P. M. (1980). Breeding for resistance to diseases of taro, *Colocasia esculenta*, in Solomon Islands. In International Symposium on Taro and Cocoyam. Visayas State College of Agriculture, Baybay, Leyte, Philippines, 24–25 September 1979. (pp. 287–298). Stockholm, Sweden: International Foundation for Science. Provisional Report (International Foundation for Science) No. 5.

    Breeding in the Solomon Islands for resistance to taro leaf blight and taro viruses is reviewed.

195. Johnson, A. (1960). A preliminary plant disease survey in Hong Kong, 32 pp. Rome, Italy: FAO, Plant Production and Protection Division.

196. Johnston, A. (1969). A preliminary plant disease survey in the British Solomon Islands Protectorate. (p. 31 pp.). Honiara, Solomon Islands: Government Printing Office.

    In this survey carried out in 1959, *Phytophthora colocasiae* is recorded on taro and its distribution (Choiseul, Ganongga, Malaita, Shortlands) in the Solomon Islands given.

197. Johnston, M., & Gendua, P. A. (1998). The growth performance of taro (*Colocasia esculenta*) grown from true seed. Tropical Agriculture **75**(1/2), 13–17.

    Some variation in resistance to taro leaf blight was observed in seedlings and this was correlated with corm yield.

198. Kamlesh. (1989). Antifungal activity of some homoepathic drugs against *Phytophthora colocasiae*. Unpublished doctoral dissertation, Kurukshetra University, Kurukshetra, India.

199. Karanya, I. (1984). Rok bai mai (*Phytophthora colocasiae* Raciborski) khong phuak lae kan thotsop phit khong sankhemi. (*Phytophthora* leaf blight of taro (*Phytophthora colocasiae* Raciborski) and fungitoxicity test. Unpublished

doctoral dissertation, Kasetsart University, Graduate School., Bangkok, Thailand . In Thai.

In this MSc thesis, the fungus that caused taro leaf blight during the rainy season was identified as *Phytophthora colocasiae*. Studies on the physiological properties of *P. colocasiae* demonstrated that the optimum temperature and pH for maximum mycelial growth were 25–30 C and pH 4–8, respectively. This was found only when *P. colocasiae* was cultured on PDA with added taro extract and OMA media. *P. colocasiae* could successfully be mated with *P. palmivora* in the A1 group. *P. colocasiae* is categorized as belonging to the A2 mating group. It is concluded that *P. colocasiae* is a heterothallic fungus. Pathogenicity tests showed that *P. colocasiae* could successfully infect and colonize all parts of the taro, except the rhizome. *P. colocasiae* produced clear and specific symptoms of concentric zones of leaf blight lesions. Morphological observation of *P. colocasiae* showed that it was capable of producing either ellipsoid or elongated ellipsoid zoosporangium *in vivo*. Indirect germination of this structure was found on taro leaf that yielded a large number of zoospores and later formed and encysted zoospores. Several germ tubes could be formed before direct penetration into intercellular space of the host epidermal cells. Evaluation on the fungitoxicity of various fungicides showed that Ridomil and Galben inhibited mycelial growth. Application of Ridomil at 250 ppm on taro leaves could visibly control the growth of *P. colocasiae,* but at higher dosea (2000 ppm) phytotoxicity was apparent.

200. Karanya, I., & Thammasak, S. (1984). Kan suksa rok bai mai khong phuak (*Phytophthora colocasiae* Rac.) duai scanning electron microscope. (Scanning electron microscope studies of taro leaf blight disease (*Phytophthora colocasiae*) in Thailand.). Journal of Thai Phytopathological Society **4**(2), 69–76.

201. Karanya, I., & Thammasak, S. (1984). Kan thotsop phit khong san khemi kanchat ra kap chua *Phytophthora colocasiae* Rac. sahet rok bai mai khong phuak. (Evaluation on fungitoxicity against taro blight pathogen (*Phytophthora colocasiae* Rac.) in Thailand). Journal of Thai Phytopathological Society **4**(2), 60–68.

202. Karanya, I., & Thammasak, S. (1983). Rok bai mai ru rok ta-sua khong phuak (Taro (*Colocasia antiquorum* Schott.) blight disease (*Phytophthora colocasia*e) in Thailand. Journal of Thai Phytopathological Society **3**(1), 1–9. In Thai.

203. Kay, D. E. (1987). Taro. In Root Crops (pp. 233–251). London, UK: Tropical Development and Research Institute.

In this chapter on taro, *Phytophthora colocasiae* is identified as an important pre- and post-harvest disease.

204. Ko, W. H. (1979). Mating-type distribution of *Phytophthora colocasiae* on the island of Hawaii. Mycologia **71**(2), 434–437.

All 101 isolates from 16 *Colocasia esculenta* fields were of mating type A1; 8 from the island of Maui and 5 from Kauai were also of A1. Five isolates previously reported (3 from Asia) were all A2. It is suggested that the fungus originated in Asia.

205. Kohler, F., Pellegrin, F., Jackson, G. V. H., & MacKenzie, E. (1997). Taro. In Diseases of Cultivated Crops in Pacific Island Countries (pp. 52–53, 169). Noumea, New Caledonia: Secretariat of the Pacific Community.

    Symptoms of the disease are briefly described and illustrated. Control measures are also outlined.

206. Kokoa, P. (1991). A checklist of plant diseases in the Highlands of Papua New Guinea 1985–1990, 22 pp. Papua New Guinea: Department of Agriculture and Livestock. Technical Report No. 91/2.

    Phytophthora colocasiae is recorded on taro in Gulf Province and Western Highlands Province.

207. Kokoa, P. (1999). Genetic diversity of *Phytophthora colocasia*e in Papua New Guinea. In Annual Report for 1998 (p. 96). Taro Network for South-East Asia and Oceania (TANSAO).

    Collections of *P. colocasiae* in Papua New Guinea are described. One batch of isolates has been sent to CIRAD, France for isoenzyme anaysis.

208. Kokoa, P. (1993). Taro leaf blight in Papua New Guinea: an overview. In Book of Abstracts. The First Taro Symposium. Lae, Papua New Guinea, 25 October 1993. (p. 15). Lae, Papua New Guinea: University of Technology.

    The importance of the disease and methods of controlling it in Papua New Guinea were examined in this paper presented at this meeting. The importance of breeding for resistance is emphasised.

209. Kokoa, P. (1996). Taro leaf blight in Papua New Guinea: an overview. Taro Leaf Blight Seminar. Proceedings. Alafua, Western Samoa, 22–26 November, 1993. (pp. 45–49). Noumea, New Caledonia: South Pacific Commission. Unpublished.

    In this report of taro leaf blight in Papua New Guinea, the importance of taro as a staple food crop, occurrence of the disease in the country and methods of control are described. Research on the disease carried out at Bubia Agricultural Research Centre is also highlighted, which includes work on screening for resistance, the epidemiology of taro leaf blight, disease and loss assessment and breeding for disease resistance.

210. Kokoa, P., & Darie, A. (1996). Field screening of taro varieties for resistance to taro leaf blight. In The Second Taro Symposium. Proceedings of an International Meeting. Faculty of Agriculture, Cenderawasih University, Manokwari, Indonesia, 23–24 November 1994. (p. 127).

In this abstract it is reported that taro varieties from the Papua New Guinea germplasm collection were screened under field conditions for resistance to taro blight. Of 433 varieties, 3 (K333, K345 and Ainaben) showed a high degree of resistance or immunity to the disease. Their use in a breeding programme at Bubia Agricultural Research Centre is noted.

211. Kokoa, P., & Darie, A. Screening of taro (*Colocasia esculenta*) for resistance to taro blight (*Phytophthora colocasiae*). In Annual Report 1992–1995, Bubia Agricultural Research Centre . Lae, Papua New Guinea: Department of Agriculture and Livestock.

212. Kokoa, P., Ivancic, A., & Ganua, T. (1996). Laboratory methods of testing taro varieties for resistance to taro leaf blight. In The Second Taro Symposium. Proceedings of an International Meeting. Faculty of Agriculture, Cenderawasih University, Manokwari, Indonesia, 23–24 November 1994. (p. 127).

    In this abstract, it is reported that spore counts on leaf pieces inoculated with a pure culture of *Phytophthora colocasiae*, were a better measure of disease resistance testing than measurement of lesion diameter.

213. Kulkarni, S. N., & Sharma, O. P. (1975). Corm rot of *Colocasia antiquorum* Schoff, due to *Phytophthora colocasiae* Sacc. JNKVV Research Journal **9**(1–2), 70.

214. Lambert, M. (1979). Storage and processing of root crops in the Pacific. In D. L. Plucknett (Editor), Small-scale Processing and Storage of Tropical Root Crops (pp. 47–52). Boulder, Colorado, USA: Westview Press. Westview Tropical Agriculture Series, No. 1.

    Included in this chapter is a brief discussion of postharvest problems of taro. It is emphasised that strict plant quarantine is necessary to protect Pacific islands currently free of taro leaf blight from the introduction of *Phytophthora colocasiae.*

215. Larsen, A. (1989). Notes on root crops in Vanuatu, 32 pp. Rome, Italy: FAO/SPC. RAS/83/001 Field Document.

    Taro leaf blight was not found in Vanuatu, but the proximity of the disease in Papua New Guinea and Solomon Islands is noted.

216. Lebot, V. (1992). Genetic vulnerability of Oceania's traditional crops. Experimental Agriculture **28**(3), 309–323.

    The genetic reasons for the deterioration of the agronomic performance of traditional crops of Oceania, using information mostly derived from surveys of genetic resources conducted in more than 50 Pacific islands, coupled with genetic investigations, are reviewed.

217. Leonian, L. H. (1930). Differential growth of *Phytophthora* under the action of malachite green. American Journal of Botany **17**, 671–677.

218. Liloqula, R. (1986). Crop protection services and problems in the Solomon Islands. In UNDP/FAO/GTZ/IRETA Regional Crop Protection Workshop. Apia, Western Samoa, 8–12 September 1986. (pp. 79–82). Suva, Fiji: UNDP.

    In this description of crop protection services in the Solomon Islands, the control of taro leaf blight and the screening of local and foreign varieties for resistance are included in the list of priorities for the plant pathology section.

219. Liloqula, R. (1989). Taro breeding programmes. In Annual Report 1986. Solomon Islands Government. Research Department, Agriculture Division, Ministry of Agriculture & Lands. (pp. 35–36). Honiara, Solomon Islands.

    Results of 2 trials to evaluate yielding ability of taro varieties resistant to taro leaf blight are reported.

220. Liloqula, R., & Saelea, J. (1996). Taro disease situation in Solomon Islands. Taro Leaf Blight Seminar. Proceedings. Alafua, Western Samoa, 22–26 November, 1993. (pp. 57–61). Noumea, New Caledonia: South Pacific Commission. Unpublished.

    The importance of taro to agriculture in the Solomon Islands and diseases of the crop, including taro leaf blight, and their control are discussed.

221. Liloqula, R., Saelea, J., & Levela, H. (1996). The taro breeding programme in Solomon Islands. Taro Leaf Blight Seminar. Proceedings. Alafua, Western Samoa, 22–26 November, 1993. (pp. 143–147). Noumea, New Caledonia: South Pacific Commission. Unpublished.

    The breeding programme for taro diseases in the Solomon Islands, with special reference to the taro leaf blight back-crossing breeding programme, is described. Breeding work on nematode and virus resistance is also discussed and the future work programme outlined.

222. Liloqula, R., Saelea, J., & Levela, H. (1993). Traditional taro cultivation in the Solomon Islands. In Proceedings of the Sustainable Taro Culture for the Pacific Conference. University of Hawaii, 24–25 September 1992. (125–131.). Honolulu, Hawaii: Hawaii Institute of Tropical Agriculture and Human Resources. HITAHR Research Extension Series No. 140.

    In this discussion on the traditional cultivation of taro in the Solomon Islands, diseases, including *Phytophthora* blight, are considered.

223. Lin, C. K., & Liang, P. Y. (1965). Studies on nitrogen, calcium and organic acid requirements with reference to pH relations in the nutrition of some species of *Phytophthora*. Acta Microbiologica Sinica **11**, 470–479.

224. Liyanage, A. d. S., & Misipati, P. (1995). Taro leaf blight (*Phytophthora colocasiae*). In IRETA and SOA 1993 Annual Research Report (pp. 60–63). Samoa: IRETA Publications, University of the South Pacific, Alafua Campus.

The outbreak of taro leaf blight in Samoa in 1993 is discussed. Symptoms of the disease, the pathogen, its spread and the susceptibility of all indigenous cultivars is considered.

225. Lucas, J. A., Shattock, R. C., Shaw, D. S., & Cooke, L. R. (1991). *Phytophthora*. (p. 447 pp.). Cambridge, UK: Cambridge University Press.

226. Luthra, J. C. (1938). India: some new diseases observed in Punjab and mycological experiments in progress during the year 1937. International Bulletin of Plant Protection **8**(4), 73–74.

