A New Coconut Rhinoceros Beetle Biotype Threatens Coconut and Oil Palms in Southeast Asia and the Pacific

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The purpose of this white paper is to alert stakeholders to an emergent pest problem threatening coconut and oil palms in the Asia/Pacific regions and to recommend action to minimize economic, cultural, and ecological damage.

Background

The coconut rhinoceros beetle (CRB),Oryctes rhinoceros, is a major pest of coconut palm, oil palm and other palm species. Palms are damaged when adult beetles bore into the crowns of palms to feed on sap. Tree mortality occurs when beetles destroy the growing tip (meristem). Immature beetles (grubs) do no damage. They feed on dead, decaying vegetation in breeding sites. Preferred breeding sites are dead, standing coconut stems, and piles of decaying vegetation such those left behind by typhoons or after replanting of oil palm plantations. If a CRB population is not suppressed, it is possible for a positive feed-back cycle to initiate whereby adult beetles kill massive numbers of palms, thereby generating more food for even more grubs which turn into adults which kill even more palms. An outbreak following this scenario occurred in the Palau Islands during the late 1940s resulting in about 50% coconut palms being killed by CRB throughout the archipelago and 100% mortality on some of the smaller islands (Gressitt 1953).

Following 40 years of no geographical range expansion, CRB is "on the move" in the Pacific. CRB was recently detected for the first time at several Pacific Island locations including Saipan (2006), Guam (2007), Port Moresby, Papua New Guinea (2010), Oahu, Hawaii (2013), and Honiara, Solomon Islands (2015). Eradication of CRB is extremely difficult, having been achieved only once, on Niuatoputapu (Keppel) Island, an island with an area of only 16 km^2 belonging to the Kingdom of Tonga (Catley 1969). Failing eradication, the usual response to CRB infestations during the second half of the 20^{th} century was introduction of *Oryctes rhinoceros* nudivirus (OrNV), the biological control agent of choice for this pest (T. A. Jackson 2009). OrNV attacks only *Oryctes rhinoceros* beetles, typically reducing CRB damage by up to 90% with population suppression lasting indefinitely (Bedford 2013). OrNV is auto-disseminated, meaning the pathogen is carried between feeding and breeding sites by CRB adults. Like many biocontrol agents, OrNV is density-dependent, working best at high population densities. After release, OrNV has suppressed CRB populations to levels that result in only minor damage.

Current invasions of Pacific Islands by CRB involve a new invasive biotype that has escaped from biological control by OrNV (Marshall, Vaqalo, Moore, Quitugua, and T. Jackson 2015).

Discovery of *Oryctes rhinoceros* nudivirus in the 1960s enabled the successful management of populations in Pacific Island Countries (Huger 2005). Augmentative release of OrNV continues to be an important mechanism for CRB management in both coconut and oil palm growing regions. For 40 years after adoption of this biocontrol strategy, no new outbreaks of CRB were reported from uninfested palm growing islands in the Pacific ensuring continuity of palm based village economies.

However, the situation has recently changed. For the first time in 40 years, CRB invasion into completely new areas has been reported. Additionally, Pacific areas with established CRB populations (e.g. Palau) have reported increased severity and frequency of CRB damage. Common to all these areas is the high incidence of severe palm damage by beetles not seen since the introduction of OrNV.

Initial attempts to introduce OrNV into the Guam CRB population were unexpectedly unsuccessful, raising the possibility that the population that invaded Guam is tolerant or resistant to the commonly applied OrNV isolates. Subsequent DNA analysis showed that the Guam population is genetically different from other populations in the region. On the basis of distinct genetics and tolerance to currently available OrNV isolates, the Guam population has been designated a new biotype, CRB-Guam.

Recent analysis of DNA from an ongoing survey has detected CRB-Guam in Guam, Hawaii, Palau, Port Moresby (PNG) and Honiara (Solomon Islands). Thus, current inva-

sions in the Pacific involve the CRB-Guam biotype and it is expected that these populations are tolerant to all available isolates of OrNV.

Worst Case Scenario

Uncontrolled infestations of CRB may kill most palms within a few years. A worse case scenario may be triggered by a massive outbreak of adult CRB emerging from abundant breeding sites made by large amounts of decaying vegetation left in the wake of a typhoon (such as Typhoon Dolphin which visited Guam in May, 2015). Very high feeding activity will kill mature coconut palms, leaving standing dead coconut trunks that are ideal breeding sites for subsequent generations of beetles. During a CRB outbreak, there will be an increased risk of further spread to uninfested islands throughout the Pacific.

Palms are important on Pacific Islands for various reasons: as a cash crop for nuts, oil and lumber, as an ornamental tree appreciated by residents and tourists. On some of the smaller, more traditional islands the coconut palm is referred to as *the tree of life*. Here, this species is an essential natural resource providing income, housing, food, oil, soap, clothing, mats, baskets, and other containers. The smaller, poorer Pacific islands will suffer the most if the spread of CRB-Guam cannot be controlled.

Recommendations

A coordinated regional collaboration should be organized and adequately staffed and funded to accomplish 3 objectives:

1. Survey CRB populations throughout the Asian/Pacific region to delimit the geographical distribution of CRB-Guam and identify its centre of origin.

2. Survey CRB-Guam populations from the centre of origin to find isolate(s) of OrNV (or other pathogens) that are highly pathogenic for the CRB-G biotype.

3. *In vivo* or *in vitro* propagation of selected OrNV isolates for auto-dissemination on islands infested with CRB-Guam.

It is estimated that these objectives will take four years to accomplish, with an annual cost of $1M U.S.

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