

Report of the

**EXPERT CONSULTATION ON COCONUT BEETLE
OUTBREAK IN APPPC MEMBER COUNTRIES**

26-27 October 2004, Bangkok, Thailand



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For copies write to:

Piao Yongfan
FAO Regional Office for Asia and the Pacific
Maliwan Mansion
39 Phra Atit Road
Bangkok 10200
THAILAND
Tel: (+66) 2 697 4000
Fax: (+66) 2 697 4445
E-mail: yongfan.piao@fao.org

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Executive summary

The expert consultation was held in Bangkok from 26 to 27 October 2004 under the auspices of the FAO Regional Office for Asia and the Pacific. It was attended by 17 representatives from 11 countries, namely Cambodia, China, Indonesia, Lao PDR, Malaysia, Maldives, Myanmar, Pakistan, Sri Lanka, Thailand and Viet Nam. An international consultant from Fiji joined FAO technical officers to facilitate the expert consultation.

In his address to the participants of the expert consultation, He Changchui, the Assistant Director-General (ADG) and Regional Representative of FAO, reminded participants that in the past classical biological control of coconut pests were successful and, indeed, this ecologically sound approach to pest management is particularly important as FAO has designated 2004 as the Year of Biodiversity for Food Security.

Mr Liebregts described the achievements to date with classical biological control of *Brontispa longissima*. In some countries, the use of chemical insecticides was initiated but did not stop the outbreaks and the problem continued to spread. However, experiences in Viet Nam and the Maldives have shown that biological control works. The Viet Nam project has shown a return on investment of US\$3 000 for every dollar invested in biological control.

Mr Ooi discussed the need to educate coconut farmers about Integrated Pest Management (IPM). Two examples of managing coconut pests were described and the need for developing a strong base for biological control was recommended. The outbreaks of *B. longissima* should help national programmes commit investment in developing capacity to face the challenges of managing invasive species.

B. longissima is reported in Cambodia, China, Lao PDR, Maldives, Myanmar, Thailand and Viet Nam. Sri Lanka, India, Bangladesh, Malaysia, Philippines and possibly some other Pacific Island countries are threatened. Indonesia is the centre of origin and will be a valuable source of additional natural enemies.

The participants discussed guidelines for introduction of beneficial organisms and also endorsed a set of recommendations that focused on:

- developing a regional programme to build national capacity to tackle invasive species;
- enhancing synergy of cooperation and catalysing sustainable use of natural resources through a regional programme;
- individual countries continuing to enhance their capacity to conduct classical biological control and cooperate with neighbouring countries;
- guidelines for safe and responsible introduction, production and release of biological control agents.

Participants visited the laboratory of the Department of Agriculture, Thailand to witness the rearing of parasitoids of *B. longissima*.

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I. Introduction

The expert consultation was held in Bangkok from 26 to 27 October 2004 under the auspices of the FAO Regional Office for Asia and the Pacific. It was attended by 17 representatives from 11 countries, namely Cambodia, China, Indonesia, Lao PDR, Malaysia, Maldives, Myanmar, Pakistan, Sri Lanka, Thailand and Viet Nam. An international consultant from Fiji joined FAO technical officers to facilitate the expert consultation.

The meeting was declared opened by He Changchui, Assistant Director-General (ADG) and Regional Representative for Asia and the Pacific. In his address, he pointed out that the main objective of the consultation was to exchange experiences and lessons learned among member countries of the Asia-Pacific Plant Protection Commission (APPPC) that are facing or may face coconut beetle outbreaks. It is important for countries affected or at risk of incursion to work together and FAO stands ready to facilitate the cooperation and provide technical assistance to build capacity to tackle this invasive insect.

In addressing the outbreaks, it is often unsustainable to rely on chemical insecticides. One successful approach in the past was to introduce effective biological control agents that attacked only the coconut beetle. This ecologically sound approach does little harm to the environment and helps restore the balance that contributes to sustaining a sound coconut ecosystem. The biological control approach is particularly important as FAO has designated 2004 as the Year of Biodiversity for Food Security. In this aspect, FAO has put forth specific guidelines to ensure successful and specific action of introduced species to control invader pests.

