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Towards management of *Musa* nematodes in Asia and the Pacific

Country reports presented during the training workshop on enhancing capacity for nematode management in small-scale banana cropping systems held at the Institute of Plant Breeding, University of the Philippines Los Baños, Laguna, Philippines, 1-5 December 2003

F.S. dela Cruz, Jr., I. Van den Bergh, D. De Waele, D.M. Hautea and A.B. Molina, editors

VVOB

The mission of the **International Network for the Improvement of Banana and Plantain** (INIBAP) is to sustainably increase the productivity of banana and plantain grown on smallholdings for domestic consumption and for local and export markets.

The programme has four specific objectives:

To organize and coordinate a global research effort on banana and plantain, aimed at the development, evaluation and dissemination of improved banana cultivars and at the conservation and use of *Musa* diversity.

To promote and strengthen collaboration and partnerships in banana-related activities at the national, regional and global levels.

To strengthen the ability of NARS to conduct research and development activities on bananas and plantains.

To coordinate, facilitate and support the production, collection and exchange of information and documentation related to banana and plantain.

INIBAP is a network of the International Plant Genetic Resources Institute (IPGRI), a Future Harvest center.

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Cover Photos: (counterclockwise starting from the top) a. participants of the training workshop; b. fruit-bearing banana plant; c. banana field in the Philippines, planted with different accessions; d. root and soil sample collection for nematode evaluation; e. (center photo) banana root necrosis.

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An overview of banana research and plant-parasitic nematode studies in the Federated States of Micronesia

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Introduction

The Federated States of Micronesia (FSM) is located at the northwest Pacific and is a relatively young independent nation. It was a part of the United Nations Trust Territory of the Pacific Islands (TTPI) administered by the United States of America until the two nations signed a Compact of Free Association in 1986, leading to the trusteeship termination by the United Nations in 1991. The Compact treaty established a special relationship with America that provides economic support to the FSM. The total landmass is 438 square miles (702 km^2 with a declared Exclusive Economic Zone (EEZ), covering over one million square miles). The FSM is comprised of 607 islands with land elevation ranging from sea level to the highest elevation of about 2500 feet (760 m). The archipelago lies in the western Pacific Ocean, north of the equator, between 1.0-9.9°N and 138.2-162.6°E.

Agriculture in the FSM

The rich and diverse agroforests and related traditional agricultural systems of the FSM have attracted the interest of scientists from around the world as possible models for sustainable agricultural development. Agricultural production in the FSM is primarily for subsistence, with some semi-commercial and commercial activities. The extensive man-made agroforests are complex and environmental sustainable agriculture systems are a result of thousands of years of development. They mimic natural forest ecosystems and shelter extremely high species/cultivar diversity. The cultivars of taro, yam, breadfruit, swamp and fruit trees such as banana, orange, tangerine, mango, lime etc. interspersed in an integrated system of shifting gardens and tree garden/taro patch systems.

Banana, taro, breadfruit and yams are the major staple food crops in the FSM, of which banana cultivation is significant for local consumption and export. There are over 50 cultivars including *Eumusa* and Fe'i bananas (Raynor and Fownes 1991). Similarly, the FSM is the

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world centre for swamp taro diversity (FSM 2002). Intercropping of bananas, taro and other tuber crops with coconut is more common in the island states of Kosrae, Pohnpei and Yap. While swamp taro and yam cultivation is chiefly for domestic consumption, FSM produced about 2300 metric tonnes of banana in 2000 (FAO 2001). The FSM exported dessert banana for US$ 455 628 in 1994 but then declined to US$ 154 317 in 1997 (FSM 1999). Production constraints (diseases and pests) and marketing problems are the reasons for the decline in export.

Research on bananas

Research on banana in the FSM is progressing in the following five directions:

1. tissue culture and genetic improvement
2. disease-resistance trials
3. introduction and performance evaluation of new cultivars
4. nutritional value of banana
5. germplasm conservation.

Following recommendations from the Asian Development Bank (ADB Report 1997), Kosrae State has invested about US$ 500 000 to develop an agribiotech laboratory, Micronesia Plant Propagation and Research Center (MPPRC). MPPRC has developed tissue-culture procedures for several locally grown cultivars of *Eumusa* and *Australimusa*. Results of field trials confirmed better rate of field establishment, faster growth and shorter pre-bearing period as advantages of tissue-culture bananas (Josekutty *et al*. 2001, 2002, 2003a, b, c, 2004; Josekutty and Nena 2002). Research is also underway to develop variant bananas resistant to fusarium wilt affecting cv. Saba. MPPRC also succeeded in introducing disease-indexed tissue cultures of cv. Macao from Guam, which is undergoing field trial in Kosrae. The College of Micronesia-FSM Land Grant program in Pohnpei has gathered a few improved and new banana varieties introduced by INIBAP which are now under field trials. Early results indicate that some of these cultivars are performing better in comparison with many local cultivars under Pohnpei conditions. Englberger (2001) analyzed several cultivars of banana for the nutritional value and some of them are reported to be high in precursor of vitamin A. MPPRC has also embarked on a drive for conserving banana germplasm *in situ*. Twenty-eight cultivars from Kosrae State have been documented and established in a conservation garden and the majority of them are also being multiplied *in vitro*.