227. Macfarlane, R. (1996). Taro—a preliminary pest risk analysis. Taro Leaf Blight Seminar. Proceedings. Alafua, Western Samoa, 22–26 November, 1993. (pp. 113–115). Noumea, New Caledonia: South Pacific Commission. Unpublished.

A preliminary PRA for taro in the Pacific region is presented. The occurrence of diseases and pests in different countries is tabulated and recommendations for the movement of taro between any two countries or territories summarised.

228. Macfarlane, R. (1985). Taro beetle (*Papuana uninodis*). Annual report 1984, Research Department, Agriculture Division. (pp. 7–8). Honiara, Solomon Islands: Ministry of Agriculture and Lands.

Four plant spacings (5000–40 000 plants/ha) were tested in the Solomon Islands for their effects on damage by *Papuana uninodis* on taro. Total yields increased and mean corm weights increased with planting density, but no significant differences in beetle damage were found. However, increased plant density was accompanied by increasing damage to the leaves by *Phytophthora colocasiae*.

229. Maheshwari, S. K., Sahu, A. K., & Misra, R. S. (1999). Efficacy of fungicides against *Phytophthora colocasiae* under laboratory conditions. Annals of Plant Protection Sciences **7**(2), 228–229.

The efficacy of 9 fungicides against *P. colocasiae* under laboratory conditions was assessed. Of the fungicides tested Ridomil MZ (metalaxyl + mancozeb), Indofil M-45 (mancozeb), Blitox 50 (copper oxychloride) and Hill Copper (copper oxychloride) completely inhibited the growth of the pathogen. The remaining fungicides (Bavisitn (carbendazim), Borax, Kitazin (iprobenfos), streptocycline and Topsin-M (thiophanate-mtheryl)) inhibited the fungus to varying degrees.

230. Malaki, I., & Atkinson, W. (1998). Review of the taro trade and prospects in the South Pacific. Journal of South Pacific Agriculture **5**(2), 23–30.

Taro trade is discussed, with particular reference to the role played by Fiji and Samoa. The devastating effect of taro leaf blight on taro trade by Samoa in 1993 is considered.

231. Manner, H. (1991). Report of a visit to Ulithi Atol. In A. M. Vargo (Compiler), A Rapid Rural Appraisal of Taro Production Systems in Micronesia, Hawaii and American Samoa. (pp. 147–153). Hawaii, USA: University of Hawaii.

    Phytophthora colocasiae is reported as one of the most common problems on taro on Ulithi.

232. Manner, H. (1991). Report of the rapid rural assessment of taro production systems in Guam. In A. M. Vargo (Compiler), A Rapid Rural Appraisal of Taro Production Systems in Micronesia, Hawaii and American Samoa. (pp. 39–55). Hawaii, USA: University of Hawaii.

    A rapid rural appraisal of taro production on Guam is reported. *Phytophthora colocasiae* was identified on 15 farms but in general farmers did not perceive the disease to be a constraint to production.

233. Manrique, L. A. (1995). Taro production principles and practices, 215 pp. Honolulu, Hawaii: Manrigue International Agrotechnology.

234. Matanubun, H., & Paiki, F. A. (1996). Taro research in Irian Jaya: its present status and future. In The Second Taro Symposium. Proceedings of an International Meeting. Faculty of Agriculture, Cenderawasih University, Manokwari, Indonesia, 23–24 November 1994. (pp. 102–104).

    Yield losses due to blight of up to 72% have been reported. None of the varieties in Irian Jaya were resistant and no control could be achieved by altering plant density or soil tillage practices. *Pseudomonas fluorescens*, *Bacillus subtilis* and *Gliocladium fimbriatum* controlled *Phytophthora colocasiae* both *in vitro* and *in vivo.* Metalaxyl was also more effective than Dithane M-45.

235. Mathur, P. N., & Paharia, K. D. (1964). Screening of *Colocasia* varieties for resistance to *Colocasia* blight (*Phytophthora colocasiae* Racib.). Science and Culture **30**(1), 44–46.

236. Matthews, P. J. (1998). Taro in Hawaii: present status and current research. Plant Genetic Resources Newsletter (No. 116), 26–29.

    In this popular account, breeding work being carried out at Mauai Agricultural Research Centre, Hawaii, for blight resistance are briefly mentioned.

237. Mattos, J. K. d. A. (1994). Doencas da batata-doce, beterraba, cara, gengibre e inhame. [Diseases caused by fungi on sweet potato, beetroot, *Dioscorea* spp., ginger and yam.]. Informe Agropecuario Belo Horizonte **17**(182), 25–28. In Portuguese.

Fungal diseases affecting sweet potato, beetroot, *Dioscorea* spp., ginger and yam in Brazil are briefly reviewed, including symptoms, susceptible cultivars, importance and control measures. The main diseases included *Phytophthora colocasiae* on yam.

238. McKenzie, E. H. C. (1996). Life cycle of *Phytophthora colocasiae* Racib. Taro Leaf Blight Seminar. Proceedings. Alafua, Western Samoa, 22–26 November, 1993. (pp. 75–81). Noumea, New Caledonia: South Pacific Commission. Unpublished.

    The taxonomy, host range, asexual life cycle and sexual reproduction in *Phytophthora colocasiae* is described. The origin of the pathogen and notes on how to distinguish *P. colocasiae* on taro and in culture are given. Finally a synoptic key to the 17 *Phytophthora* species recorded in the Pacific is provided.

239. McKenzie, E. H. C., & Jackson, G. V. H. (1986). The fungi, bacteria and pathogenic algae of Solomon Islands. RAS/83/001 (Field Document No. 11), 206–207.

    A report produced as part of the FAO/SPC Strengthening Plant Protection and Root Crops Development in the South Pacific project. *Phytophthora colocasiae* is recorded as present in the Solomon Islands. The biology of the pathogen is briefly outlined.

240. McKenzie, E. H. C., & Jackson, G. V. H. (1990). The fungi, bacteria and pathogenic algae of the Republic of Palau. SPC Technical Paper (No. 198), 28–29.

    Phytophthora colocasiae is recorded as present in Palau.

241. McRae, W. (1934). Foot-rot disease of Piper betle L. in Bengal. Indian Journal of Agricultural Science **4**(4), 585–617.

242. Mendiola, N., & Espino, R. B. (1916). Some Phycomycetous diseases of cultivated plants in the Philippines. Philippine Agriculture and Forestry **5**, 67–72.

    Cited in Tucker, 1933.

243. Mirza, R., Kafi, A., & Huque, A. (1965). List of plant diseases recorded in Pakistan. Technical Document, FAO Plant Protection Commission in South East Asia **43**, 1–17.

244. Misra, R. S. (1995). Effect of dates of planting on *Phytophthora* blight severity and tuber yield in *Colocasia*. Journal of Root Crops **21**(2), 111–112.

    A field trial was conducted over a 3 year period in Bhubaneswar, Orissa, India, to determine the effects of planting date of *C. esculenta* on disease severity caused by *P. colocasiae* and tuber yield. Five dates of planting starting from May 1, at intervals of 15 days were used as treatments. Planting on May 1 and May 15 resulted in higher yields compared with the other dates. However, the percentage of plants infected, the percentage leaf area damaged

and the percentage of disease intensity were also higher on crops planted on these dates. It is suggested that the early planted crops were mature at the time of infection whereas the later planted crops were still developing at the time of infection.

245. Misra, R. S. (1996). A note on zoosporogenesis in *Phytophthora colocasiae*. Indian Phytopathology **49**(1), 80–82.

A brief report on zoosporangial morphology and germination of *P. colocasiae* (the causal agent of leaf blight in *Colocasia esculenta* and *C. antiquorum*) is given.

246. Misra, R. S. (1994). In *Phytophthora* diseases of Horticultural Crops. Proceedings of the National Group Meeting on *Phytophthora* diseases of Horticultural Crops. Calicut, India, 22–23 September.

247. Misra, R. S. (1996). Prevalence and assessment of yield losses caused by *Phytophthora* leaf blight in *Colocasia* in Northern and Eastern parts of India. In G. T. Kurup, M. S. Palaniswami, V. P. Potty, G. Padmaja, S. Kabeerathumma, & S. V. Pillai (Editors), Tropical tuber crops: problems, prospects and future strategies. (pp. 380–387). Lebanon, New Hampshire, USA: Science Publishers, Inc.

An extensive survey of major *Colocasia* growing areas in the states of Orissa, West Bengal, Bihar and Uttar Pradesh in northern and eastern parts of India was undertaken during 1988 and 1989 to record the incidence of leaf blight, caused by *P. colocasiae.* Out of 128 representative fields of *Colocasia* visited during the 1988 monsoon season, 94% of fields were infected by leaf blight, and 78.38% fields had >80% incidence. During 1989, of 164 fields visited 92% showed blight infection and 81.75% of fields showed >80% incidence. A strong positive correlation existed between disease severity and yield loss (r=0.867 and 0.84 in farmers field and experimental farm, respectively). A corresponding negative correlation existed between disease severity and tuber yield (r=0.884 and -0.661 in the farmers' field and experimental farm, respectively). In the farmers' fields a mean yield loss of 33.64% was recorded due to leaf blight, whereas in the experimental farm 50.39 and 26.26% mean yield losses were recorded in susceptible and tolerant cultivars, respectively due to blight.

248. Misra, R. S. (1993). Prevalence and assessment of yield losses of *Phytophthora* blight of *Colocasia* in the Northern and Eastern parts of India. In Proceedings of the International Symposium on Tropical Tuber Crops. Trivandrum.

249. Misra, R. S. (1991). Prevalence of *Phytophthora* leaf blight of *Colocasia* in Northern and Eastern India. Phytophthora Newsletter (No. 17), 36.

In 1988 and 1989, 94% and 92%, respectively, of fields were found to be infected with blight, with 78% and 81%, respectively, showing more than

80% incidence. Yield losses of 50–60% are estimated. A high degree of resistance in a local variety 'Jankhri' is reported.

250. Misra, R. S. Studies of *Phytophthora* leaf blight of *Colocasia*. In Annual Report 1990–91 . Trivandrum, India: Central Tuber Crops Research Institute.

251. Misra, R. S. (1993). Yield losses in *Colocasia* caused by *Phytophthora* leaf blight. Phytophthora Newsletter **19**, 16–17.

    Tuber yield losses due to *Phytophthora colocasiae* were assessed in Orissa, India. In farmers' fields a mean yield loss of 34% was recorded at the experimental farm, 50% and 26% in susceptible and tolerant varieties, respectively.

252. Misra, R. S., & Chowdhury, S. R. (1996). *Phytophthora* leaf blight of taro: effect on dry matter production. Journal of Root Crops **22**(1), 54–57.

    Phytophthora leaf blight of taro (*Colocasia esculenta*) appeared early and progressed fast in susceptible cultivars compared with tolerant ones. The effect of leaf blight on dry matter production was more pronounced in susceptible cultivars, and fungicide sprays increased dry matter accumulation (measured as crop growth rate) in susceptible cultivars. Crop growth rate was least influenced by leaf blight in the tolerant cultivar Jankhri, in which fungicidal spraying did not increase dry matter accumulation. Use of the tolerant cultivar without using fungicides is advocated to minimise the yield losses caused by *Phytophthora*.

253. Misra, R. S., & Singh, D. P. (1991). Resistance in *Colocasia* against *Phytophthora* blight and progress of the disease in selected cultivars. Phytophthora Newsletter **17**, 36–37.

    Of the 43 cultivars screened in Bhubaneswar, India, 4 (Muktakeshi, Mahasaru, Jankhri and Topi) showed a high level of resistance to taro leaf blight. All other cultivars were moderately to highly susceptible to the disease, with cultivars Telia and Barnandi the most susceptible.

254. Misra, R. S., & Singh, D. P. (1991). Varietal resistance in *Colocasia* against *Phytophthora* leaf blight and progress of the disease in selected cultivars. Phytophthora Newsletter (No. 17), 36–37.

    Of 43 cultivars tested in 1988 and 1989, the following showed a high degree (<10% taro leaf blight) of resistance: Jankhri, Nahasaru, Muktakeshi and Topi.

255. Moles, D. J., Rangai, S. S., Bourke, R. M., & Kasamani, C. T. (1984). Fertilizer responses of taro in Papua New Guinea. In S. Chandra (Editor), Edible Aroids (pp. 64–71). Oxford, UK: Clarendon Press.

Shortage of land of suitable fertility and *Phytophthora colocasiae* are identified as reasons for the reduction of area under taro in Papua New Guinea.

256. Muthappa, B. N. (1987). Records of microorganisms in Papua New Guinea 1977–1986. Department of Agriculture and Livestock, Port Morseby, Research Bulletin (No. 43), 72 pp.

257. Narula, K. L., & Mehrotra, R. S. (1987). Biocontrol potential of *Phytophthora* leaf blight of *Colocasia* by phylloplane microflora. Indian Phytopathology **40**(3), 384–389.