The ADG expressed confidence that the discussion would galvanize the member countries to work together proactively within a regional programme to prepare for the possible invasion of other pests and on other crops too. FAO has been successful in developing the IPM Farmer Field School (FFS) approach to help farmers manage their agro-ecosystem. This outbreak presents a unique opportunity for the member countries to recommit their agricultural development towards farmer education to sustain rural development and reduce poverty.

II. Presentations by resource persons

Impact and control of the coconut hispine beetle, *Brontispa longissima* gestro (Coleoptera: Chrysomelidae) by Wilco Liebrechts

Brontispa longissima is one of the most serious pests of coconut in Asia and the Pacific. Recent estimates from Viet Nam indicate that, if left untreated, damage to the coconut industry there would have been in excess of one billion US\$ over a 30-year period. *Brontispa* can be successfully brought under sustainable, environment-friendly

control by classical biological control, as shown in Samoa and other Pacific Island countries. FAO is supporting TCP projects in Viet Nam, Nauru and Maldives, which have seen the collection of the parasitoid *Asecodes hispinarum* from Samoa and its subsequent introduction in these countries. Initial surveys have confirmed the establishment of the parasitoid in Viet Nam and Maldives, where observations show that damage to young emerging leaves is reduced. The Viet Nam project has shown a return on investment of US\$3 000 for every dollar invested by FAO in this project.

The pest has continued to spread in Southeast Asia, and is now found in different climate zones, where the effectiveness of *A. hispinarum* may be reduced. In this view, it is highly desirable to seek and identify additional species of natural enemies for study and selection to complement biocontrol efforts in the region. Such efforts should be accompanied by a revision of the genus *Brontispa* and of other relevant hispinae since confusion has arisen in the region on the presence of other coconut pests which show similarities in appearance and damage symptoms to coconut in the region.

Integrated Pest Management (IPM) of key coconut pests by Peter A.C. Ooi

Integrated Pest Management (IPM) concerns farmer education that empowers farmers to become more effective managers and decision-makers. The focus is about IPM by farmers and not IPM for farmers! In IPM, biological control and ecological principles are the founding principles. Through Farmer Field Schools (FFS), farmers develop skills in critical and informed decision-making. Experiences with IPM for the rhinoceros beetle and the coconut leaf moth demonstrated the need to educate farmers in IPM principles to sustain good coconut management practices. Farmers can learn to avoid disruption of biological control when they understand the ecological basis of pest outbreaks.

Besides *Brontispa longissima*, two other hispinae beetles occur in the region and, indeed, *Promecotheca cumingii* may pose a serious threat to the coconut industry in areas where it does not yet occur. *Artona catoxantha* has the same ability to invade new areas and may cause outbreaks at the level currently caused by *B. longissima* and perhaps even worse. Lessons learned from the classical biological control of *B. longissima* point to the synergy of sharing information, experiences and beneficial agents between countries in the region. FAO can catalyze this through activities, such as this expert consultation. It is hoped that success in the biological control of *B. longissima* will encourage national programmes to enhance their capacity to face pest outbreaks and conduct classical biological control.

As invasive species transcend boundaries, it stands to reason that the sharing of information, especially through a regional entity such as FAO's Asia-Pacific Plant Protection Commission (APPPC) will greatly benefit the task of managing new pest situations. In this respect, a regional programme will allow countries in the region to enhance the readiness of national programmes to meet the challenges of invasive species and its control by introduced specific natural enemies. It is hoped that this expert consultation will discuss the possibility of setting up regional collaboration to address this important aspect of capacity enhancement. This is critical in the light of the outbreak of *B. longissima* and the possibility of new pests coming from within the region as well as from outside the region. For example, the coconut mite from Africa has already arrived in Sri Lanka and is spreading. The threat of the palm miner,

Coelanomenodera sp. from Africa to the oil palm is of concern to the region in the light of expanded air travel between continents. This is also true of pests from the region moving around, for example *Rhynchophorus* sp. invading the Middle East.

