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"Social Homeostasis of Small Islands in an Island-zone"

SUSTAINING AGRICULTURAL PRODUCTION IN YAP: AN ASSESSMENT OF PEST INSECTS AND PLANT DISEASE

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Abstract

In a survey of Yap Island, we found that the ratio of broad-distributed pests is so high, more than 70%. Those pests, which were imported or invaded from other area, have a great opportunity to be prevalent on Yap, because of a "poor-enemy" environment brought about by the isolation of the small island. We also found damaged taro in many villages. The agent causing the damage was not a nematode, but was probably a root-rot disease.

Sustaining healthy agriculture, the Yapese need to make the most of advantages of traditional small-scale forest farming and strictly prevent inadvertent import of pests.

Key words: broad-distributed pests, isolation in small islands, taro, nematode, Yap

Pest Insects in Yap Island

Once upon a time most Yap proper people consumed mainly Taro, Yam, and Banana as chief starchy food resources, while today young Yapese tend to prefer rice, ramen noodle and bread to local foods. The Yap diet has changed for decades, as many new foods and crops are imported or cultivated. And with these new foods and crops in Yap, many pest insects have also been imported.

In general, islands contain fewer species than apparently comparable mainland areas. (BEGON et al, 1990). This trend is observed also in the insect fauna of Yap Island. During our survey, we found significantly fewer insects in Yap than in Japan. (In Japan we typically get more than 100 species of moths with light trapping in one night, for example, while in Yap we collected fewer than 50 species in a two weeks visit.) However, the ratio of broad-distributed insect species is higher in Yap than in Japan more than 70%. These broad-distributed species have been able to fly from other islands, or to invade by riding on crops imported over the last several decades. In the survey, we visited many farms in various villages of the island. Table 1 lists the pest species which were collected during our two weeks survey. A total of 23 pests found attacking crops is enumerated. Seventeen species of them are broad-distributed species (cosmopolitan, Asian-Pacific or invading from the Americas). According to the lists in NELSON et al. (1990) and NAFUS & SCHTEINER (1999), about 70 species of 91 known pest insects in Yap Island are broad-distributed species, which originated from another locality. Thus, over the last few decades many new pest insects have been invading and colonizing Yap, as transport of people, commodities and crops has increased, while Yap's defenses, the fauna of natural enemies and insects antagonistic to such pests, is poor because Yap is a such small island.

During our survey, we also researched the Yapese fauna of some natural pest insect enemies. We found only three species attacking pest insects (Table 2). We can infer that the list of natural enemies is poor, because it correlates with essentially poor insect fauna generally in

Table 1. Pests found in the integrated survey in Yap Island (from 20, October to 2 November, 1999)

Name of pest	Crops attacked	Distribution
Japanese grasshopper, *Oxya japonica* (THUNBERG)	Sugar cane	Asian-pacific
Migratory locust, *Locusta migratoria manilensis* (MEYEN)	Sugar cane	Pan-tropical
Orange cucumber beetle, *Aulacophora similis* (OLIVIER)	Cucurbits (cucumber, pumpkin etc.)	N. America & Pacific
Sweetpotato weevil, *Cylas formicarius* (FABRICIUS)	Sweet potato	Asian-pacific
Cowpea aphid, *Aphis craccivora* KOCH	Cow pea	Cosmopolitan
Cotton or melon aphid, *Aphis gossypii* GLOVER	Cucumber	Cosmopolitan
Taro leafhopper, *Tarophagus proserpina* KIRKALDY	Taro	Pacific
Diaspidid scale, Diaspididae Gen. sp.	Taro (mainly *Cyrtosmerma*)	-
Mealybug, *Pseudococcus macrocirulus* BEARDSLEY	Taro	Pacific
Striped mealybug, *Ferrisia virgata* (COCKERELL)	Cockscomb, cucurbits, solanaceous crops etc.	Pan-tropical
Black island stink bug, *Brachyplatys insularis* (RUCKES)	Cowpea	Asian-pacific
Leaf-footed plant bug, *Leptoglossus australis* (FABRICIUS)	Cucumber	Asian-pacific
Red stainer bug, * *Dysdercus cingulatus* (FABRICIUS)	Okura	Asian-pacific
Bean bag, *Riptortus clavatus* (THUNBERG)	Cowpea	Asian-pacific
Bagworm, Psyche sp.	Taro (mainly *Cyrtosmerma*) New to Yap Is.	-
Cosmopterigid moth, *Cosmopterix* sp. (leaf miner)	Sugar cane New to Yap Is.	-
Sweet Potato Leaf Miner, *Bedellia somnulentella* ZELLER	Sweet potato	Cosmopolitan
Gelechiid moth, Gelechiidae Gen. sp. (leaf miner)	Yam New to Yap Is.	-
Sweet potato hawk moth, *Agrius convolvuli* (LINNAEUS)	Sweet potato	Cosmopolitan
Rice cut worm, *Spodoptera litura* (FABRICIUS)	Chinese Cabbage	Asian-pacific
Lawn armyworm, *Spodoptera mauritia* GUENÉE	Corn	N. America & Pacific
Spotted bollworm, *Earsia vittella* (LINNAEUS)	Okra	Pan-tropical
Slug, *Eleutherocaulis alte*	Chinese Cabbage	Asian-pacific

* In NELSON et al. (1990), this species is misidentified as *Oxycarenus bicolor* FIEBER of Lygaeidae.