    Two bacteria, 3 actinomycetes and 4 fungi showed antagonistic potential against *P. colocasiae in vitro*. *In vivo*, the bacteria reduced disease incidence by 37–43%. *Streptomyces albidoflavus* reduced percentage infection by 90–93% and *S. diastaticus* by 76%. Among the fungi, *Botrytis cinerea* gave the best control (33% reduction).

258. Narula, K. L., & Mehrotra, R. S. (1984). The epidemiology of *Phytophthora* leaf blight of *Colocasia*. Proceedings, National Academy of Sciences, India, Section B—Biological Sciences **54**(3), 227–235.

259. Narula, K. L., & Mehrotra, R. S. (1980). Occurrence of A1 mating type of *Phytophthora colocasiae*. Indian Phytopathology **33**(4), 603–604.

    The mating type was isolated from *Colocasia antiquorum* var. *esculenta* (*C. esculenta* var. *antiquorum)* from 3 North Indian states.

260. Narula, K. L., & Mehrotra, R. S. (1981). Phylloplane microflora of *Colocasia esculenta* (L.) Schott in relation to *Phytophthora colocasiae* Racib. Geobios **8**(4), 152–156.

    Alternaria spp., the most abundant on young and mature leaves, were replaced on senescent ones by *Cladosporium cladosporioides, Penicillium rubrum, P. chrysogenum, Botrytis cinerea*, and *Myrothecium roridum.* Three *Streptomyces* spp. and 2 bacterial isolates were antagonistic to *P. colocasiae* in dual culture plates.

261. Narula, K. L., & Mehrotra, R. S. (1989). Phytophthora blight of Colocasia—control with antibiotics and selective fungicides. Indian Phytopathology **42**(2), 328.

    An abstract of a paper presented at the Proceedings of 41st Annual Meeting of Indian Phytopathological Society, held in New Delhi 28 February, 1989 to 2 March, 1989.

262. Narula, K. L., & Mehrotra, R. S. (1984). Saprophytic survival of *Phytophthora colocasiae* in soils. Indian Phytopathology **37**(2), 256–261.

263. Naskar, S. R. (1989). Evaluation of taro varieties under rainfed conditions in Orissa. Journal of Root Crops **15**, 59–60.

264. Newton, K., & Jamieson, G. I. (1968). Cropping and soil fertility studies at Keravat, New Britain. Papua New Guinea Agricultural Journal **20**, 1–2.

265. Ngiralmau, M., & Bishop, R. (1991). A report on the rapid rural appraisal of *Colocasia* taro agriculture in Palau. In A. M. Vargo (Compiler), A Rapid Rural Appraisal of Taro Production Systems in Micronesia, Hawaii and American Samoa. (pp. 97–111). Hawaii, USA: University of Hawaii.

A rapid rural appraisal of taro production in Palau carried out in 1990 is reported. Taro leaf blight was prevalent but was not considered serious by farmers.

266. O'Connor, B. A. (1967). Exotic plants and diseases. Noumea, New Caledonia: South Pacific Commission.

Included in this book is a datasheet on the distribution, symptoms, spread and damage, and control of taro leaf blight (one page).

267. Okpul, T. (1999). Taro (*Colocasia esculenta*) breeding in Papua New Guinea. In Annual Report for 1998. (pp. 92–95). Taro Network for South-East Asia and Oceania (TANSAO).

Progress with taro breeding, including that for blight resistance, in Papua New Guinea is reported.

268. Okpul, T., Ivancic, A., & Simin, A. (1997). Evaluation of leaf blight resistant taro (*Colocasia esculenta*) varieties for Bubia, Morobe province, Papua New Guinea. Papua New Guinea Journal of Agriculture, Forestry and Fisheries **40**(1–2), 13–18.

Taro (*Colocasia esculenta*) varieties (35) resistant to taro leaf blight (TLB) (*Phytophthora colocasiae*) were evaluated at Bubia Agricultural Research Centre, Lae, Papua New Guinea, for yield components and eating quality in comparison with the locally preferred cultivar, Numkowec. The main factors affecting eating quality were presence of conspicuous corm fibre and acridity. Leaf blight resistant varieties AN 65, 17, 50, 32, 46, 21, 12 and AN 20 had acceptable eating quality. Their corm yield ranged from 300 g/plot (AN 50) to 570 g/plot (AN 21). However, their corm yield was not significantly different from that of Numkowec (430 g/plot). These resistant varieties are recommended to farmers in the Lae area based on their resistance to TLB and their similarities in corm yield and eating quality to Numkowec.

269. Oliver, D. (1973). Bougainville: a personal history. Melbourne, Australia: Melbourne University Press.

270. Onwueme, I. C. (1978). Harvesting, storage, diseases, and pests of cocoyams. In The tropical tuber crops. Yams, cassava, sweet potato, cocoyams. (pp. 215–219). UK: John Wiley & Sons.

In this chapter, diseases of taro, including blight, are briefly described.

271. Onwueme, I. C., & Charles, W. B. (1994). Tropical root and tuber crops: production, perspectives and future prospects. FAO Plant Production and Protection Papers (No. 126), 153–154.

    In this chapter on harvesting, storage, diseases and pests of cocoyams, taro blight is described and control measures outlined.

272. Ooka, J. J. (1983). Taro diseases. In J. K. Wang (Editor), Taro. A review of *Colocasia esculenta* and its potentials. (pp. 236–257). Honolulu, Hawaii: University of Hawaii Press.

    This chapter includes discussion of taro leaf blight and its control.

273. Ooka, J. J. (1990). Taro diseases. In Proceedings of taking taro into the 1990s: a taro conference. Komohana Agricultural Complex, Hilo, Hawaii, 17 August 1989. (pp. 51–59). Honolulu, Hawaii: University of Hawaii. Research Extension Series, Hawaii Institute of Tropical Agriculture and Human Resources No. 114.

    Although taro [*Colocasia esculenta*] is susceptible to attack by at least 23 pathogens, only a few cause serious reduction in growth and production. *Phytophthora* blight (*P. colocasiae*) and *Pythium* root and corm rot are the most serious fungal diseases of *C. esculenta*. Dithane-M45 [mancozeb] is available for control of *Phytophthora* blight.

274. Ooka, J. J. (1994). Taro diseases. A guide for field identification. Honolulu, Hawaii, USA: University of Hawaii. HITAHR Research Extension Series No. 148.

275. Ooka, J. J., & Trujillo, E. E. (1984). Taro diseases and their control. In M. Lambert (Editor), Taro Cultivation in the South Pacific (pp. 52–66). Noumea, New Caledonia: South Pacific Commission. SPC Handbook No. 22.

    This chapter includes a description of taro leaf blight, its symptoms and control.

276. Packard, J. C. 144 pp. Honolulu, Hawaii: University of Hawaii. Miscellaneous work papers (University of Hawaii, Pacific Islands Studies Program).

    This is a reproduction of an MA thesis with minor revision.

277. Packard, J. C. (1974). The history of the Bougainville taro blight. Unpublished doctoral dissertation, University of Hawaii at Manoa, Honolulu, Hawaii. Thesis for Master of Arts in History, no. 1152.

278. Paharia, K. D., & Mathur, P. N. (1961). New host plant of *Colocasia* blight (*Phytophthora colocasiae* Rac.). Current Science (Bangalore) **30**(9), 354.

279. Paharia, K. D., & Mathur, P. N. (1964). Screening of *Colocasia* varieties to *Colocasia* blight (*Phytophthora colocasiae*). Current Science (Bangalore) **30**(1), 44–46.

Twenty cultivars were screened for resistance to taro leaf blight One was considered immune (Poonampat), one resistant (Sakin V), 7 moderately resistant and 11 susceptible. Results are tabulated.

280. Paiki, F. A. (1988). Identifikasi *Phytophthora* dan *Pythium* pada talas (*Colocasia esculenta*) dan pengaruh beberapa caru budidaya serta fungisida Metalaxyl terhadap perkembangan penyakit hawar daun danbusuk umbi. [Identification of *Phytophthora* and *Pythium* on taro (*Colocasia esculenta*) and the effect of cultivation techniques including metalaxyl fungicide towards the development of leaf blight and corm rot. Unpublished report of the Faculty of Postgraduate Studies, Bogor Agricultural Institute.

281. Paiki, F. A. (1993). Pathogenicity of *Phytophthora* and *Pythium* on taro (*Colocasia esculenta*) in Irian Jaya. Book of Abstracts. The First Taro Symposium. Lae, Papua New Guinea, 25 October 1993. (p. 13). Lae, Papua New Guinea: University of Technology.

    Taro leaf blight in Irian Jaya is described. Metalaxyl gave good control of the disease.

282. Paiki, F. A. (1996). Symptoms of taro leaf blight disease (*Phytophthora colocasiae*) and relationship with yield components in Biak, Irian Jaya. Science in New Guinea **21**(3), 153–157.

    P. colocasiae causes leaf blight and rot on taro flowers, petioles, stem bases and corms in Irian Jaya. Significant symptoms of leaf blight and corm decay were always found on the same plant. Disease intensity on monoculture cropping systems was higher than on mixed cropping systems. Leaf blight disease intensity showed a linear relationship with yield components. An increase in disease intensity was followed by a reduction of the corm weight/crop.

283. Paiki, F. A., & Erari, D. K. (1985). Ketahanan klon-klon talas terhadap panyakit bercak daun (*Phytophthora colocasiae*). [The resistance of taro clones to taro leaf blight (*Phytophthora colocasiae*). Unpublished report of the Faculty of Agriculture UNCEN, Manokwarai.

284. Paiki, F. A., & Ruimassa, R. (1996). Identification of fungi attacking taro leaves. In The Second Taro Symposium. Proceedings of an International Meeting. Faculty of Agriculture, Cenderawasih University, Manokwari, Indonesia, 23–24 November 1994. (p. 124).

    In this poster, taro leaf blight was identified as one of the fungal diseases infecting taro in Irian Jaya. All varieties were affected and infection was evident when the plants were 8 months-old.

285. Palomar, M. K. (1981). Evaluation techniques for disease resistance in root crops. In Southeast Asian and the Pacific Training Course on Root and Tuber Crops

Germplasm Evaluation and Utilization (pp. 252–263). Leyte, Philippines: Visayos State College of Agriculture.

286. Pardales, J. R. (1999). Past, present and future research and development activities on taro in the Philippines. In Annual Report for 1998. (pp. 6–24). Taro Network for South-East Asia and Oceania (TANSAO).

    It is reported that the variety VG-2 (Iniito) and two promising selections from the germplasm collections in the Philippines were sent to Western Samoa following the outbreak of taro leaf blight. Iniito is reported to be growing well in Samoa.

287. Pardales, J. R., & Villanueva, M. R. Cultural management for lowland taro under monoculture system in the Phillipines.

288. Pardales, J. R., Villanueva, M. R., & Cotejo, F. R. (1982). Performance of taro under lowland conditions as affected by genotype, nutritional status and population density. Annual Tropical Research , 156–167.

289. Parham, B. E. V. (1949). Country paper Fiji. In Annual Report of the Economic Botanist for the Year ending 1948. (pp. 24, 31–35). Journal of the Legislative Council, Fiji, Council Paper No. 24.

290. Parham, B. E. V. (1947). Ecomomic botany notes. 3. Disease of taro. Agriculture Journal (Fiji) **18**(3), 80.

    A disease of taro is reported from the British Solomon Islands Protectorate in July 1946. Although the disease was originally thought to be caused by a virus, the causal organism was identified as *Phytophthora colocasiae.*

291. Park, M. (1939). Report on the work of the Division of Plant Pathology. In Administrative Report of the Director of Agriculture, Ceylon for 1937. (p. D42–D48). Ceylon.

    Phytophthora colocasiae is reported for Ceylon [Sri Lanka] for the first time. The fungus was found on *Alocasia* sp.

292. Parris, G. K. (1941). Diseases of taro in Hawaii and their control. Circular (University of Hawaii, Hawaii Agricultural Experiment Station), (No. 18), 29 pp.

    A description of taro leaf blight is included in this leaflet.

293. Patel, M. Z. (1984). Progress report on breeding work in Solomon Islands. FAO/SPC Root Crop Breeding and Germplasm Workshop. Suva, Fiji, 29 October–2 November 1984. (6 pp.). Unpublished meeting paper.

294. Patel, M. Z., & Liloqula, R. (1985). Leaf blight disease (*Phytophthora colocasiae*). Annual Report 1984 (Solomon Islands, Ministry of Agriculture and Lands,

Agriculture Division, Research Department) (pp. 8–12). Honiara, Solomon Islands.

Progress in breeding for taro leaf blight is reported.

295. Patel, M. Z., & Liloqula, R. (1985). Progress on breeding disease resistant taro in Solomon Islands. In Fifth Conference of the Australasian Plant Pathology Society. Auckland, New Zealand, 20–24 May 1985. (p. p. 53).