III. Summary of country reports

Cambodia

Brontispa longissima invaded Cambodia around 2001. Of the total 12.3 million coconut trees, 1.95 million trees or 16 percent were killed by *B. longissima*, 7.2 million trees or 58 percent were attacked. Due to lack of information about this invasive species, the country mounted an extensive chemical control campaign, incurring much expense but with negligible results. The representative at the meeting indicated the need for sustainable management of *B. longissima* in Cambodia.

China

The coconut leaf beetle was found in Hainan, Guangdong and Taiwan provinces, but the worse affected areas are in Hainan province.

In Hainan province, 11 species of host palm trees such as *Cocos nucifera*, *Areca catechu*, *Archontophoenix alexandrae*, *Roystonea regia*, *Washingtonia filifera*, *Hyophorbe lagenicaulis*, *Washingtonia robusta*, *Liviston chinensis* and *Chrysalidocarpus lutescens* were recorded. The major host plant is *Cocos nucifer*. Dry periods favour the development of *Brontispa* populations. The long distance spread is aided by human activities.

Two biological agents, *Asecodes hispinarum* and *Metarhizium anisopliae*, are being intensively tested to manage this pest and promising results have been reported. Larger releases, especially of *A. hispinarum*, are being planned together with arrangements for monitoring its impact.

Indonesia

Brontispa longissima is one of the major pests in several provinces of Indonesia. There are three potential natural enemies for controlling *B. longissima*, namely: pupal parasitoid (*Tetrastichus brontispa*), entomopathogenic fungi (*Metarhizium anisopliae* var. *anisopliae* and *Beauveria bassiana*). *T. brontispa* has an important role as pupal parasitoid both under laboratory and field conditions. Percent parasitism of pupa under laboratory and field conditions ranged from 76.7 to 87.0 percent and 35.71 to 73.56 percent, respectively. Pathogenicity of *M. anisopliae* var. *anisopliae* and *B. bassiana* were examined under laboratory and field conditions. The results showed that these fungi could infect both larvae and adults of *B. longissima*.

Lao PDR

Brontispa longissima was reported in Lao PDR from 2001. A survey showed that six villages in two provinces are faced with damage from the coconut beetles. These included Namthon village in the Pakkading district of Bolikamxay province and the villages of Novilay, Vangboangtai, Vangboangnuua, Fouang and Nabo in the Sepon district of Savannaket province.

With support from FAO, national plant protection staff are learning to rear *Brontispa* parasitoid in Viet Nam and will benefit from the experiences of classical biological control there. *A. hispinarum* will be released soon.

Malaysia

Coconut leaf-eating beetles, particularly *Plesispa reichei*, have become important pests in Malaysia. Frequent and sporadic infestations of *P. reichei* beetle have been reported on the coconut and ornamental palms throughout the country. As this pest was relatively unknown previously, little was known about its biology and ecology and effective control measures. More collaborative efforts among affected countries are required to develop effective short and long term control measures of this pest.

Maldives

It is most probable that the *Brontispa* infestation originated from adult or immature stages of the pest that were concealed in ornamental palms imported in 1999 from nurseries in Malaysia and Indonesia, as *Brontispa* is believed to be endemic to the Indonesian and Papua New Guinean region.

A survey confirmed that the beetle had spread from the known distribution range (Fenfushi, Tholhufushi, Nalaguraidhoo, Dhiffushi, Maamigili and Ariyadhoo) to islands further eastwards (Dhidhdhoo, Dhidhoofinolu and Dhigurah). The extent of infestation on Dhidhdhoo village indicated that the beetle had been present there at least for one year. Few infested palms were found on Dhidhoofinolhu and Dhigurah and it appears that the beetle reached the island at a later stage.