Table 2. Natural enemies found in the integrated survey in Yap Is. (20, October to 2 November, 1999)

Enemy insects	Host
hover fly (Syrphidae Gen. sp.)	*Aphis gossypii* on cucumber
brown lacewing (Hemerobiidae Gen. sp.)	*Aphis gossypii* on cucumber
Pteromarid wasp (Pteromaridae Gen. sp.)	Diaspidid scale on swamp taro

the environment of Yap Island. In such a “poor-enemy” environment, broad distributed invading pests have a great chance to prevail.

Do Nematodes Really Attack Ginat Swamp Taro in Yap?

Present day Yapese are beginning to have a better opinion of traditional local foods. However, we found giant swamp taro (*Cyrtosperma* sp.) frequently damaged by a disease, which poured cold water on such a better opinion. The symptoms were:-dwarfism, rotting roots and slow death of above ground parts. Infected plants were not densely concentrate, but were found in the most of patches we visited. Some informants told us that the disease might be caused by nematode attack, so we tried to isolate nematodes from swamp taro roots collected in various taro patches (Towoway village in Gilman, Runuw village in Fanif) by the Baerman funnel

method. The nematodes isolated were sent to the National Institute of Agro-Environmental Science, Japan, and were identified as a species of non-phytophagous free-living nematode belonging to the family Cephalobidae (Fig. 1). In general, the Cephalobid nematode is an inhabitant of soil with decaying plant material, and it apparently feeds on the products of decomposition, including associated bacteria and perhaps other microorganisms (THORNE, 1961). It was the only nematode species isolated. Consequently, we concluded that the agent damaging giant swamp taro in Yap was not this nematode, and then we should look for another agent.

The detailed symptoms we observed were developmental delay, plants stunted, and outer leaves wilting and dying prematurely on older established plants. Leaf symptoms included crinkled leaf blades, and remaining leaves slightly rolled or curled inwards. The roots of damaged plants had the following characteristcs: - decayed and healthy root tissue of root separated by a sharp boundary; nematodes contributing to the developing disease; only a fringe of healthy root remaining at the top of the corm as disease proceeded, and root interior transformed into a foul-smelling soft mass. These matched the characteristics of a kind of root rot disease caused by a fungus belonging to the genus *Phythium*. Giant swamp taro, however, is resistant to *Phythium* rot disease as far as we know (ADAP PROJECT, 1995). To precisely identify the agent of disease we need to collect additional samples of damaged taro root.

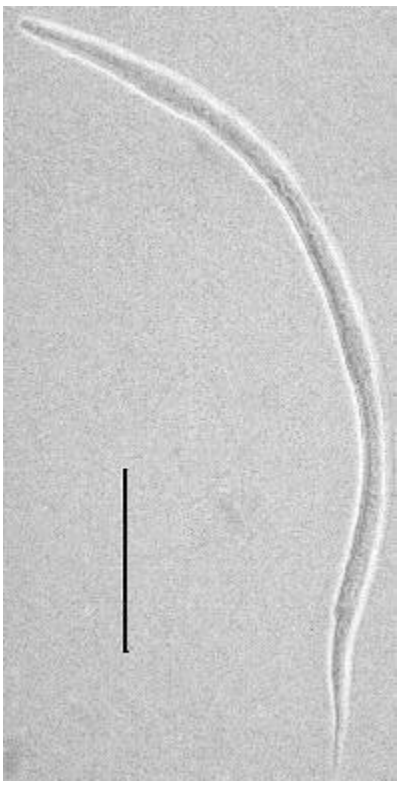

Fig.1. The Cephalobid nematode isolated from the root of giant swamp taro planted in Yap Island (scale: 0.1mm).

The Way to Sustain Healthy Agriculture in Yap

Agriculture in tropical islands generally was small-scaled farming originally. Such farms were located in forest, which could prevent rich soil from washing away and people planted traditional crops well fitted to small scale farming. The traditional way of farming in small-scaled forest patches sustained a complex web of ecosystems, that is, adaptable living-communities with numerous prey and numerous predators, and thus a high ability to restore ecological relationships even if they collapsed temporarily under pressure of invading prevalent pests. The forest buffer may also have prevented the invasion of prevalent pests such as the firewall. In present day Yap, some of the new crops originated in Temperate areas (other Asian countries and North America) and farming styles have gradually changed to those where people utilize large open fields. Such a farming style is economically efficient in a short-term view, but it is doubtful that it will continue being efficient in the long view. It tends to make the ecological web simple, and this must affect distinctly isolated islands like Yap which naturally have rather poor insect fauna. Consequently, there is a high possibility that intensely prevalent pests with cosmopolitan distribution will colonize and severely attack some of the new temperate crops.

The Division of Agriculture and Forestry in Yap State strongly restricts the import of chemical insecticides, because these chemical control agents have so many disadvantages: - danger to the user and to others, possible contamination of the farm, killing of beneficial insects, and increasing farm costs, for instance. To sustain healthy agriculture in Yap from the point of view of pest and disease controls, it is necessary to exploit the advantages of traditional small-scale farming in a forest location. These advantages include the possibility of usisng modern “IPM”, cultural and biological controls. But Yapese needs to strictly prevent pest invasion via the transporting of people, commodities and new crops into Yap.

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