In this poster progress in the breeding programme initiated in 1979 is described. The programme reached the third backcross generation. Results of yield trials are presented. Resistance to taro leaf blight was found to be controlled by a single dominant gene, so additional sources of resistance have been sought from India and South East Asia. Possible approaches to combine resistance from various sources are discussed.

296. Patel, M. Z., & Liloqula, R. (1986). Progress on breeding disease resistant taro in the Solomon Islands. In UNDP/FAO/GTZ/IRETA Regional Crop Protection Workshop. Apia, Western Samoa, 8–12 September, 1986. (133–151.). Suva, Fiji: UNDP.

Progress in the breeding programme initiated in 1979 is described. The programme has reached the third backcross generation. Results of yield trials are presented. Resistance to taro leaf blight was found to be controlled by a single dominant gene, so additional sources of resistance have been sought from India and South East Asia. Possible approaches to combine resistance from various sources are discussed.

297. Patel, M. Z., & Liloqula, R. (1987). Taro breeding programme. Solomon Islands Government, Research Department, Agriculture Division, Ministry of Agriculture and Lands, Annual Report 1995 (pp. 10–11). Honiara, Solomon Islands: Dodo Creek Research Station.

The breeding programme for resistance to *Phytophthora colocasiae* and *Hirschmanniella miticausa* in the Solomon Islands is briefly described.

298. Patel, M. Z., Saelea, J., & Jackson, G. V. H. (1984). Breeding strategies for controlling diseases of taro in Solomon Islands. In Proceedings: sixth symposium of the International Society for Tropical Root Crops, Lima, Peru. Lima, Peru, 21–26 February, 1983. (pp. 143–149). Lima, Peru: International Potato Center.

Resistance to leaf blight caused by *Phytophthora colocasiae* was found in a wild taro (*Colocasia esculenta*) accession introduced from Thailand and designated Bangkok. F1 and BC1 data from crosses between Bangkok and local cultivars indicated that resistance is controlled by a single dominant gene.

299. Patiasina, J. W., Karafir, J. P., Killian, A. M., & Paiki, F. A. (1981). Preliminary study on the control of taro leaf blight in Irian Jaya. Manokwari, Indonesia: Faculty of Agriculture, Cenderawasih University.

300. Paulson, D. D., & Rogers, S. (1997). Maintaining subsistence security in Western Samoa. Geoforum (No. 28), 173–187.

    In this discussion, the effect of taro leaf blight on food security in Samoa is considered.

301. Pena, R. S. d. l. (1989). Development of new taro varieties through breeding. In J. R. Hollyer, & D. M. Sato (Editors), Taking taro into the 1990s. (pp. 32–36). Honolulu, Hawaii: University of Hawaii.

    Some of the advantages, problems and a general method of hybridizing taro are discussed. It is stressed that an organised crop improvement programme through breeding should be established and supported.

302. Pena, R. S. d. l. (1978). Upland taro. Home Garden Vegetable Series , Chap. No. 18,). Hawaii, USA: Hawaii Cooperative Extension Service, University of Hawaii.

303. Peregrie, W. T. H. (1971). Annual Report of the Plant Pathologist, Brunei, 1970.

304. Petch, T. (1918). Fungus diseases of food crops in Ceylon. Tropical Agriculture **50**, 159–163.

    Cited in Tucker 1933.

305. Philemon, E. C. (1997). An overview of the pathology of genus *Colocasia*. Papua New Guinea Journal of Agriculture, Forestry and Fisheries. **37**(2), 53–61.

    Information available from various sources, which relates to diseases of taro in Papua New Guinea, is reviewed.

306. Philemon, E. C., & Hyde, K. (1990). Plant diseases of Western Province in Papua New Guinea: a survey report, 107 pp.

307. Pillai, S. V., & Thankappan, M. (1991). Breeding for leaf blight resistance in taro: problems and prospects. Journal of Root Crops **17**, 57–61. (ISRC National Symposium Special).

308. Pillai, S. V., Thankappan, M., & Misra, R. S. (1996). Intervarietal hybridization for induction of resistance to leaf blight in taro. In G. T. Kurup, M. S. Palaniswami, V. P. Potty, G. Padmaja, S. Kabeerathumma, & S. V. Pillai (Editors), Tropical tuber crops: problems, prospects and future strategies. (pp. 164–168). Lebanon, New Hampshire, USA: Science Publishers, Inc.

    Four *Phytophthora colocasiae* leaf blight tolerant taro (*Colocasia esculenta*) cultivars and their open pollinated progenies were selfed and intercrossed to

isolate resistant recombinants from the segregating generations. The highest numbers of resistant genotypes were obtained from selfed tolerant lines, followed by open pollination of progenies of tolerant lines. A high proportion of second generation hybrids of tolerant cultivars also showed resistance. Selfed susceptible genotypes did not produce resistant lines, whereas crosses involving different susceptible lines gave a low percentage of resistant progeny. Genotypes with combined resistance, high yields and good cooking quality were identified. From a third cycle of segregating generations, 4 genotypes were identified with a high degree of resistance under field conditions and after artificial inoculation.

309. Pillai, S. V., Thankappan, M., & Misra, R. S. (1993). Leaf blight resistant hybrids of taro. Journal of Root Crops **19**(1), 66–68.

    Of 270 *Colocasia esculenta* seedlings screened for natural resistance to leaf blight, caused by *Phytophthora colocasiae*, in the field at Trivandrum, India, 119 lines were resistant.

310. Po KiHo, & Ramsden, L. (1998). Mechanisms of taro resistance to leaf blight. Tropical Agriculture **75**(1/2), 39–44.

    Five taro cultivars and 2 related aroids were screened for the induction of pathogenesis-related proteins in reponse to infection by *Phytophthora colocasiae*. Infected plants showed increased levels of PR proteins but this did not correlate with resistance in the most susceptible cultivars. Despite high levels of PR proteins, these cultivars were unable to prevent infection. Successful resistance in other plants was more closely linked to the pattern of expression of proteinase inhibitors, which appear to be an important defence strategy in taro and related aroids.

311. Pone, S. (1996). Taro leaf blight—a regional approach. In The Second Taro Symposium. Proceedings of an International meeting. Faculty of Agriculture, Cenderawasih University, Manokwari, Indonesia, 23–24 November 1994. (pp. 86–90).

    A Taro Leaf Blight Network for the South Pacific is proposed. The Network will involve collaboration between scientists within Pacific island countries and international organizations and institutes outside the region. The aims of the Network are to assist in the development of alomae and bobone virus-testing techniques, identification of molecular markers for taro leaf blight resistance genes, breeding of taro leaf blight resistant varieties and the mass production and distribution of pathogen-indexed taro plantlets through tissue culture to member countries. Support will also be given to other taro leaf blight control measures. A meeting to formally launch the Network was planned for 8–12 May 1995. Names and addresses of contact people are given.

312. Pouono, K., & Hunter, D. G. (1988). Taro breeding and research in Samoa. In Proceedings of the Taro Breeding Workshop. Suva, Fiji Islands, 26–28

August 1998. (pp. 9–10). Noumea, New Caledonia: Secretariat of the Pacific Community. AusAID/SPC Taro Genetic Resources: Conservation and Utilisation.

313. Pouono, K., & Tuugasala, S. (1996). The incidence of taro leaf blight (*Phytophthora colocasia*) in relation to rainfall in Western Samoa: a progress report. In Mineral nutrient disorders of root crops in the Pacific: Proceedings of a workshop. Nuku'alofa, Kingdom of Tonga, 17–20 April 1995. (pp. 137–139). ACIAR Proceedings No. 65.

    This paper presents preliminary findings on the interrelationships between rainfall, incidence of leaf blight [*Phytophthora colocasiae*], growth, yield and corm quality of taro on Upolu Island in Western Samoa. Disease incidence was positively related to rainfall and plant age.

314. Prana, M. S. (1999). Past, present and future R&D programmes on taro (*Colocasia esculenta*) in Indonesia. In Annual Report for 1998 (pp. 50–61). Taro Network for South-East Asia and Oceania (TANSAO).

    Taro research in Indonesia is reported. Problems with isolating *Phytophthora colocasiae* from taro are outlined. However, it is reported that 4 successful isolations were made and these will be sent to France for molecular analysis.

315. Price, T. V. (1978). Pathosystem analysis of taro blight in Papua New Guinea. In Epidemiology and crop loss assessment. Proceedings of a workshop. Lincoln College, Canterbury, New Zealand., 29–31 August, 1997.

316. Primo, A. (1993). *Colocasia* taro on Pohnpei Island. In Proceedings of the Sustainable Taro Culture for the Pacific Conference. University of Hawaii, Honolulu, 24–25 September 1992. (pp. 6–8). Hawaii: Hawaii Institute of Tropical Agriculture and Human Resources. HITAHR Research Extension Series No. 140.

    Research into the control of *Phytophthora* blight of taro is highlighted as a future research need for taro in Pohnpei.

317. Purwanti, H. (1986). Ketahanan talas terhadap hawar daun (*Phytophthora colocasiae*). Penelitian Pertanian **4**, 5–7.

318. Purwanti, H. (1986). Ketahanan varietas talas terhadap penyakit hawar daun (*Phytophthora colocasiae*). (Resistance of taro (*Colocasia esculenta*) varieties to leaf blight (*Phytophthora colocasiae*)). Penelitian Pertanian (Indonesia) **6**(1), 5–7.

319. Putter, C. A. J. Disease resistance in plants and its role in crop production strategy and tactics in Papua New Guinea. In Proceedings of the First Papua New Guinea Food Crops Conference. Port Morseby, Papua New Guinea.

320. Putter, C. A. J. (1980). The management of epidemic levels of epidemic diseases under tropical subsistence farming conditions. In J. Palti, & J. Kranz

(Editors), Comparative Epidemiology: a tool for better disease management (pp. 93–103). Wageningen, Netherlands: CTA.

The epidemic patterns of temperate and tropical plant pathogens are contrasted in a comparison of diseases caused by 2 species of *Phytophthora*, *P. infestans* and *P. colocasiae*. Disease and control strategies for the 2 epidemic patterns are compared. Epidemicity is proposed as a paradigm of tropical epidemiology and its implications for disease control are discussed. The socio-economic and ecological constraints imposed on pathosystem management in developing countries are evaluated and an attempt is made to formulate a control strategy for tropical diseases.

321. Putter, C. A. J. (1976). Phenology and epidemiology of *Phytophthora colocasiae* Racib. on taro in the East West Province, Papua New Guinea. Unpublished doctoral dissertation, University of Papua New Guinea, Faculty of Science.

In this thesis, the taro leaf blight pathosystem is described and analysed and management of the pathosystem considered.

322. Putter, C. A. J. (1993). Some epidemiological explanations to guide the design of taro blight resistance evalutation experiments, unnumbered. Rome, Italy: FAO. FAO unpublished report.

Techniques to be used for evaluating taro blight resistance in varieties are considered.

323. Putter, C. A. J. (1993). Some thoughts on taro improvement in the Pacific, 12 pp. FAO unpublished report.

The taro blight epidemic in Samoa is discussed and a general taro improvement programme is suggested that could be adopted and implemented as a crop improvement network approach in the Pacific.

324. Putter, C. A. J. (1993). Taro blight (*Phytophthora colocasiae*) in Western Samoa, 24 pp. FAO Mission Report TCP/SAM/2353.

In this report, details of a training workshop on the biology and epidemiology of taro blight held in 1993 are given and an assessment of the current situation and recommendations for an integrated disease management strategy made.

325. Quevedo, M. A., Sanico, R. T., & Baliad, M. E. (1991). The control of post-harvest diseases of taro corms. Tropical Science **31**(4), 359–364.

Results of trials of pre- and postharvest control measures for the control of postharvest decay of taro are reported. Benlate dips and packing taro corms delayed decay.

326. Quitugua, R. J., & Trujillo, E. E. (1998). Survival of *Phytophthora colocasiae* in field soil at various temperatures and water matric potentials. Plant Disease **82**(2), 203–207.

    The survival of zoosporangia of *P. colocasiae*, isolated from *Colocasia esculenta* and produced on V8 agar, mixed with soil and stored at 3 soil water matric potentials and 4 temperatures was studied. A large number of the zoosporangia germinated by zoospore discharge and/or lysed in the soil during the first 5 days of incubation, decreasing the initial number of colony-forming units (c.f.u.) from 1X104 to 1X102 per g of soil in all treatments. Eighteen days after incorporation, the viable zoosporangia present in moist soils had thickened their cell walls and germinated only directly (i.e.,germinated by germ tube and hyphal production), often producing smaller zoosporangia. A few thick-walled chlamydospores were observed and they germinated only directly. Zoosporangia in soils at -1500 J/kg matric potential survived longer than 107 days and the amount of viable zoosporangia present at that time was approximately 0.1X102 c.f.u./g of soil. The majority of the thin-walled zoosporangia produced on V8 agar, when incorporated into moist soil, germinated indirectly (i.e., by zoospore release) in the first 5 days of incubation. Zoosporangia that did not germinate became resting zoosporangia by increasing their wall thickness or by producing chlamydospores. These enabled the pathogen to survive in soil at -1500 J/kg matric potential for more than 3 months. However, in the absence of the host, the pathogen is predicted to survive less than 1 year due to its lack of saprophytic ability to colonize non host tissues.

