REPORT DOCUMENT
ON
DIAGNOSIS OF BANANA, YAM
AND
OTHER DISEASES IN POHNPEI

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FOREWARD

A suspected ‘new’ disease of the banana was reported as early as December 2000 in Pohnpei that prompted us to invite Dr. Scot C. Nelson, Associate Professor (Plant Pathology), University of Hawaii (Manoa) to conduct the disease identification through the Office of the Vice-President, Cooperative Research & Extension for Agriculture Experiment Station (AES) Land Grant Programs (LGP) and the Researcher (Agriculture-Horticulture) assisting. This was also the concern of Pohnpei State Agriculture to identify the diseased bananas in Pohnlangas, Madolenihmw. Other diagnoses of diseased yam, cucumber, tomato and breadfruit fruit were also conducted. The report document covers the result of the diagnoses done for the period of the invitational trip to Dr. Nelson from June 27, 2001 to July 21, 2001.

As Vice-President, Cooperative Research & Extension I am supportive and very thankful for this collaborative work of our Researcher and Dr. Scot C. Nelson with the official approval of the University of Hawaii (Manoa). I am providing this formal report in printed form to make it available for the offices and departments concerned, students and others for the information on the technical procedures of disease diagnosis and identification and awareness.

Yasuo I. Yamada
Vice-President
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BANANA DISEASE AT POHNLANGAS

Dr. Scot Nelson
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ABSTRACT. A severe disease or condition affecting bananas at Pohnlangas, Pohnpei was reported in 2000-2001. Disease symptoms were plant decline, unthrifty growth, stunting, wilt and plant death. Significant necrosis of xylem tissues was observed inside affected banana pseudostems. Microscopic examination of diseased tissues revealed the presence of white fungal mycelium in association with diseased tissues. Fruiting bodies of the banana pathogen, *Marasmiellus inoderma*, were found on the exterior of several symptomatic banana plants. Isolations of fungi from symptomatic tissues onto water agar, and their subsequent culture on nutrient agar (PDA, potato dextrose agar) consistently produced cultures of the plant pathogenic fungus, *Marasmiellus inoderma.* A nonpathogenic species of *Fusarium* was recovered at the basal stem/root interface for one diseased plant. On the basis of disease symptoms and signs, and the consistent solation and association of *Marasmiellus* from affected psuedostems, it was concluded that the disease at ohnlangas is stem rot, caused by *Marasmiellus inoderma.* No evidence of the disease known as 'Panama wilt', caused by the fungus *Fusarium oxysporum* was found.

Introduction and Field History.

<u>Planting date</u>: August, 1998
<u>Banana varieties</u>: a mixture of local Pohnpeian varieties and a Chinese variety from tissue culture.
<u>Fertilizer</u>: only one fertilizer application
<u>Weed control</u>: no weed control after first harvest
<u>Disease and pest control</u>: no disease or pest control
<u>Observations</u>: The bananas in this field began to show poor growth and disease symptoms shortly after the field was planted.

Disease Symptoms.

The symptoms were poor growth (Figure 1), wilting (Figure 2), a brownish-black to maroon colored internal pseudostem necrosis (Figure 3; Figure 4), plant stunting (Figure 1), and plant death (Figure 2). The internal stem necrosis was confined primarily to the outer layers of the banana pseudostem. Only one of the sampled plants showed stem necrosis toward the center of the pseudostem (Figure 5).

Pathogen Signs.

Signs of possible pathogens included: white mycelial growth within the external layers of the pseudostem (xylem) and at the base of psuedostems (Figure 6); and white to cream-colored fungal fruiting bodies of *Marasmiellus inoderma* adhering to outer layers of banana pseudostems (Figure 7).

Sampling of Diseased Banana Tissue.

Approximately 20 diseased banana plants in various stages of decline were sampled by cutting the pseudostems approximately 0.5-1 meter from ground level to obtain pieces of necrotic tissue from the internal tissues of the pseudostem xylem. Necrotic root samples were also obtained by detaching them from symptomatic plants in the upper 2-5 cm of soil.

Fungal Isolation from Diseased Banana Tissue.

Sections of necrotic banana pseudostems and roots were surface-sterilized with a solution 10% Clorox for 30-60 seconds, blotted dry, and placed aseptically onto water agar for incubation at room temperature (22-29C). After 2-3 days of fungal growth, fungi that emerged from the necrotic tissue were subcultured by selecting hyphal tips and placing them directly on PDA (potato dextrose agar) for 7 days.

