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# Coconut Risk Management and Mitigation Manual for the Pacific Region

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# B. RISKS LINKED TO PESTS AND DISEASES

*By M. A. M. Gruber, R. Bourdeix, T. McKenzie and S. B. Woruba*

Pests and diseases are challenges for coconut production in almost all tropical countries. Small island developing states (SIDS) in the Pacific are extremely vulnerable to the impacts of invasive species, due to limited resources to combat pests and diseases.

Overall losses are difficult to estimate, but a striking example is the Coconut scale (*Aspidiotus rigidus*) in the Philippines, which has caused the deaths of around 65% of affected trees, with an average loss of about 60% of fruit yield. Regarding diseases, the situation in the Pacific region seems better than in most of the other tropical regions, mainly because of the low extent of phytoplasma diseases when compared to the African continent and the Americas, for instance. A major problem is a new biotype (strain: CRB-G) of the Coconut Rhinoceros Beetle (CRB), *Oryctes rhinoceros* L., which is not susceptible to the *Oryctes rhinoceros* NudiVirus isolate that is used as a classical biological control agent. The new biotype has destroyed thousands of coconut palms in Guam, in parts of the Solomon Islands, Papua New Guinea, Hawai'i and other places where it has spread to. The older biotype of *Oryctes rhinoceros* in the Pacific (CRB-S or CRB-P) seems also to have had a resurgence in some countries, perhaps due to a combination of senescent palms, cyclone damage creating breeding opportunities, coconut planting in locations where the NudiVirus is not present, and renewed interest in coconut cropping.

To help farmers control coconut pests and diseases, sources of knowledge and information have been developed at the national, regional and international levels. For national initiatives, relevant information is often available on the websites of Ministries of Agriculture, Forestry or Quarantine Services. Several initiatives are also being made at a regional level. In the framework of the project **Coconut Industry Development for the Pacific**, funded by the European Union, an **online Coconut Pests and Diseases** toolkit (CPDT: http://coconutpests.org) has been developed in order to aid in basic training for the management of coconut pests and diseases in the Pacific region. Much information presented in this manual comes from CPDT. The website has six main sections:

- **Coconut pests & diseases:** many of the more serious possible pests and diseases affecting coconut. Those causing more severe problems are described in more detail.
- **Identification**: assists to identify possible pests or diseases using the symptoms that are observed.
- **Prevention:** general approaches to prevention (biosecurity).
- **Diversity & resilience:** global change, its effects on coconut production, and ways to minimise these effects.
- **Learning & teaching:** resources for awareness and training
- **Getting help:** as well as the resources in the CPDT, technical experts, regional agencies and NGOs can aid.

CPDT strongly recommends an integrated pest management (IPM) approach to the control of all insects, where possible. This is a combination of methods (pesticides, physical controls such as site hygiene, pheromone trapping, and biological controls) to minimise the use of pesticides and the cost of control. In an agricultural context the Food and Agriculture Organization (FAO) defines IPM as 'the careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep pesticides and other interventions to levels that are economically justified and reduce or minimize risks to human health and the environment'. The goal of IPM is to keep pest populations to a level below which they cause economic harm through the synergistical use of the various management approaches.

Biological control (biocontrol) is often a preferable method of controlling pests such as insects, mites, weeds and plant diseases. Biocontrol of coconut pests is often achieved using predators, parasites, parasitoids, fungal and viral diseases. Biocontrol involves active management in selecting, releasing and maintaining populations of controlling organisms. Over 6000 introductions of more than 2000 insect biological control agents have been carried out worldwide to control insect pests, while over 2000 releases of more than 500 biological control agents have been made against invasive weeds. Biological control can have unintended impacts on biodiversity through attacks on non-target species by any of the same mechanisms. Some biocontrol introductions have gone on to become pests. One of the most dramatic is the cane toad initially introduced to control insects in sugarcane plantations. The main problem is the poisoning of many animals that eat the cane toad which has poison glands and toxic skin. Biological control can sometimes work too efficiently, as described in a famous case from Fiji. A former pest of the coconut palm, the endemic moth *Levuana iridescens*[7], seems extinct because of its biological control by an introduced fly (Bessa remota, see Plate 6). Many lessons have been learned in the best practice for biological control. A sound methodology for new programs of biological control is essential and should include scientists and quarantine officers, in agreement with local farmers.

Biological control has proven to be the most sustainable option to efficiently manage pests and