327. Quitugua, R. J., & Trujillo, E. E. (1997). Taro leaf blight evaluations of 30 different taro cultivars (*Colocasia esculenta*) produced in tissue culture. [Abstract]. Proceedings of the College of Arts and Science Conference. University of Guam.

328. Raciborski, M. (1900). Parasitic algae and fungi. Java Batavia Bulletin **19**, 189.

    First report of the taro leaf blight pathogen in Java.

329. Ragus, L. (1991). Rapid rural appraisal of taro agriculture in the Commonwealth of the Northern Mariana Islands. In A. M. Vargo (Compiler), A Rapid Rural Appraisal of Taro Production Systems in Micronesia, Hawaii and American Samoa. (pp. 81–94). Hawaii, USA: University of Hawaii.

    A rapid rural appraisal in the Northern Mariana Islands is reported. *Phytophthora colocasiae* was identified on Rota and Tinian.

330. Rajesh Kumar, & Dubey, S. C. (1996). Screening of *Colocasia* genotypes for resistance to *Phytophthora* leaf blight. In G. T. Kurup, M. S. Palaniswami, V. P. Potty, G. Padmaja, S. Kabeerathumma, & S. V. Pillai Tropical tuber crops: problems, prospects and future strategies. (pp. 388–390). Lebanon, New Hampshire, USA.: Science Publishers, Inc.

Fifteen genotypes of *C. esculenta* were screened for resistance to leaf blight caused by *Phytophthora colocasiae*. Genotype C189 had the highest infection rate (53.9%) as well as disease intensity (52.7%). Telia had the highest leaf infection (26.6%). Highly restricted disease symptoms were observed in Jhangdi and Topi. No symptoms or infections were observed in Kadma local, Muktakeshi or Nadia local. These genotypes showed immune reactions to blight.

331. Rangai, S. S. (1982). Preliminary results of a survey of taro (Colocasia esculenta) cultivation on the Gazelle Peninsula of New Britain. In Proceedings of the Second Papua New Guinea Food Crops Conference. Port Moresby, Papua New Guinea, 14–18 July, 1980. (pp. 123–133). Port Moresby, Papua New Guinea: Department of Primary Industy.

    In a survey of growers, taro leaf blight was rated as a serious problem in taro production. A decline in the number of varieties grown is noted and it is suggested that this is due to the presence of blight.

332. Rangi, S. S. (1993). The vanishing status of taro. In Book of Abstracts. The First Taro Symposium. Lae, Papua New Guinea, 25 October 1993. (p. 21). Lae, Papua New Guinea: University of Technology.

    The decline of taro production in Papua New Guinea, and the role of taro leaf blight in this decline, are discussed. Breeding for disease resistance is considered to be important in order to combat genetic erosion.

333. Rao, V. R. (1996). Taro genetic resources: conservation and use. In The Second Taro Symposium. Proceedings of an International Meeting. Faculty of Agriculture, Cenderawasih University, Manokwari, Indonesia, 23–24 November 1994. (pp. 19–28).

    In this discussion the importance of considering taro leaf blight and taro viruses when conserving taro germplasm is outlined.

334. Rao, V. R. (1996). Taro genetic resources—International Board for Plant Genetic Resources (IBPGR). Taro Leaf Blight Seminar. Proceedings. Alafua, Western Samoa, 22–26 November, 1993. (pp. 139–142). Noumea, New Caledonia: South Pacific Commission. Unpublished.

    Taro genetic resources with special reference to taro blight and taro viruses and the safe movement of germplasm are considered. IBPGR's interest in taro in Asia, the Pacific and Oceania is described.

335. Rasyid, A. (1988). Efikasi fungisida Ridomil 35 SD terhadap penyakit hawar daun (*Phytophthora colocasiae*) pada talas. [The efficacy of Ridomil 35 SD fungicide on controlling taro leaf blight (*Phytophthora colocasiae*) in taro.]. Unpublished report of the Faculty of Agriculture UNCEN, Manokwarai.

336. Raynor, B. (1991). Report on the rapid rural assessment of taro agriculture on Pohnpei Island, F.S.M. In A. M. Vargo (Compiler), A Rapid Rural Appraisal of Taro Production Systems in Micronesia, Hawaii and American Samoa. (pp. 117–144). Hawaii, USA: University of Hawaii.

    A rapid rural appraisal of taro production on Pohnpei carried out in 1990 is reported. *Phytophthora* leaf blight was identified as the most important disease and was cited by growers as the major problem. Removal of infected leaves was the control measure used.

337. Raynor, B., & Silbanus, S. (1993). Ecology of *Colocasia* taro production on Pohnpei. In Proceedings of the Sustainable Taro Culture for the Pacific Conference. University of Hawaii, 24–25 September 1992. (20–24.). Honolulu, Hawaii: Hawaii Institute of Tropical Agriculture and Human Resources. HITAHR Research Extension Series No. 140.

    In a survery of taro production on Pohnpei in which data were collected from December 1990 to July 1991, *Phytophthora* blight was identified as the most serious disease. Leaf blight was more serious on low-input farms than on high-input farms. Reasons for this are discussed and low-input strategies to improve disease control are recommended.

338. Reddy, D. B. (1970). A preliminary list of pests and diseases of plants in Western Samoa. Technical Document, FAO Plant Protection Commision in South East Asia **15**.

339. Reinking, O. (1919). Diseases of economic plants in China. Philippine Agriculturist **8**, 109–134.

340. Reinking, O. A. (1918). Philippine economic plant diseases. Philippine Journal of Science A **13** , 165–274.

341. Reinking, O. A. (1919). Philippine plant diseases. Phytopathology **9**, 114–149.

342. Ribeiro, O. K., Erwin, D. C., & Zentmyer, G. A. (1975). An improved synthetic medium for oospore production and germination of several *Phytophthora* species. Mycologia **67**(5), 1012–1019.

343. Robinson, R. A. (1996). Aroids. In Return to Resistance (pp. 237–238). Davis, California, USA: AgAccess.

344. Rogers, S., Iosefa, T., Hoponoa, T., Hazelman, S., & Hunter, D. (2000 July). Farmer inovation in the South Pacific. In ILEIA Newsletter, 2000 July, pp. 7–8.

    This article describes how Samoan farmers have innovated to ensure rapid multiplication of leaf blight-resistant taro cultivars.

345. Rogers, S., & Schwanz, V. (1998). Coupling participatory research to technology transfer. In Diffusion and transfer of agricultural technology in the Pacific. Reports and papers from the third annual meeting of cooperators. Vava'u,

Kingdom of Tonga, 24–28 November 1997. (pp. 101–108). Suva, Fiji: Pacific Regional Agricultural Programme.

Included in this paper are the general recommendations for taro leaf blight control in Samoa.

346. Rwimassa, P. M. R. (1988). Permaduan beberapa dosis Dithane M-45 dan jenis klon talas dalam pengendalian penyakit hawar daun (*Phytophthora colocasiae*). [The impact of Dithane M-45 application rate and taro clones in controlling taro leaf blight (*Phytophthora colocasiae*).]. Unpublished report of the Faculty of Agriculture UNCEN, Manokwarai.

347. Saena, T. B. (1997). *In-vitro* multiplication of taro (*Colocasia esculenta* var. *esculenta* L. Schott.). Unpublished masters dissertation, University of the South Pacific.

This thesis contains general background information on taro leaf blight in Samoa and it's economic impact.

348. Sahu, M. P., & Singh, K. P. (1987). Fungicidal control of leaf blight disease of taro (*Colocasia esculenta* (L.) Schott). In Tropical tuber crops: production and utilization. Proceedings, National Symposium on Production and Utilization of Tropical Tuber Crops. Trivandrum, India, 27–29 November 1985. (pp. 183–185). Trivandrum, India: Indian Society for Root Crops.

349. Sahu, M. P., Singh, K. P., & Singh, J. R. P. (1989). Control of blight disease of taro. Indian Farming **39**(2), 22–23.

Four sprays of zineb at 15 d intervals starting from the end of Jul. to early Aug. reduced the incidence of *Phytophthora colocasiae* on *Colocasia esculenta* and increased the yield. Other measures including minimising the source of inoculum, maintenance of sanitary field conditions, crop rotation and the use of disease-free plant material, are also recommended.

350. Santos, G. H. (1993). *Colocasia* taro varieties on Pohnpei. In Proceedings of the Sustainable Taro Culture for the Pacific Conference. University of Hawaii, 24–25 September 1992. (8–14.). Honolulu, Hawaii: Hawaii Institute of Tropical Agriculture and Human Resources. HITAHR Research Extension Series No. 14.

The characteristics of the eight commonly grown taro varieties in Pohnpei are described, including their susceptibility/resistance to blight.

351. Sar, S. A., Wayi, B. M., & Ghodake, R. D. (1998). Review of research in Papua New Guinea for sustainable production of taro (*Colocasia esculenta*). Tropical Agriculture (Trinidad) **75**(1), 134–138.

Studies on taro leaf blight, including breeding, are reported.

352. Sarejanni, J. A. (1936). La pourriture du Collet des Solan'ees cultivees et la classification du genre *Phytophthora*. [Collar rot of cultivated Solanaceae and classification of the genus *Phytophthora*]. Annales De L'Institute Phytopathologique Benaki **2**, 35–52.

353. Sato, D. M. (1991). The rapid rural appraisal of taro agriculture on the Island of Hawaii. In A. M. Vargo (Compiler), A Rapid Rural Appraisal of Taro Production Systems in Micronesia, Hawaii and American Samoa. (pp. 59–77). Hawaii, USA: University of Hawaii.

    A rapid rural appraisal of taro production on Hawaii conducted in 1989 is reported. *Phytophthora* leaf blight was identified in both lo'i and low input systems. In the former it affected leaf production but not corm production, and in the latter was not perceived as a constraint. No fungicides were used in either system to control the disease.

354. Savage, E. J., Clayton, C. W., Hunter, J. H., Brenneman, J. A., Laviola, C., & Gallegly, M. E. (1968). Homothallism, heterothallism, and interspecific hybridization in the genus *Phytophthora*. Phytopathology **58**, 1004–1021.

355. Sawada, K. (1931). Descriptive Catalogue of the Formosan Fungi, Part V. Formosa: Department of Agriculture, Research Institute.

356. Sawada, K. (1911). Infection of taro. In (Special Report of the Formosan Agricultural Experiment Station), (p. 11).

357. Sawada, K. (1911). *Phytophthora* disease of taro. In (Special Report of the Formosan Agricultural Experiment Station), (pp. 75–84).

358. Sawant, I. S., Sawant, S. D., & Nanaya, K. A. (1995). Biological control of *Phytophthora* root-rot of coorg mandarin (*Citrus reticulata*) by *Trichoderma* species grown on coffee waste. Indian Journal of Agricultural Sciences **65**(11), 842–846.

    During 1989–92 the biological control of root-rot of mandarins caused by *P. nicotianae* var. *parasitica* and *P. colocasiae* was studied. *T. harzianum, T. viride* and *Gliocladium virens* were widely distributed in *Citrus* orchards in Kodagu, Karnataka, India, with populations of 200–2000 colony forming units/g soil. Seventeen isolates were highly antagonistic to both *Phytophthora* spp. *in vitro*. For large-scale fungal multiplication, local waste (coffee-cherry husk, fruit skin and berry mucilage, poultry manure and mushroom-grown waste) was a suitable substrate with 20–30 million colony forming units/g. Pot trials amended with coffee-cherry husk and poultry manure in a 1:2 ratio decreased feeder root-rot and increased seedling growth. Akomin 0.3%, metalaxyl + 0.25% mancozeb (as Ridomil MZ) spray and drenching 0.2% chlorothalonil were the best chemical treatments for disease control and increased seedling growth. Isolates E, T3, 3HR and D of *T. harzianum* and isolate B of *T. viride* grown on coffee-cherry husk decreased the feeder root-rot and increased plant growth when applied as 1% inoculum in soil.

359. Semisi, S. T. (1996). Taro leaf blight disease, *Phytophthora colocasiae,* in Western Samoa. Taro Leaf Blight Seminar. Proceedings. Alafua, Western Samoa, 22–26 November, 1993. (pp. 63–68). Noumea, New Caledonia: South Pacific Commission. Unpublished.

    The importance of taro to the Samoan economy and as a staple food is highlighted. The occurrence, distribution, spread and control of taro leaf blight (which includes quarantine, training and public awareness campaign and a spraying campaign) are outlined. Research activities and collaboration with international/regional organisations are listed.