Fungal Identification.

Fungi were observed by microscopic examination of slide mounts at 100-400X. Morphology of mycelium and spores were examined and noted, if present. Fungal morphology was the basis for genus and species identification.

Results.

Marasmiellus inoderma was readily isolated from all internal necrotic banana pseudostem tissues. No *Fusarium* species were isolated from necrotic pseudostems.

A *Fusarium* sp. was isolated from the tissues at the interface of the basal pseudostem and banana roots. The cultural characteristics and spore morphologies of this fungus (i.e., the macroconidia and the microconidia) were <u>not</u> consistent with published data for *Fusarium oxysporum* (the cause of Panama wilt disease).

Disease Control Recommendations.

1) Ensure disease-free planting material
2) Ensure adequate or improved soil drainage
3) Ensure adequate or improved plant nutrition
4) Ensure adequate weed control
5) Crop rotation with non-susceptible plants
6) Field sanitation practices
7) Avoid intercropping with coconut (*Cocos nucifera*), an alternate host of *Marasmiellus inoderma* where disease is severe. Dying coconuts were observed adjacent to diseased bananas in the Pohnlangas region.

A YAM RUST DISEASE IN POHNPEI

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ABSTRACT. In the yam-growing season of 2000-2001, a severe yam (*Dioscoreae* spp.) leaf spot and stem blight disease occurred on the island of Pohnpei in the Federated States of Micronesia. Distribution of the disease on the island was virtually pandemic. At some locations, severe rust epidemics developed and caused 80-100% yield losses. Significant variation in symptom expression and disease severity was observed, ranging from minor leaf spotting to severe leaf blight and stem dieback. Microscopic examination of leaf and stem lesions revealed the presence of an associated rust fungus. The presence of this fungus and the severity of the symptoms are consistent with some rust diseases of other crops. However, the symptoms and severity of the yam rust disease in Pohnpei differed significantly from the yam rusts reported elsewhere in the Pacific. Particularly severe were the yam stem symptoms, which appeared to be unique in their severity and limited to Pohnpei. Two Pohnpei yam varieties appeared to have moderate to high disease resistance. Similar rust disease symptoms were found on a possible alternate host (not a yam) occurring on Sokehs ridge. Strategies for disease control were identified. Dried samples of infected yam foliage were submitted to fungal specialists at CABI Bioscience in the United Kingdom for species identification. The yam rust was determined as *Goplana dioscoreae* (Chaconiaceae), based on *Trans. Brit. Mycol. Soc*. 24: 369, 1983. This was the first time CABI had observed stem symptoms associated with this pathogen. Although *Goplana dioscoreae* was reported to occur in Pohnpei previously, the disease caused by this pathogen has never been reported to be as severe as we observed in July, 2001. This suggests the possibility that a new race of this pathogen has developed in Pohnpei. Variation in symptom expression among yam varieties suggests that possible resistance mechanisms exist.

History of the Problem.

A relatively severe foliar disease of yam (*Dioscoreae* spp.) was reported for the first time on the island of Pohnpei in the municipality of Kitti during the summer months of 2000. The ultimate effects of the disease were plant dieback and poor yields. By July, 2001 the disease spread throughout the island of Pohnpei and reached epidemic proportions on some of the most popular yam varieties.

Disease Symptoms.

Disease symptoms were observed primarily on yam foliage (leaves, petioles, stems).

<u>Leaf symptoms</u>.

Leaf spots. Extensive spotting of leaves was observed at all locations and for most yam varieties. The expression of these symptoms varied among locations, planting methods and yam varieties. Significant variation in symptom expression and severity was observed.

Two primary leaf spot symptoms were observed:

