

Biological Control of CRB-G

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Abstract

Please provide an abstract of your suggestion, of no more than 500 words (or approximately 3,000 characters).

Technical Approach

Background

The population of coconut rhinoceros beetles (CRB) recently established on Guam is genetically distinct from other populations of this major palm pest and it is being referred to as the CRB-G biotype (Marshall 2015; Sean David Goldie Marshall et al. 2015; Marshall et al. 2017; Sean D G Marshall et al. 2015; Vaqalo et al. 2015; Marshall, Sean, Moore, Aubrey, and Vaqalo, Maclean 2016). CRB-G is resistant to *Oryctes* nudivirus (OrNV), which is the major biocontrol agent for CRB, and it appears to have other characteristics, which make it more invasive and harder to control than other CRB biotypes. While there were no range expansions of CRB for a quarter of a century (1980 to 2005), CRB is now on the move with the invasion of Guam in 2007, the Port Moresby area of Papua New Guinea in 2009, Oahu, Hawaii in 2013, and the Honiara area of Guadalcanal, Solomon Islands in 2015. It is significant that all of these new invasions involve CRB-G. Thus, CRB-G is a regional problem, with Guam currently experiencing massive mortality of coconut palms as the result of a CRB population explosion triggered by abundant larval breeding sites left in the wake of a recent typhoon.

The overall objective of this project is to stop an uncontrolled outbreak of CRB-G on Guam which is rapidly killing coconut and other palms. Entomologists working on this problem agree that the most feasible solution is establishment of biological control using an isolate of OrNV which is highly pathogenic to CRB-G.

Financial assistance will facilitate:

1. continued support of an international collaborative project with the goal of discovering a strain of OrNV or other microbial biocontrol agent which

is highly pathogenic for CRB- Guam

2. continued support for a graduate research assistant at the University of Guam
3. continued support for operating an insect pathology laboratory at the University of Guam to evaluate candidate biocontrol agents discovered during foreign exploration
4. support for a semiannual island-wide coconut palm health survey for Guam

Items 1, 2 and 3 are currently supported by my FY2016 Farm Bill (performance period: August 1, 2016 through July 30, 2017). Item 4, which establishes a semiannual coconut palm tree health survey, is a new activity.

This project is aligned with FB goal 6: Enhance Mitigation and Rapid Response.

Objective 1: Find an OrNV Isolate which is Highly Pathogenic for CRB-G

Regional Collaboration on CRB-G Management Moore will continue to work with collaborators at AgResearch New Zealand and the Secretariat of the Pacific Community (SPC) to put together a regional collaboration with the objective of finding an effective biocontrol agent for CRB-G.

Foreign Exploration for an Effective Biocontrol Agent for CRB-G During January, 2017, Moore, Iriarte and Marshall did field work on Negros Island, Philippines, where CRB-G coexists with other CRB biotypes. The major objective was to find an effective biocontrol agent for CRB-G and a secondary objective was to develop and test protocols for further foreign exploration. DNA analysis of CRB and OrNV from rhino beetle gut samples collected during the trip is being done by Dr. Sean Marshall in his lab at AgResearch New Zealand. Bioassays of any detected OrNV will be done at the University of Guam. Further foreign exploration for an effective biocontrol agent for CRB-G is contingent on results from this first expedition.

Objective 2: Establish Sustainable Biocontrol of CRB-G by Autodissemination

Objective 3: Establish a Sustainable Coconut Palm Health Monitoring System

The CRB-G outbreak on Guam is currently unmonitored on an island-wide basis. An island-wide pheromone trapping system, using about 1500 traps, was operated by the University of Guam from 2008 to 2014. This monitoring system was transferred to the Guam Department of Agriculture which abandoned the effort at the end of February, 2016. Currently, many coconut palms are being

killed by CRB-G. But, in the absence of a monitoring system, we do not have an estimate of tree mortality or whether or not the damage is increasing or decreasing.

Clearly, establishment of a monitoring system is necessary if we want to evaluate success of the proposed biocontrol project, or any other mitigation efforts. We intend to establish a semiannual coconut tree health survey rather than re-establish pheromone trapping.

4.1 Survey Method [DANGER]

The Coconut Palm Health Survey will use the following methodology to track changes in levels of damage caused by CRB-G.

- The survey will monitor at least 1,000 palms located throughout the island. An aluminum tag with a unique identifier will be affixed to each palm on the initial visit.
- The free smart phone app, EpiCollect+ will be used to georeference each palm, record a digital image, and record damage data. (We have successfully used this free app for several localized palm health surveys.)
- The survey will be performed twice per year.
- CRB damage will be recorded in 3 boolean data fields:
- Mortality: 1 if palm is dead; 0 otherwise
- New damage: 1 if any of the 4 youngest fronds have V-shaped cuts; 0 otherwise
- Old damage: 1 if any other fronds have V-shaped cuts; 0 otherwise

4.2 Digital Image Analysis

We propose to add a methods development component to the survey. CRB damage symptoms in the form of V-shaped cuts in fronds are distinctive and easy to see in digital images. Digital imagery has been used for detection and monitoring of CRB. For example, Solomon Sar in Papua New Guinea has developed a Rapid Damage Assessment System in which geotagged images of palms are rated for damage severity. It may be possible to automate detection and monitoring of CRB damage by training a computer to detect V-shaped cuts in digital images of coconut palms. We will test this idea using human classified image libraries as training sets. If successful, we will program a Raspberry Pi 3 equipped with a camera to detect and quantify CRB damage in real time. This small, inexpensive CRB damage detector could be mounted on a drone or a conventional vehicle for automated detection and monitoring of CRB and damage caused by this pest.

Timeline

Impacts and Benefits

- Foreign exploration leading to discovery of a highly pathogenic strain of OrNV or other microbial biocontrol agent for CRB-Guam could lead to implementation of self sustaining population suppression and tolerable damage levels on Guam and other islands invaded by CRB-G.
- Loss of 50% or more of Guam’s palms may be prevented if an effective biocontrol agent is found and released quickly.
- Reduction in CRB population levels on Guam will reduce the risk of accidental of the highly invasive CRB-Guam biotype to other Pacific islands and elsewhere.
- Development of image analysis methods may lead to a small, inexpensive, automated CRB damage detector which could be mounted on a drone or a conventional vehicle. This device could be used for early detection or monitoring of CRB damage.

Prior Experience

Upload accomplishment report.

Budget

Upload budget request.

References

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