360. Semisi, S. T., Mauga, T., & Chan, E. (1998). Control of leaf blight disease, *Phytophthora colocasiae* Racib. in taro, *Colocasia esculenta* (L.) Schott, with phosphorous acid. Journal of South Pacific Agriculture **5**(1), 77–83.

    Phosphorous acid applied at 14 ml/litre gave excellent control of taro (*Colocasia esculenta*) leaf blight disease caused by *P. colocasiae*. The duration of control varied, mainly due to prevailing climatic conditions. Under Western Samoa conditions, this appeared to be no more than 2–4 weeks. This compared poorly with control obtained for root and heart rot diseases in pineapple (one crop cycle) caused by *P. cinnamoni* with a single application of phosphorous acid. It is suggested that the high rainfall and rapid growth rates of taro may result in more rapid dilution of the fungicide. It is also suggested that it may be related to its indirect mode of action, i.e., that of stimulating host defence responses to the pathogen. Since there is an additive effect of phosphorous acid, and taro in the Pacific is believed to lack genetic resistance, the effect of the fungicide would not be as pronounced.

361. Semisi, S. T., Mauga, T., & Chan, E. (1995). Control of leaf blight disease, *Phytophthora colocasiae* Racib. in taro, *Colocasia esculenta* (L.) Schott, with phosphorous acid. In 10th Biennial Australasian Plant Pathology Society Conference. Christchurch, New Zealand.

    A poster presented at this meeting.

362. Sen, H., & Das, P. K. (1991). Agronomical appraisal of some taro accessions in the Gangetic alluvium of West Bengal. Journal of Root Crops **17**(2), 154–155.

    Nine taro selections were evaluated in West Bengal, India, during 1989–90, for production potential and susceptibility to leaf blight. Cormel yields were found to vary between season and cv. Kakakachu had the highest pooled mean yield (9.71 t/ha), which was closely followed by cv. Panchmukhi (9.03 t/ha) and cv. Kovvur local (8.72 t/ha). The incidence of leaf blight was widespread in both seasons, except on cultivars Panchmukhi and Nadia local in 1989. These cultivars were slightly affected in 1990, which might be due to the unusually heavy rainfall in that season.

363. Seth, L. N. (1939). Report of the Mycologist, Mandalay, Burma, for the year ended 31 March, 1939.

364. Shaw, D. E. (1984). Microorganisms in Papua New Guinea. Department of Primary Industry, Port Moresby, Research Bulletin (No. 33), 344 pp.

365. Shaw, D. E. (1963). Plant pathogens and other microorganisms in Papua New Guinea. Department of Agriculture, Stock and Fisheries, Port Morseby, Research Bulletin (No. 1), 1–78.

366. Simin, A., Ivancic, A., Ososo, E., & Okpul, T. (1996). Variation of wild taro (*Colocasia esculenta* (L.) Schott) in Papua New Guinea. In The Second Taro Symposium. Faculty of Agriculture, Cenderawasih University, Manokwari, Indonesia, 23–24 November 1994. (pp. 32–40).

    Wild taro in Papua New Guinea showed little variation in susceptibility to taro leaf blight and taro viruses and in qualitative and quantitative characteristics. It is concluded that in Papua New Guinea, wild taro populations consist of a single clone.

367. Singh, D. (2000 March). Building up taro gene pool for better yield. In The National, Papua New Guinea ,2000 March, Agriculture Supplement, p. 14 pp.

368. Singh, D., Okpul, E., Iramu, E., Wagih, M., & Sivan, P. (2000). Breeding taro for securing PNG's traditional staple. In Proceedings Papua New Guinea Food and Nutrition Conference. Lae, Papua New Guinea.

369. Singh, D., & Okpul, T. (2000). Evaluation of 12 taro (*Colocasia esculenta* (L.) Schott) leaf blight-resistant colones for yield and eating quality in Papua New Guinea. SABRAO Journal of Genetics and Plant Breeding **32**(1), 39–45.

370. Singh, D., & Okpul, T. (1999). Genetic improvement of PNG's traditional staple. Post Courier , 33 pp. Dated 5 May 1999.

371. Singh, D., Okpul, T., & Guaf, J. (1999). Assessing genetically improved taro lines at NARI. Fresh Produce **144**, 6–7.

372. Singh, D., Okpul, T., Gunua, T., Iramu, E., Wagih, M., Hunter, D. G., Delp, C., Fonoti, P., Sivan, P., & Jackson, G. V. H. (2000). Breeding taro (*Colocasia esculenta*) for durable resistance to leaf blight (*Phytophthora colocasiae*) in the South Pacific. In Proceedings Durable Disease Resistance Symposium. Wageningen, The Netherlands, 28 November–1 December 2000. (p. 20). Abstract.

373. Singh, K. G. (1973). A check-list of host and disease in peninsular Malaysia, 189 pp. Kuala Lumpur, Malaysia: Ministry of Agriculture and Fisheries.

    In this list *Phytophthora colocasiae* is recorded on *Colocasia esculenta* and *Piper betle* in Malaysia.

374. Singh, P. N., Sindhu, I. R., & Singhal, G. (1984). Microfungi associated with non-infected and infected leaves of *Colocasia*. Acta Botanica Indica **12** (1), 82–85.

Healthy *C. antiquorum* leaves and those infected by *Phytophthora colocasiae* harboured distinct phylloplane microflora. *Actinomucor repens, Aspergillus terreus, Curvularia tuberculata, Mucor racemosus* and white sterile hyphae were restricted to non-infected leaves, *Colletotrichum* sp., *Humicola brevis, Memnoniella echinata* and *Nigrospora sphaerica* to blighted ones. *Alternaria alternata, Aspergillus humicola, A. niger, Curvularia lunata* [*Cochliobolus lunatus*], *Curvularia pallescens, Fusarium* sp. and *Sclerotium* sp. occurred occasionally on healthy leaves but were frequent on blighted ones.

375. Sinha, A. R. P., & Salam, M. A. (1988). Pathogen fungi of Andamans-I. Advances in Plant Sciences **1**(2), 214–218.

Diseases caused by *Phytophthora* [*P. nicotianae* var.] *parasitica* on pineapples and *P. colocasiae* on *Bougainvillea speciabilis* and *Colocasia antiquorum*, in Andaman, India, are described.

376. Sitansu Pan, & Ghosh, S. K. (1997). Antagonistic potential of some soil fungi on *Phytophthora colocasiae* Racib. Journal of Mycopathological Research **35**(2), 153–157.

Soils from West Bengal, India, were screened to isolate potential antagonists of *P. colocasiae.* Of 58 microbial isolates (40 fungi, 8 bacteria and 10 actinomycetes), only 10 fungal isolates showed antagonistic potential in tests on dual culture plates. Of the 10, 5 were identified as *Trichoderma viride*, 3 as *T. harzianum,* 1 as *Gliocladium virens* and 1 was an unidentified sterile fungus. Mycoparasitic/hyperparasitic activities were observed as coiling of hyphae, formation of haustoria-like structures, disorganisation of host cell contents and penetration of host hyphae.

377. Sitansu Pan, & Ghosh, S. K. (1994). Effect of temperature, moisture and soil amendment on the survival ability of hyphae of *Phytophthora colocasiae* in soil. Journal of Mycopathological Research **32**(1), 59–65.

Hyphae generally survived longer in sterilized soil (30 d) than in natural soil (5 days). At >20°C and >55% soil moisture the hyphae disappeared within 5 days of burial in natural soil. Various soil amendments, including C and N compounds, had no apparent effect on survival in natural soil, though glucose, fructose and glucose + L-asparagine delayed lysis to some extent.

378. Sitansu Pan, & Ghosh, S. K. (1997). Functional relationship of environmental factors for prediction of *Phytophthora* leaf blight severities of taro (*C. esculenta*) under natural epiphytotics. Journal of Mycopathological Research **35**(1), 41–46.

In Bangladesh, the effect of environmental factors (Xi's, i=1–7) on *Phytophthora* leaf blight (*P. colocasiae*) severity (Y) in taro (*C. esculenta*) under natural epiphytotics were analysed for predictive purposes. Correlation analysis of the variables had established a prima facia case of functional relationship of *Phytophthora* leaf blight severity of taro over minimum air

temperature (X2), maximum relative humidity (X3), minimum relative humidity (X4), total rainfall (X5), number of rainy days (X6) and mean temperature-humidity index (x7). Finally, a multivariable linear prediction model Y=- 1534.1871 - 20.2920 X2 + 2.2079 X3 + 1.4724 X4 + 2.2095 X5 - 4.6821 X6 + 25.1241 X6 with R2=0.7859 was developed that showed maximum fitness with observed data.

379. Sivan, P. (2000). Taro germplasm collection, conservation and utilisation in the Pacific Islands. In 12th Symposium of the International Society for Tropical Root Crops. Tsukuba, Japan, 10–16 September 2000.

380. Sivan, P., & Misipati, P. (1997). Taro breeding for resistance to taro blight. In L. G. G. Yapa, & M. Umar (Editors), 1996 Annual Research Report. The Institute for Research, Extension and Training in Agriculture (IRETA) and the School of Agriculture (pp. 28–29). Apia, Samoa: University of the South Pacific, Alafua Campus.

    Progress on this project on breeding taro resistant to blight in Samoa is reported.

381. Sivan, P., & Misipati, P. (1997). Taro breeding for resistance to taro leaf blight. IRETA's South Pacific Agricultural News **14**(9), 1,6.

    Taro breeding for blight resistance in Samoa with the cultivars PSG-G2, Toantal, Pastora, Pwetepwet, Interpayer, Buntafortwe and Niue is described.

382. South Pacific Commission. (1997). Taro leaf blight seminar. Proceedings. Alafua, Western Samoa, 22–26 November 1993. Noumea, New Caledonia: South Pacific Commission.

    Details of the proceedings of the taro leaf blight (caused by *Phytophthora colocasiae*) seminar held at Alafua, Western Samoa are provided. Summaries of the reports of working groups on cultural control, awareness campaign materials, taro (*Colocasia esculenta*) germplasm collection, selection and breeding and fungicide biology are presented. The recommendations of the working groups are provided. A list of the papers presented at the meeting is given. These have not been formally published, but are noted in this bibliography individually, and copies may be obtained from either IRETA or SPC.

383. South Pacific Commission. (1996). Taro Seminar II. Lae, Papua New Guinea, 26–30 June 1995. (35 pp.). Noumea, New Caledonia: South Pacific Commission.

    A summary of the proceedings of this meeting is provided. Taro leaf blight was considered at several sessions including the country reports, other reports, taro pathology, breeding and the plant pathology working groups. Recommendations of the meeting are given.

384. Stamps, D. J., Waterhouse, G. M., Newhook, F. J., & Hall, G. S. (1990). Revised tabular key to the species of *Phytophthora*. (p. 28 pp.). UK: CAB International.

385. Stewart, R. B., & Yirgou, D. (1967). Index of plant diseases in Ethiopia. Bulletin of the Experimental Station, College of Agriculture Haile Selassie University , 30 .

386. Sumich, F. N. (1996). Chemicals active on *Phytophthora colocasiae.* Taro Leaf Blight Seminar. Proceedings. Alafua, Western Samoa, 22–26 November, 1993. (pp. 149–152). Noumea, New Caledonia: South Pacific Commission. Unpublished.

Details are given of three products active against *Phytophthora colocasiae*, Ridomil MZ, Manzate 200 DF and copper oxychloride. Factors to consider when using chemical sprays to control taro leaf blight are discussed.

387. Tamori, M. (1974). Studies on the genus *Phytophthora* and pineapple heart rot disease found in Okinawa. Science Bulletin of the College of Agriculture, University of the Ryukyus, Okinawa. (No.21), 1–72.

Results are presented of a study of the host range of *Phytophthora* species in Okinawa, a comparison of their morphological characters, oospore formation and pathogenicity of isolates from different hosts. Among species newly recorded was *P. colocasiae* on *Colocasia*.

388. Tan, T., & Wicaksono, B. W. D. (1996). A preliminary study of ten taro clones under Prafi conditions. In The Second Taro Symposium. Proceedings of an International Meeting. Faculty of Agriculture, Cenderawasih University, Manokwari, Indonesia, 23–24 November 1994. (pp. 74–78).

Phytophthora colocasiae infected all 10 of the taro clones tested at Prafi, Indonesia, and decreased yields.

389. Taylor, M. B., & Palupe, A. (1996). Taro tissue culture. Taro Leaf Blight Seminar. Proceedings. Alafua, Western Samoa, 22–26 November, 1993. (pp. 89–94). Noumea, New Caledonia: South Pacific Commission. Unpublished.

The use of tissue culture to assist in the problem of taro leaf blight is discussed. Its use in the importation of taro germplasm and rapid multiplication techniques are described in some detail.