1) BLACK LEAF SPOT AND LEAF BLIGHT. One of the principal symptom types observed on the variety ‘Kehp en Dol’ consisted of large, brown to black leaf spot with well defined to diffuse margins (Figure 8). These spots were roughly circular to oval to irregularly shaped. They had tan to brown, textured centers and irregular margins, and ranged in diameter from 1-2 mm to 2.5 cm. Individual lesions were surrounded by chlorotic (yellow) halos. These rapidly expanding lesions often coalesced into extensive, blighted areas on leaves and were associated with significant veinal necrosis (Figure 9) (see description of veinal necrosis below). Many leaves were either completely destroyed or having from approximately 40-70% necrotic leaf area. Symptom progression: After infection and tissue penetration by the rust fungus, symptoms appear. The spots begin as tiny (<0.5 mm diam.) black specks on the upper (adaxial) leaf surface, which soon become visible on the lower (abaxial) surface as well. The black specks expand rapidly and radially until leaf veins are encountered by the invading fungus. Thereafter, the leaf spots tend to expand asymmetrically and leaf veins invaded more rapidly than surrounding leaf tissues. These leaf vein infections are first visible as black veins and later black veins filled with and bearing erumpent (i.e., breaking through the leaf epidermis) rust uredia (i.e., rust spore-bearing structures that contain the infective urediospores). The individual leaf spots may coalesce as they expand to form large blighted areas on the yam leaf. Eventually, leaves begin to curl and change color (yellow and brown) and fall off the vine. Note: this symptom type differs significantly from other rust diseases known to attack yams in the Pacific region, raising the possibility that this rust disease in Pohnpei is a new occurrence or new host-pathogen combination.

2) ‘BUMPY’ LEAF SPOT. A second, “bumpy” leaf spot was associated with the yam variety ‘Kilimenip en Kokonep’ from Alohkapw (Figure 10). Leaves had small, raised “bumps” (2-4 mm diameter) on the adaxial leaf surface. These green (not necrotic), raised bumps (1-2 mm in height) corresponded with the presence of similar sunken areas on the abaxial leaf surface. Orange-colored fungal spores were abundant within these sunken areas, whereas few or no spores were observed in/on the raised bumps on the upper side of the leaf. Older, mature lesions of this “bumpy” type were blackened and dry. No other yam variety had this leaf spot symptom aside from ‘Kilimenip en Kokonep.’

Defoliation: Depending on the stage of disease and other factors, the observed defoliation attributable to this disease ranged from approximately 5 to nearly 100% for individual plants (Figure 11).

Petiole symptoms.

Petiole lesions. Petiole lesions were numerous, small (1-2 mm length), longitudinal, black spots, running parallel with petiole veins.

Stem symptoms (Figure 12).

Stem lesions. Stem lesions consisted of numerous, small (2-5 mm diameter) black spots, often coalescing into larger lesions.

Stem blight. As the numerous stem lesions coalesce, large blighted areas developed on stems. Stems often became completely necrotic and black.

Stem dieback. Severely blighted stems died back to the base of the plant.

Pathogen Signs.

Evidence (signs) of plant pathogenic fungi were observed on all foliar plant tissues in association with lesions and blighted areas.

Pathogen signs consisted of the presence of orange, erumpent, powdery masses of fungal spores (visible to the unaided eye) within leaf lesions on the adaxial and abaxial leaf surfaces, particularly in association with erumpent areas within lesions and along leaf veins on the abaxial leaf surface. These orange, powdery spore masses also were observed within longitudinal lesions on the yam stems.

Microscopic examination (100-400X) of leaf and stem lesions confirmed that masses of orange rust spores were embedded in the tissue within the erumpent lesions on both abaxial and adaxial leaf surfaces. These erumpent regions within yam foliage were confirmed to be rust uredia.

The uredia contained abundant urediospores. These spores were roughly globose and ornamented. Spermatia were observed (with pycniospores) on some leaves. Spores resembling rust teliospores and/or aeciospores were observed. Further study of the structures and spore morphologies is required to attain a genus and species identity for this rust fungus.

Dried samples of infected yam foliage were submitted to fungal specialists at CABI Bioscience in the United Kingdom for species identification. The yam rust was determined as *Goplana dioscoreae* (Chaconiaceae), based on *Trans. Brit. Mycol. Soc*. 24: 369, 1983. This was the first time CABI had observed stem symptoms associated with this pathogen. Although *Goplana dioscoreae* was reported to occur in Pohnpei previously, the disease caused by this pathogen has never been reported to be as severe as we observed in July, 2001. This suggests the possibility that a new race of this pathogen has developed in Pohnpei. Variation in symptom expression among yam varieties suggests that possible resistance mechanisms exist.

Yield Suppression.

Yield suppression was significant. Some farmers at some locations reported that there will be no yam harvest this year for some varieties as a result of this epidemic. For example, a farmer in the municipality of Madolenihmw reported that last year's yam harvest was 500 pounds, whereas this year he expects to harvest nothing. Similar scenarios were encountered throughout the course of sampling for this disease at various locations.