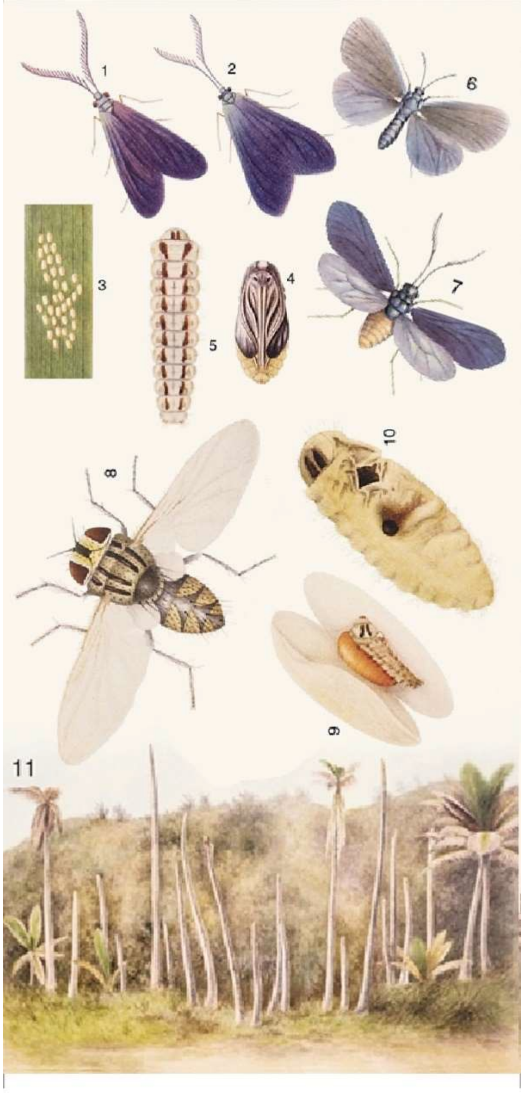


**Plate 6.** (1) L. iridescens, male, resting, (2) L. iridescens, female, resting, (3) L. iridescens egg cluster on coconut palm leaf, (4) L. iridescens, pupa, (5) L. iridescens, fifth instar larva, (6) H. dolens, wings spread, (7) L. iridescens, female, wings spread, (8) B. remota, adult, (9) cocoon of parasitized L. iridescens, opened to show dead larva of L. iridescens and pupa of B. remota, (10) larval corpse of L. iridescens with exit hole for B. remota, (11) death of coconut palms on Ovalau, after successive outbreaks of L. iridescens, prior to control by B. remota. (From Tothill et al. [1930]; paintings of insects by H.W. Simmonds; painting of shoreline by W.J. Belcher.)

[7]*Levuana iridescens* was first recorded as a serious coconut pest around 1877 from a single island, Viti Levu, in the Fijian archipelago. Earlier records on coconut production from 1846 and 1860 do not indicate a severe and widespread pest affecting palms (Simmonds, 1924).

diseases. Sometimes in cases of heavy infestation or epidemic expansion, biological control needs to be assisted using chemical methods (i.e., pesticides). However, establishing the threshold for economic injury levels needs to be established before this decision can be made for efficient and cost-effective management. Potentially it may be better sometimes to lose organic certification but avoid the complete destruction of plantation or harvest. In case of use of pesticides, it must be certain that the products do not contaminate the coconut water and kernel, and that they are fully safe for human and animal consumption. This may enable time for the crop to recover and return later with an improved biological control. A list of the main pesticides used in India is available from the 'References' section. Alternative pesticides may be available in the Pacific. Each Pacific country will have its own regulations on pesticides, and these must be consulted.

Plants have evolved a range of defences that can be actively expressed in response to damage from herbivores, pathogens and parasites at various scales, ranging from microscopic viruses to insect and mammalian herbivores. In any plant–insect and plant–pathogen interaction there is a continuum of possible outcomes, ranging from extreme susceptibility to complete resistance. For pests and disease mitigation, one of the less costly and time-consuming methods is to use resistant or tolerant varieties. This presupposes that consistent breeding programs are set up and succeeded to identify and diffuse such tolerant varieties. Sometimes networks and mutual aid between farmers can also help identify and obtain such varieties directly from farmers' fields.

Manipulating resistance to diseases like lethal yellowing is challenging because of the difficulty in effectively inducing diseases under controlled situations. However, there are many reports confirming genotype variability in resistance to most of the stress factors in coconut, with some varieties carrying exceptionally high level of resistance.

Even in the best case, resistance or tolerance to a pathogen is not likely to be permanent. Plants and animals have been involved in an 'arms race' for millions of years. Over time pathogens can naturally evolve mechanisms to overcome existing genetic tolerance or resistance. For annual crops, it seems that the resistance of a variety to a pathogen has, on average, a lifespan of only 10 to 15 years. After this delay, the variety may be no longer resistant because the pathogen has evolved.

We can extrapolate this situation to coconut. There is good reason to think that if, today, we plant a resistant palm, there is a high probability that 50 years later, before its natural death, this coconut palm will become sensitive to newly emerging forms of pathogens. Therefore, even if good and tolerant varieties are available, research to find the next good variety should never stop**.** This is the only way to mitigate the evolution of the pathogens.

It is also important to note that plant defences evolve over time and the most serious pests and diseases will likely be those that are recently introduced, as the plant has no natural immunity to those organisms. This is one reason why biosecurity is so critical in the Pacific region, which is still not affected by many pests and diseases of coconut, to prevent any potential incursion of exotic pests and diseases.

Biosecurity measures are crucial tools to mitigate pests and disease spread. With increasing global trade, the transportation of pests and diseases has also increased dramatically. The best-known examples are animal and/or human pathogens. However, the same situation also applies to the spread of plant diseases. Unintentional spread through global trade allows pests and diseases to colonise new areas over long distances. Novel areas offer new environmental conditions and novel and 'naive' hosts, enabling pest and pathogen attack. The natural enemies of pests are often absent in new areas away from the native range of pests; these natural enemies can be introduced after conducting a study to ensure that they will not upset the ecological balance.

Climate change may also be conducive to the establishment of pests and diseases in new environments (see related section in this manual). In addition to local quarantine, plant and animal health and biosecurity departments, in the Pacific regional agencies are mandated to assist with preventing (biosecurity and incursion response) and managing invasive species and pests and diseases in the Pacific. The most important of these agencies are the Pacific Community (SPC) and Secretariat of the Pacific Regional Environment Programme (SPREP). Raising community awareness of pests and diseases risks is useful in the prevention of accidental introduction of new threats or early detection and containment of any incursion.

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