390. Tedder, M. M. (1973). Staple diets in the BSIP. South Pacific Bulletin (Third quarter).

391. Teng, S. C. (1932). Some fungi from Canton. Contribution of the Biological Laboratory, Scientific Society of China, Botanical Series **8**(2), 121–128.

An annotated list of 41 fungi collected in Canton, China, and including *Phytophthora colocasiae* on Colocasia esculenta, is presented.

392. Tethool, Y. (1983). Pengaruh intensitas serangan penyakit becak daun (*Phytophthora colocasiae*) terhadap produksi talas di daerah biak.[The effect of taro leaf blight intensity (*Phytophthora colocasiae*)on taro production in Biak.]. Unpublished report of the Faculty of Agriculture UNCEN, Manokwarai.

393. Thaman, R. R. (1984). Intensification of edible aroid cultivation in the Pacific Islands. In S. Chandra (Editor), Edible Aroids (pp. 103–122). Oxford, UK: Clarendon Press.

    In this account of taro cultivation in the Pacific, it is noted that it is almost impossible to grow *Colocasia* taro in the lowland areas of Bougainville due to taro leaf blight.

394. Thankappan, M. (1986). Investigation on the disease of aroids. Annual report 1985, Central Tuber Crops Research Institute, Trivandrum, India. (pp. 93–95). Trivandrum, India: Indian Council of Agricultural Research.

    Outbreaks of *Phytophthora colocasiae* were very mild on 29 clones of *Colocasia* in 2 field trials, owing to unfavourable climatic conditions.

395. Thankappan, M. (1985). Leaf blight of taro—a review. Journal of Root Crops **11**(1–2), 1–8.

    Leaf blight (caused by *Phytophthora colocasiae*) of taro, *Colocasia esculenta*, is discussed under the following headings: distribution, extent of damage, symptoms, predisposing factors, the pathogen, perennation, collateral hosts, other *Phytophthora* sp. on *C. esculenta* and control.

396. Thankappan, M., & Malathi, V. G. (1984). Diseases of aroids. Indian Farming **33**, 47.

397. Thomas, K. M., & Ramakrishnan, T. S. (1948). Studies on the genus *Phytophthora* II. Proceedings of the Indian Academy of Science, Section B **27**(3), 55–73.

398. Thompson, A. (1939). Notes on plant diseases in 1937–38. Malaysian Agricultural Journal **27**, 86–98.

399. Thompson, A. (1940). Notes on plant diseases in 1939. Malaysian Agricultural Journal **28**, 400–407.

400. Thongjiem, M., & Poolperm, N. (1999). Advances in taro (*Colocasia esculenta*) research in Thailand. In Annual Report for 1998. (pp. 97–102). Taro Network for South-East Asia and Oceania (TANSAO).

    Phytophthora colocasiae is reported as a major disease.

401. Tilialo, R., Greenough, D., & Trujillo, E. E. (1996). The relationship between balanced nutrition and disease susceptibility in Polynesian taro. In Mineral nutrient disorders of root crops in the Pacific. Proceedings of a workshop. Nuku'alofa, Kingdom of Tonga, 17–20 April 1995. (pp. 105–109). ACIAR Proceedings No. 65.

The effects of N, P, K and Ca nutrition on the susceptibility of *Colocasia esculenta* to *Phytophthora colocasiae* are reported from field experiments in American Samoa. The importance of balanced plant nutrition in a sustainable, integrated management strategy to reduce the incidence of the disease is discussed.

402. Tomlinson, D. L. (1987). A bacterial leaf disease of taro (*Colocasia esculenta*) caused by *Xanthomonas campestris* in Papua New Guinea. Tropical Pest Management **33**(4), 353–355.

403. Trujillo, E. E. (1967). Diseases of the genus *Colocasia* in the Pacific area and their control. In Proceedings of the International Symposium on Tropical Root Crops. Volume 2. University of the West Indies, St Augustine, Trinidad, 2–8 April 1967. (IV 13-IV 19.). St Augustine, Trinidad: University of the West Indies.

    The history and characteristics of taro leaf blight are described. Chemical control is possible but costly, and the author advocates the development of resistant varieties to manage this disease in the Pacific. Taro rots and other minor diseases are also described.

404. Trujillo, E. E. (1965). The effects of humidity and temperature on *Phytophthora* blight of taro. Phytopathology **55**(2), 183–188.

    Sporulation of P. colocasiae on detached taro leaves was affected by temperature and relative humidity, with optima at 21 C and 100%. No sporulation occurred at RH lower than 90%. On washed lesions, 2–3 hours were required for sporulation to be initiated. Zoosporangia at RH lower than 90% lost viability rapidly and the percentage of indirect germination dropped significantly. This was attributed to rapid dehydration of the protoplasm. Indirect germination of zoosporangia occurred in water in less than 2 hours at the optimum temperature of 20–21 C, and zoospores germinated in less than a half hour after release. Direct germination occurred in 5–6 hour at 20–28 C. The percentage of direct germination was less than 5 at all temperatures. Epidemics of the disease occurred in the field when night temperatures and relative humidity were optimum for 6–8 hours for 3–4 consecutive days and light rains or dews prevailed in the morning. During these periods, 50% of the zoosporangia collected in the morning germinated indirectly. Zoosporangia collected at 2 pm were not viable; the phytoplasm appeared to be totally dehydrated.

405. Trujillo, E. E. (1965). The effects of humidity and temperature on *Phytophthora* blight of taro. Phytopathology **55**, 183–188.

406. Trujillo, E. E. (1965). Effects of humidity and temperature on zoosporangia production and germination of *Phytophthora colocasiae*. Phytopathology **55** (2), 126. Abstract of paper presented at the 1964 Annual Meeting of the Caribbean Division of the American Phytopathological Society, Mexico City, 26–30 July 1964.

The effect of temperature and relative humidity on sporulation of *P. colocasiae* was demonstrated, with optima of 21 C and 100%, respectively. With RH less than 90%, no sporulation occurred. At RH less than 90%, zoospores rapidly lost their viability.

407. Trujillo, E. E. (1971). A list of diseases of economic plants in the Trust Territory of the Pacific Islands, 23 pp. Saipan, Trust Territory of the Pacific Islands: Department of Resources and Development, Division of Agriculture.

408. Trujillo, E. E. (1993). Status of *Phytophthora* leaf blight of taro in Western Samoa and recommendations for its control. Washington DC, USA.: USDA/OICD/DRD/AAE.

409. Trujillo, E. E. (1996). Taro leaf blight in Micronesia and Hawaii. Taro Leaf Blight Seminar. Proceedings. Alafua, Western Samoa, 22–26 November, 1993. (pp. 41–43). Noumea, New Caledonia: South Pacific Commission. Unpublished.

    In this transcript of a presentation to the meeting, the spread of taro leaf blight into the region, with special reference to the situation in Hawaii and Micronesia, is described. Environmental factors affecting the disease and chemical control measures taken in Hawaii are outlined. Difolatan is considered to be the best fungicide. Ridomil was also effective, but copper fungicides give little control. Adequate fertilization of the crop is also considered necessary in the control strategy. In Micronesia taro varieties are disappearing. The crop is of less importance here, but taro leaf blight still limits taro production.

410. Trujillo, E. E. (1996). Taro leaf blight research in the American Pacific. ADAP Bulletin **1**, 1–3.

    The spread of taro leaf blight in the Pacific and the effect of the disease's introduction on taro production in American Samoa and Samoa in 1993/94 is discussed. The ADAP Taro Leaf Blight Project, started in 1994 is described. Micronesian taro varieties were collected and evaluated for resistance and some were multiplied by tissue culture. Field testing of promising Palauan varieties is described. Other objectives of the project were to determine the viability of zoosporangia in soil at different moisture and temperature regimes and to determine the effect of balanced nitrogen, phosphorus, potassium and calcium nutrition on taro leaf blight incidence. Spore survival in the soil of >3 months in moist soils and <20 C is reported. Balanced fertilizer applications led to an increase in yield of taro but the effect on taro leaf blight was not significant.

411. Trujillo, E. E. (1971). Taro leaf spot. (Plant Disease, Agricultural Extension Leaflet No. 31. 1 p. Saipan, Mariana Islands: Department of Resources and Development, Division of Agriculture.

412. Trujillo, E. E., & Aragaki, M. (1964). Taro blight and its control. Hawaii Farm Science **13**, 11–13.

The disease is described and control experiments in Hawaii described. Results showed that basic copper sulphate at 2 and 4 lb/100 gal gave good control of blight, while maneb at 2 lb/gal was no better than the controls. Recommendations for spraying are given.

413. Trujillo, E. E., & Menezes, T. (1995). Field resistance of Micronesian taros to *Phytophthora* blight. Phytopathology **85(**12), 1564. Abstract of a paper presented at the APS Caribbean Division Meeting, 1–5 October 1995, Guadeloupe.

    Taro cultivars from Guam, Palau and Rota were evaluated for resistance to taro leaf blight in the field at Hakalaua, Hawaii. High levels of resistance were found among the Palaun cultivars. All the cultivars tested were significantly more resistant to taro leaf blight than Niue, the principal cultivar grown in American Samoa. Disease resistance in the majority of the Palaun cultivars appeared to be related to the highly water-repellent nature of the foliage and to a hypersensitive reaction that caused infected leaves to drop off. It is concluded that the Palaun cultivars are promising for cultivation in American Samoa.

414. Trujillo, E. E., Wall, G., Greenough, D., & Tilialo, R. Effects of nitrogen, calcium, and/or potassium nutrition on the resistance and/or susceptibility of Polynesian taros, *Colocasia esculenta*, to the taro leaf blight, caused by the fungus *Phytophthora colocasiae*. ADAP Taro Leaf Blight Project Report .

415. Tsatsia, H. (1995). Taro breeding programme for disease resistance. In Annual Report 1994, Solomon Islands Government, Agriculture Division, Ministry of Agriculture & Lands, Research Department (pp. 30–32). Honiara, Solomon Islands: Dodo Creek Research Station.

    Results of some field varietal trials are briefly reported, together with taste tests of some promising varieties.

416. Tucker, C. M. (1933). Description of the genus *Phytophthora*. University of Montana Agricultural Experiment Station Research Bulletin, 184, 80 pp.

    The work of Mendiola in the Philippines and Petch in Ceylon (Sri Lanka) are described.

417. Tucker, C. M. (1931). Taxonomy of the genus *Phytophthora* de Bary. University of Montana Agricultural Experiment Station Research Bulletin **153**.

418. Umbala, K. G., & Ramarao, P. (1972). Leaf blight of *Colocasia* caused by *Phytophthora palmivora*. Indian Journal of Mycology and Plant Pathology **2**(2), 187–188.

    The fungus was recorded on *C. esculenta*. Symptoms and the pathogen are described.

419. Unnikrishnan, M., Nayar, G. G., Pillai, P. K. T., Vasudevan, J. S., Jos, J. S., Venkateswarlu, M., Thankappan, M., & Lakshmi, K. R. (1987). Sree Rashmi and Sree Pallavi: two promising varieties of *Colocasia*. Journal of Root Crops **13**(2), 111–116.

    Of the two promising varieties, Sree Pallavi (C-266) showed high field tolerance to leaf blight.

420. Vargo, A. M. (1991). The rapid rural appraisal of taro agriculture in American Samoa. In A. Vargo (Compiler), A Rapid Rural Appraisal of Taro Production Systems in Micronesia, Hawaii and American Samoa. (pp. 7–30). Hawaii, USA: University of Hawaii.

    A rapid rural appraisal carried out in American Samoa in 1989 is reported. *Phytophthora colocasiae* was identified as an important disease during this appraisal.

421. Vargo, A. M. (1991). The rapid rural appraisal of taro production in Chu'uk. In A. M. Vargo A Rapid Rural Appraisal of Taro Production Systems in Micronesia, Hawaii and American Samoa. (pp. 33–34). Hawaii, USA: University of Hawaii.

    In a survey carried out in 1990, *Phytophthora colocasiae* was identified as a major problem in taro cultivation on Moen and Uman.

422. Vasquez, E. A. (1989). Screening taro varieties for resistance to insect pests and diseases. R and D Philippines (No. 6–7), 28–29.

423. Vasquez, E. A. (1990). Yield loss in taro due to *Phytophthora* leaf blight. Journal of Root Crops **16**(1), 48–50.

    Four taro (*Colocasia esculenta*) accessions (PRG-686, PRG-688, PRG-538 and PRG-179) with varying resistance to *P. colocasiae* were inoculated with the pathogen 2 or 4 months after planting (MAP). In general, plants inoculated at 4 MAP had a higher disease rating and lower yield than those inoculated earlier, except accession PRG-688 (resistant). Yield reductions were low in resistant accessions (2.9–4.7%) but higher in moderately resistant and susceptible accessions (24.4–36.5%). No significant differences were observed between yield reductions of susceptible and moderately resistant accessions.