However, it was evident that as of July, 2001 the rust disease had not spread with great severity to some locations and/or was not affecting susceptible varieties equally among all locations examined. We were not able to determine the precise cause of the existence of susceptible varieties without severe disease. A number of possible explanations exist, such as disease escape and/or unfavorable environment for disease progression in those areas.

Disease Epidemiology.

The rust favored high or frequent rainfall and high relative humidity. Spread of the disease among yam plants (i.e., dispersal of urediospores) is favored by windy conditions required for significant spore dispersal.

Spores of rust fungi are dispersed within and among plants by wind, wind-blown rain and mists and by splashing or running water. Rusts are obligate pathogens, i.e., they require a living host for their metabolism and are not able to grow saprophytically on non-living plant matter or other carbon sources. Therefore, the life cycle of this rust fungus can only be completed on a living host plant. Some rust fungi have two different host plant genera or species in their life cycle. We do not know yet whether this rust fungus has an alternate host in its life cycle besides yam.

Disease Distribution.

We found that the yam rust disease was generally and widely distributed throughout the island of Pohnpei. However, disease severity among and within locations varied significantly.

In the municipality of Madolenihmw, most farms sampled had severe rust symptoms. Yams in and around Kolonia also showed very severe symptoms.

At some locations, varieties that are thought to be susceptible (e.g., ‘Kehp en Dol’) were found to be relatively free from disease, suggesting either disease “escape” or unfavorable microenvironment for disease initiation and spread.

Similarly, varieties thought resistant or tolerant (based on observations at one location) at some locations, showed some disease symptoms at other locations. Further study is needed to determine the potential for disease resistance among Pohnpei yam varieties.

Suggested Disease Control Measures.

(1) <u>Fungicide sprays</u>. This is not a very attractive or feasible alternative. Yams are grown almost exclusively using organic methods in Pohnpei, the use of chemical fungicides for disease control is discouraged, and the availability of fungicide products is very limited and prohibitively expensive for the average yam farmer. In addition, the practice of allowing yam vines to scale the heights of tall breadfruit trees makes fungicide sprays of yam foliage very difficult if not practically impossible.

(2) <u>Resistant or tolerant yam varieties</u>. Plant resistant varieties. Use resistant varieties in a mixture with susceptible varieties.

a) Yam varieties thought to be <u>susceptible</u> on Pohnpei (all Dioscoreae alata):

Kehp en Dol Yai (although not heavily diseased at some locations)
Kehp en Dol Pohnpei
Kilimenip en Kokonep
Peniou
Kipar
Unsouna

b) Potentially <u>resistant</u> yam varieties on Pohnpei:

Kilimenip Namuu Pwetepwet	(*Dioscoreae alata*)
Neir	(wild yam variety, *Dioscoreae nummularia*)

(3) <u>Humidity management</u>. Dry conditions are not favorable for infection and disease development, and pathogen dispersal. A number of options exist for reducing levels of relative humidity within and around yam canopies.

- *Weed control*. Tall weeds within and around yam plantings create high humidity in the yam plant canopy. Infection and disease favored by high humidity.

- *Cultivation method*. Select a cultivation method that increases distance among plants and allows adequate sunlight and air movement to reach the yam canopy.

- *Adequate soil drainage*. Continually wet soil in and around yam plantings creates high humidity through evaporation into the yam canopy. Improved soil drainage can result in lower levels of rust disease.

- *Wind and canopy management*. Clear unnecessary foliage of surrounding plants to allow fresh air circulation in the yam canopy. This will reduce humidity levels and allow for more rapid drying of leaf and stem surfaces.

(4) <u>Scattered plantings</u>. Disease spread within and among plants can be reduced by not planting large populations of susceptible yams in one area or location, or in one trellis.

(5) <u>Sanitation</u>. Sanitation involves the removal and destruction of diseased plant parts. This practice reduces the amount of airborne inocula (infective spores). Defoliated (symptomatic) yam leaves lying on the ground should be removed on a regular basis and either buried or burned to destroy viable spores in/on the leaves before they can be dispersed to susceptible plants.

(6) <u>Remote planting sites</u>. Remote planting sites have a lower probability of receiving “spore showers” from other farms.

(7) <u>Full-sun cultivation</u>. Cultivation of yams in full sun produces leaves and foliage that are less tender. In full sun, yam leaves tend to dry off rapidly after rains. Leaves that often remain wet for several hours are prone to rust infection and disease development.