Plant nematological studies

While surveying plant-parasitic nematode problems of several islands in the region, Bridge (1988) reported that nematology is in its infancy in the Pacific region. This is true for the FSM as well. Except for a report of burrowing nematode in swamp taro, no effort has ever been taken to survey or diagnose Micronesian soils. The small-scale farmers of this region, being unaware of the nature and harmfulness of nematode infestations in their fields, do not seriously consider the destructive effect of these pests on their crops. Agricultural research in the FSM is also in its infancy and has not focused on the circumstances and needs of the majority of small-scale farmers, particularly women farmers. With a notable exception of swamp taro, symptoms of nematode damage are unknown for other crops to assess the yield loss. Lack of trained work force is the reason behind the situation. In the FSM, a comprehensive survey is necessary in order to assess the damage caused by nematodes on economically important crop species.

Dry corm rot of swamp taro in Yap: a novel candidate for nematological research

Giant swamp taro (*Cyrtosperma merkusii* (Hassk) Schott) is the most popular root crop and had served the Micronesians for many centuries as a cultivated plant of status and great economic significance (Figure. 1). Its starchy corm is the principal food source, especially of Yapese, consumed several times a day all year long. Some of the yellow cultivars are good sources of vitamin A, thus making it an ideal crop for vitamin A-deficient island population.

The plants with corm rot show little or no above-ground symptoms. However, lesions and extensive loss of feeder roots are very common symptoms of pathogen attack.

Figure 1. Swamp taro patch.

Figure 2. Corm showing lesions.

Figure 3. Cross section of a corm showing symptoms of dry rot.

Figure 4. At an advanced stage, decay reaches center of the corm.

Lesions vary in size, from 1.0 to 3.0 cm in diameter and 0.5 to 3.0 cm deep (Figure 2). Beneath these tissues, a brown-black rot is shown, occasionally channeled deep into the corm (Figures. 3 and 4).

The first report of burrowing nematode, *Radopholus similis,* associated with dry corm-rot of swamp came from Yap (Jackson 1986). Later, Grandison (1990) studied the corm-rot disorder in samples collected from Yap and Palau and confirmed the presence of this ubiquitous pathogen. It is interesting, however, to note that a recent survey conducted by Kagoshima University in Japan revealed the presence of free-living Cephalobid nematodes, associated with infected corms of swamp taro and not burrowing nematodes (Onjo *et al*. 2001). The scientifically interesting aspect of this disorder is that we have a serious nematode pest of many tropical crops that grow in normal drained soils, but here it is infecting corms that grow in swampy areas. Nevertheless, there is little doubt that nematodes, either on their own or in combination with other pathogenic organisms, constitute an important constraint to agriculture of the FSM.

The burrowing nematode has a wide host range in the Pacific and is a major banana root pathogen. It was reported from Fiji, Guam, Niue, Norflok, Papua New Guinea, Palau, Samoa, Solomon Islands and Tonga (Bridge 1988; 1992; Bridge and Page 1984; Kirby *et al*. 1978). Although extensive studies have been carried out in islands like Fiji and Papua New Guinea (Bridge and Page 1984; Kirby *et al*. 1980; Orton Williams 1980), Micronesian islands remain unexplored by nematologists.

Susceptibility symptoms vary with cultivars. There are at least seven cultivars of swamp taro in Yap with varying symptoms of susceptibility. In Yap and many of its outer-lying islands, the extent of the problem is not fully realized by the local farmers and they call the disease '*ngal*', or termite damage, though they know termites are not the causal organism. During the survey, we found about 80–90% infestation, depending on the cultivars. Being the staple food crop, such severe infections may eventually affect food security of the island.

Future perspectives

Plant-parasitic nematodes are a severe constraint for the swamp taro cultivation in Micronesia. Although report of nematodes affecting banana and other crops in the FSM are non-existent, considering the traditional way of cultivation, it is reasonable to speculate that nematodes are a matter of concern for these crops as well. Research conducted so far revealed conflicting reports about the presence of burrowing nematode and free-living nematodes. An extensive study is therefore required to identify the host associations of plant-parasitic nematodes from the FSM. Equally important is the cultivar screening of major crops including banana and swamp taro to determine their susceptibility to nematodes and associated yield loss. Information on nematode diagnosis, biology, population dynamics and host-parasite relationships are an essential prerequisite for the future establishment of nematode control practices.

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