424. Villanueva, M. R., & Tupas, G. L. (1980). Taro production in the Philippines—its prospects and problems. In International Symposium on Taro and Cocoyam. Visayas State College of Agriculture, Baybay, Leyte, Philippines, 24–25 September 1979. (pp. 99–111). Stockholm, Sweden: International Foundation for Science.

    In this paper, taro leaf blight is identified as the most important disease of taro in the Philippines, causing more damage than insects.

425. Wagih, M. E. (1996). Disease-free baby corms of taro regenerated from axillary bud cultures coupled with thermotherapy. In The Second Taro Symposium. Proceedings of an International Meeting. Faculty of Agriculture, Cenderawasih University, Manokwari, Indonesia, 23–24 November 1994. (p. 124).

    In this poster at the conference it is reported that axillary buds from taro severely infected by blight and viruses were excised, surface sterilised, treated at 55 C for 3 minutes and cultured. Shoots remained without symptoms for 6 months and were assumed to be disease-free. By 4–5 months small cormels had formed, providing an ideal way to transfer taro germplasm.

426. Wagih, M. E., Taufa, L., & Okpul, T. (1993). The use of seed-rescue culture technique in the production of pathogen-free taro for germplasm preservation and breeding for leaf blight resistance. In Book of Abstracts. The First Taro Symposium. Lae, Papua New Guinea, 25 October 1993. (p. 9). Lae, Papua New Guinea: University of Technology.

    In this abstract, the use of seed rescue culture to produce pathogen-free taro plants in Papua New Guinea is reported. Three resistant varieties were identified.

427. Wahi, C. P. (1969). Vitamin requirements of *Phytophthora colocasiae* Racib. and *Helminthosporium euphorbiae*. Hans. Journal of Applied Science, India **1**(2), 71–76.

428. Wall, G. C. (1996). Life after blight. The current taro leaf blight status on Guam. Taro Leaf Blight Seminar. Proceedings. Alafua, Western Samoa, 22–26 November, 1993. (pp. 39–40). Noumea, New Caledonia: South Pacific Commission. Unpublished.

    Taro leaf blight is endemic in Guam but is of little economic importance. The reasons for this are briefly discussed. The use of disease resistant varieties and cultural practices are highlighted as important control measures.

429. Wall, G. C., & Wiecko, A. T. (1998). Screening of 29 taro cultivars (*Colocasia esculenta*) propagated *in vitro*, for resistance to taro leaf blight (*Phytophthora colocasiae*). Journal of South Pacific Agriculture **5**(2), 9–12.

    Twenty-nine taro varieties from Guam, American Samoa, Yap, Pohnpei and Thailand have been propagated *in vitro* and screened at the University of Guam for susceptibility to taro leaf blight. The most resistant varieties were: Gilin, Kugfel, Oglang, Pwetepwet, Thailand, Sushi, Ol and Pasdora.

430. Wall, G. C., Wiecko, A. T., & Trujillo, E. E. (1998). Evaluation of resistance to taro leaf blight in 29 *Colocasia esculenta* cultivars. Phytopathology **88**(9 (Supplement)), S123.

Twenty nine taro cultivars were collected from Pohnpei, Yap and Guam. After *in vitro* propagation, plants were transferred to a screenhouse until they reached a mature size. Three plants per test for each cultivar, and each was tested 3 or 4 times. Plants (1 leaf) were spray-inoculated with 100–200 zoospores per ml. They were then covered with black plastic overnight. The evaluation was based on percentage leaf area damaged by the pathogen in 6–8 days. Tests included resistant and susceptible controls. Six cultivars out of 29 showed a good degree of resistance.

431. Walton, P. (1996). Taro leaf blight bibliography. Taro Leaf Blight Seminar. Proceedings. Alafua, Western Samoa, 22–26 November, 1993. (pp. 161–168). Noumea, New Caledonia: South Pacific Commission. Unpublished.

    In this preliminary bibliography, references to almost 100 publications on taro leaf blight are included. Most of the references have abstracts.

432. Ward, R. G., & Ashcroft, P. (1998). Samoa: mapping the diversity.

    Background information on the taro leaf blight problem in Samoa is given.

433. Waterhouse, G. M. (1970). The genus *Phytophthora* De Bary, 104 pp. UK: Commonwealth Agricultural Bureaux. Mycological Paper No. 122.

    This volume contains the text of the original description of *Phytophthora colocasiae* in both German and English.

434. Waterhouse, G. M. (1963). Key to the species of *Phytophthora* de Bary. (p. 22 pp.). UK: Commonwealth Agricultural Bureaux. Mycological Papers. No. 92.

435. Waterhouse, G. M. (1931). The production of conidia in the genus *Phytophthora*. Transactions of the British Mycological Society **15**, 311–321.

436. Waterhouse, G. M., Newhook, F. J., & Stamps, D. J. (1983). Present criteria for classification of *Phytophthora*. In D. C. Erwin, S. Bartnicki-Garcia, & P. H. Tsao (Editors), *Phytophthora*: its Biology, Taxonomy, Ecology and Pathology (pp. 139–147). St Paul, Minnesota, USA: APS Press (American Phytopathological Society).

    The classification of *Phytophthora* species is discussed.

437. Wei, C. T., & Hwang, H. S. (1942). A checklist of fungi deposited in the mycological herbarium of the University of Nanking, I (1924–1937). Nanking Journal **9**(1–2), 329–372.

438. Weston, W. H. Jr. (1918). Report on plant diseases in Guam. Guam Agricultural Experiment Station Report 1917 , 45–62.

439. Wiecko, A. T., Wall, G. C., & Trujillo, E. E. Taro leaf blight evaluations of 30 different taro cultivars (*Colocasia esculenta*) produced in tissue culture.

[Abstract]. In Proceedings of the College of Arts and Science Conference. University of Guam, Guam.

440. Worapan, K., & Thammasak, S. (1993). Rok bai mai ru rok ta-sua khong phuak. (Taro [*Colocasia antiquorum* Schott] blight disease [*Phytophthora colocasiae* in Thailand). Journal of Thai Phytopathological Society **3**(1), 1–9.

441. Xu, X. L., Ko, W. H., Xu, X. L., & Ko, W. H. (1998). A quantitative confined inocultation method for studies of pathogenicity of fungi on plants. Botanical Bulletin of Academia Sinica **39**(3), 187–190.

A technique for inoculation with precise numbers of fungal spores on leaves and stems of plants was developed. The technique consisted of placing 1-µl drops with a fixed number of spores on the surface of leaves and stems, and covering each inoculum drop with a 10-µl drop of low-temperature gelling SeaPlaque agarose to fix the inoculum on the target site. With this technique single zoospores of *Phytophthora capsici* were able to cause local lesions on leaves and stems of peppers (*Capsicum annuum* cv. California Wonder), and the size of the lesions directly correlated with the number of spores in the inoculum drops. Similar results were obtained when the technique was used to inoculate taro (*Colocasia esculenta*) leaves with zoospores of *Phytophthora colocasiae* and black mustard (*Brassica nigra*) leaves with *Alternaria brassicae*. This method has the advantages of being accurate and precise, and it is also easy to handle the inoculated plants. It may also be applicable to other pathogens.

442. Yap, T. C. (1999). Taro cultivation and research in Malaysia. In Annual Report for 1998. (pp. 27–32). Taro Network for South-East Asia and Oceania (TANSAO).

In a disease survey, no *Phytophthora colocasiae* was found in Malaysia.

443. Yokoyama, K. M., Hollyer, J. R., Nakamoto, S. T., & Wanitprapha, K. (1989). Taro. Hawaii, USA: Department of Agriculture and Resource Economics, College of Tropical Agriculture and Human Resources, University of Hawaii. Economic Fact Sheet No. 1.

444. Yu, J. Y., & Chang, H. S. (1980). Chemical regulation of sexual reproduction in *Phytophthora colocasiae*. Botanical Buletin of Academia Sinica **21**(2), 155–158.

Both A1 and A2 isolates produced substance(s) which initiated the formation of oospores in isolates of *P.* [*nicotianae* var.] *parasitica, P. palmivora* and *P. cinnamomi*, but were relatively insensitive in response to hormone(s) produced by opposite mating types.

445. Yu, J. Y., Chang, H. S., & Ko, W. H. (1981). Factors affecting the induction of sexual reproduction in *Phytophthora parasitica* by *P. colocasiae*. Journal of General Microbiology **123**(2), 249–252.

When *P. colocasiae* (A2) was used as a hormone producer and *P.* [*nicotianae* var.] *parasitica* (A1) as a hormone receptor, no sex organs of the latter were observed in matings lasting for 7 h, but the amount of hormone produced was sufficient to stimulate the production of 341 oospores/cm2 6 days later. Max. induction of sex organs was reached in matings lasting 48 h. Hormone production was inhibited by light, but the effect of light on oospore development was small. Temperatures of 10 and 15 deg C inhibited growth of, and hormone production by, *P. colocasiae*, and prevented *P. nicotianae* var. *parasitica* from forming new sex organs after stimulation by hormone. The effect of temperature on hormone and oospore formation differed. Hormone formation was poor at 30 deg , but oospore development was good.

446. Yusuf, R. (1987). The influence of *Phytophthora colocasiae* on distribution of *Colocasiae esculenta* varieties in Jawa Island, Indonesia. Berita Biologia. (Indonesia) (Supplement 3), 17–19.

447. Zentmyer, G. A. (1988). Origin and distribution of four species of *Phytophthora*. Transactions of the British Mycological Society **91**(3), 367–378.

Information is presented on possible origins, and on the distribution of *P. infestans, P. cinnamomi, P. palmivora* and *P. colocasiae*. Little information is available on the origin of *P. colocasiae*, but there are indications of an Asiatic origin. The fungus has been distributed by means of vegetatively propagated material, and also probably by soil.

448. Zentmyer, G. A. (1990). Origin, distribution and significance of species of *Phytophthora* in the Tropics. In Proceedings 3rd International Conference on Plant Protection in the Tropics: volume IV. Genting Highlands, Pahang, Malaysia, 20–23 March 1990. (pp. 210–214). Kuala Lumpur, Malaysia: Malaysian Plant Protection Society .

The controversy of the centres of origins of tropical species of *Phytophthora* are discussed. Information is presented on the possible origin of *P. palmivora, P. cinnamomi, P. infestans,* and *P. colocasiae*.

449. Zentmyer, G. A. (1983). The world of *Phytophthora*. In D. C. Erwin, S. Bartnicki-Garcia, & P. H. Tsao (Editors), *Phytophthora*: its Biology, Taxonomy, Ecology, and Pathology (pp. 1–7). St Paul, Minnesota, USA: APS Press (American Phytopathological Society).

Although most of this introductory chapter relates to work on *Phytophthora cinnamomi* and *P. palmivora*, it does contain a note stating the first description of *P. colocasiae* Raciborski was in1900.

450. Zettler, F. W., Jackson, G. V. H., & Frison, E. A. (1989). Taro leaf blight. In FAO/IBPGR Technical Guidelines for the Safe Movement of Edible Aroid Germplasm. (pp. 16–17). Rome, Italy: FAO/IBPGR.

The symptoms, distribution, biology, alternative hosts and quarantine measures for this disease are outlined.

451. Zhang, K. M., Zheng, F. C., Li, Y. D., Ann, P. J., & Ko, W. H. (1994). Isolates of *Phytophthora colocasiae* from Hainan Island in China: evidence suggesting an Asian origin of this species. Mycologia **86**(1), 108–112.

Of 280 isolates of *P. colocasiae* obtained from Hainan Island, China, 136 were mating type A1, 102 were type A2 and 42 were A0. The 3 mating types were all pathogenic to taro (*Colocasia esculenta*) leaves and had similar electrophoretic patterns of soluble proteins. The representative isolates tested showed considerable variation in growth response to temperature, in ability to produce sporangia and in morphology of sporangia. It is suggested that Hainan Island in inside the centre of origin of *P. colocasiae*.

452. Zheng, F. C., & Ward, E. (1998). Variation within and between *Phytophthora* species from rubber and citrus trees in China, determined by polymerase chain reaction using RAPDs. Journal of Phytopathology **146**(2–3), 103–109.

Variation among 39 isolates of *Phytophthora* of 6 morphological species (*P. citrophthora*, *P.* [*nicotianae* var.] *parasitica, P. capsici*, *P. palmivora* and *P. meadii*, from rubber and citrus trees, and *P. colocasiae* from taro) was studied using random amplified polymorphic DNA (RAPD) analysis. Ten randomly-chosen 10-mer primers were used. Generally, the banding patterns were similar within species and different between species, but no one primer was able to distinguish all 6 species from one another. Cluster analysis on pooled data from all the primers gave 6 groups of isolates corresponding to the 6 morphological species. The group corresponding to *P. citrophthora* was divided further into subgroups that were related to host species and geographical location. This work confirmed the existing morphological classification of *Phytophthora* isolates from rubber and citrus trees in tropical China and showed the validity of using RAPDs to study the taxonomy of *Phytophthora*.

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