(8) Elimination of alternate or non-economic hosts. It is possible that there is an alternate host in addition to yam in the life cycle of the rust fungus that causes this disease on yam. For example, while sampling wild yams on Sokehs ridge, an identical rust disease (the same symptoms and similar-appearing fungus spores and structures) was observed on an unidentified, viny climbing plant that resembles yam. The plant was identified as *Dioscorea bulbifera*, the "air potato" (Figure 13). Further testing and study are required to determine the identity of the rust fungus responsible for the disease symptoms on *D. bulbifera*.

(9) Biological control. A species of fungal-feeding mite was observed in most of the rust lesions, feeding on the rust urediospores. It is possible that large populations of this mite can or will afford some levels of disease control at present and in the future.

(10) Breeding for disease resistance. The possibility exists that susceptible and resistant yam varieties may be crossed to produce rust-resistant progeny with desirable agronomic properties (taste, color, appearance, yield, etc.).

The Pros and Cons of Yam Planting Methods in Relation to the Rust Disease.

Trellis planting method.

Pros: High potential yields in a small area; leaves are accessible to disease management activities.

Cons: High relative humidity ("incubation chamber" for disease); plants crowded together enhances disease occurrence and spread, poor soil drainage at lower elevations or in flat areas.

Forest understory (multistory) method

Pros: Better aeration for yam plant canopy in some locations, fewer plants per unit area (less plant crowding), adequate soil drainage at higher elevations

Cons: If forest canopy is very dense, high levels of rust disease may develop.

Recommended Future Research Needs and Priorities for Yam Rust in Pohnpei.

- Elucidate the life cycle of the pathogen (i.e., is the rust heteroecious? Is the rust macrocyclic? What, if any, is the alternate host?)

- Study the epidemiology of the disease and quantify the conditions that are favorable for infection, disease development and spore dispersal.

- Quantify the disease reaction (susceptibility vs resistance) for each of the major yam varieties in Pohnpei.

- Characterize disease resistance of resistant varieties (Figure 14; Figure 15).

- Correlate levels of disease with planting practices and locations.
- Quantify yield losses attributed to this disease.
- Evaluate disease control options.
- Establish a yam breeding program to incorporate disease resistance in the most popular yam varieties.
- Develop optimum cultivation methods that minimize rust occurrence and severity.
- Establish effective quarantine measures to reduce the probability of new yam disease entering Pohnpei.

ADDITIONAL YAM PEST RECORDED

An additional pest of yam was observed on nearly all yam varieties and on most yam leaves examined.

Symptoms: The abnormal symptom associated with this pest was black leaf veins at the leaf axil (the interface between petiole and leaf). Tiny black holes were observed in the petioles near the leaf axil (Figure 16).

Pest: Larvae of an unidentified stem-boring insect were observed in the small holes and in the necrotic veins.

Microscopic examination of the small holes on the leaf axil during the recent survey on insect pests of crops done in Pohnpei on August 14-21, 2001 with Dr. Nelson M. Esguerra (Entomologist/ Resource Person) showed no larvae at this time and contended that the hole could be that of a kind of insect 'piercing bug' that suck the sap (due to confined internal necrotic tissue inside the hole) and some kind of fly could have laid eggs (on the hole). Further study and monitoring is needed.

TOMATO DISEASE AT DOLONIER, NETT

Dr. Scot Nelson
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A severe tomato disease was reported at Dolonier, Nett.

Disease symptoms: Disease symptoms were plant wilting, leaf chlorosis and necrosis, unthrifty plant growth, defoliation, root rot and internal stem necrosis.

Disease signs: Copius bacterial streaming was observed from tomato stem samples submerged in water.

Diagnosis: Bacterial wilt of tomato, caused by *Ralstonia solanacearum* (syn. *Pseudomonas solanaceraum*).

Disease control measures: (1) resistant varieties or non-hosts; (2) improved soil drainage; (3) crop rotation (4) sanitation; (5) destruction of infested crop residues

CUCUMBER WILT DISEASE AT PALIKIR

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A severe cucumber disease was reported at a cucumber farm at Palikir.

Disease symptoms: Disease symptoms were plant wilting, leaf chlorosis and necrosis, unthrifty plant growth, defoliation, root rot and internal stem necrosis.

Disease signs: Sections of cucumber stems were placed aseptically on water agar and allowed to incubate at 22-29C for several days. A *Fusarium* sp. was recovered from these samples.

Diagnosis: Fusarium wilt of cucumber, caused by *Fusarium* sp.

Disease control measures: (1) resistant varieties or non-hosts; (2) improved soil drainage; (3) crop rotation (4) sanitation; (5) destruction of infested crop residues.

CUCUMBER LEAF SPOT DISEASE AT PALIKIR

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A severe cucumber leaf spot disease was reported at a cucumber farm at Palikir.

Disease symptoms: Brown leaf spots, approximately 3-6 mm diameter.

Disease signs: Microscopic examination of lesions revealed the presence of fungal structures of *Colletotrichum* sp.

Diagnosis: Anthracnose leaf spot.

Disease control measures: (1) humidity control (adequate aeration); (2) fungicide sprays; (3) sanitation (removal of severely diseased leaves); (4) intercropping with non-susceptible crops.

BREADFRUIT DISEASE AT MUNICIPALITY OF U

Dr. Scot Nelson
Dr. Flordeliza Javier

A severe breadfruit fruit disease was reported on a Samoan breadfruit variety at a farm in the municipality of U.

Disease symptoms: Symptoms were large (up to 4-5 cm diameter), brown, circular to oval lesions on fruit surface; discharge of white latex from lesions (Figure 17).

Disease signs: Microscopic examination (100X) of symptomatic tissue revealed the presence of abundant *Phytophthora* sp. sporangia and mycelium (*Phtyophthora* is a plant pathogenic pseudo-fungus).

Diagnosis: *Phytophthora* fruit rot.

Disease control measures: (1) resistant varieties or non-hosts; (2) improved soil drainage and air circulation; (3) sanitation; (5) destruction of infested crop residues.

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APPENDICES

Figure 1. Unthrifty, diseased and dying banana plants observed at Pohnlangas, Pohnpei in July 2001.

Figure 2. Necrotic, wilted banana plant at Pohnlangas, Pohnpei in July 2001.

Figure 3. Typical banana pseudostem necrosis (transverse section) at Pohnlangas, Pohnpei in July 2001.

Figure 4. Typical banana pseudostem necrosis (longitudinal section) at Pohnlangas, Pohnpei in July 2001.

Figure 5. Atypical internal banana pseudostem necrosis (transverse section) at Pohnlangas, Pohnpei in July 2001, resembling Panama wilt disease.

Figure 6. White mycelial growth of *Marasmiellus inoderma* within the external layers of the banana pseudostem (xylem) and at the base of pseudostem observed at Pohnlangas, Pohnpei in July 2001.

Figure 7. White to cream-colored fungal fruiting bodies of *Marasmiellus inoderma* adhering to outer layers of banana pseudostems observed at Pohnlangas, Pohnpei in July 2001.

Figure 8. Large, brown to black leaf spots with well defined to diffuse margins observed on yam in Pohnpei in July 2001.

Figure 9. Veinal necrosis of yam leaves associated with rust disease observed in Pohnpei in July 2001.

Figure 10. “Bumpy” leaf spot symptom associated with yam rust disease observed onthe yam variety ‘Kilimenip en Kokonep’ in Pohnpei in July 2001.

Figure 11. Significant defoliation due to yam rust disease in Pohnpei in July, 2001.

Figure 12. Severe stem symptoms associated with yam rust in Pohnpei during July, 2001. Stem symptoms are rare in association with *Goplana dioscoreae*.

Figure 13. *Dioscorea bulbifera* (the "air potato") found on Sokehs Ridge in July, 2001, showing rust symptoms. This plant is a possible alternate host for *Goplana diosoreae*, the fungal cause of yam rust disease in Pohnpei.

Figure 14. Stems of rust-free yam 'Kehp en dol en Wai' in Pohnpei suggesting possible disease resistance or immunity.

Figure 15. Leaves of rust-free yam 'Kehp en dol en Wai' in Pohnpei, suggesting possible disease resistance or immunity.

Figure 16. Leaf vein necrosis associate with possible insect pest in Pohnpei.

Figure 17. Breadfruit lesions caused by a *Phytopthora* sp. in Pohnpei in July 2001.

Acronyms

CABI - CAB International
CES - Cooperative Extension Office
CSREES - Cooperative States Research, Extension and Education Service
USDA - United States Department of Agriculture