As in Cambodia, insecticides were recommended prior to introduction of biological control agents. While this measure afforded some relief, these were both expensive, polluting and provided only short term control of the pest. The parasitoid *A. hispinarum* was imported to the Maldives from Viet Nam. It was transferred to a semi quarantine laboratory at Sun Island resort for quarantine, mass rearing and field release to all infected islands of the Maldives. About 230 000 parasitoids have been released. Following its initial release in February 2004, the larval parasitoid *Asecodes hispinarum* now appears established on Sun Island. Parasitoid establishment on the inhabited islands of Maamigili and Fenfushi appears more difficult, despite the release of large numbers of adult parasitoids and mummies on both islands.

Myanmar

Brontispa longissima is a serious pest of coconut palms and it had been known to occur in Myanmar since early 2004. Plant protection teams of two states and four divisions have been assigned to conduct the specific survey for *Brontispa* with available support. There is an urgent need to build national capacity to address the problem of invasive pests to ensure sustainable development.

Sri Lanka

P. reichei is a minor coconut pest and *B. longissima* is not yet reported in Sri Lanka.

Thailand

Brontispa represents a threat to the coconut industry of the southern and central parts of Thailand with US\$30 million production and 50 000 smallholder farmers. It is also a threat to the tourist industry of Koh Samui and Koh Pa-ngan.

Damage caused by *Brontispa* was first recorded in Narathiwat province, the border area near Malaysia, in 2000. Heavy infestation was first reported in February 2004 in southern provinces including Surat Thani (Samui Island and Pa-ngan Island) and Prachuap Khiri Khan.

It is reported that the total areas hit by the coconut beetle outbreaks amounted to 7 229 hectares.

Both the Department of Agriculture (DoA) and Department of Agricultural Extension (DoAE) are rearing *Asecodes hispinarum* from a shipment received from Viet Nam on 25 August 2004.

Other biological control agents are being reared by DoAE but, based on the results from Viet Nam, it would be more appropriate to educate farmers about the positive impact of *A. hispinarum*. Other biological control agents will be useful to educate farmers about biological control.

Viet Nam

Brontispa longissima was first detected in the Mekong Delta region in 1999. Despite extensive use of chemical insecticides to control this pest, the beetle spread and incurred losses estimated at US\$17.8 million to the coconut industry by 2002. Indeed, the cost of insecticide use was estimated at US\$722 323. These were not only expensive, they caused much damage to the environment and further exacerbated the problem of the *Brontispa* outbreak. The beetle continued to spread to new areas.

With the support of FAO, *A. hispinarum* was introduced from Western Samoa in June 2003 and these were reared under quarantine conditions and later released into the field in August 2003. By 2004, the parasitoid was released and became established in 15 provinces in South and Central Viet Nam. The parasitoids spread at the rate of 5-8 km in two months and, within four months, 60-90 percent recovery of palms was observed.

A quick economic analysis covering a time frame of 30 years puts a return of US\$3 000 for every dollar invested. It is concluded that classical biological control of *Brontispa longissima* can be quickly, effectively and sustainably controlled by the introduction and releases of *Asecodes hispinarum*. However, this means that there is an urgent need to enhance the capability of national programmes in the areas of quarantine, biological control and IPM. In this respect, every country has to adhere to the guidelines contained in the International Standards for Phytosanitary Measures (ISPM) #2 and #3¹. It is necessary that countries in the region strengthen their capability in addressing this issue of invasive species and ways and means to resolve them through sustainable methods that protect the biodiversity and ensure poverty reduction.

¹ International Standards for Phytosanitary Measures (ISPM) #2 and #3 can be found in this report as Annexes 8 and 9.

IV. Recommendations

Coconut plays a major role in the economies of many countries in the Asia and Pacific region directly by providing food and income from coconut products, and indirectly as an important component of the landscape where tourism plays a key role in the economy.

The expert consultation notes with great concern that these economies are threatened due to a serious outbreak of coconut chrysomelid hispine beetle, *Brontispa longissima*, that has spread to new areas at a rapid pace in the region. This invasive species demonstrates the need for strengthening the technical information base, quarantine and IPM capabilities within countries in the region.

The traditional pest management approach and strategy based on insecticide use has not been able to stop the spread and the damage continues unabated. Experiences from countries in the Pacific that were invaded years earlier as well as information from the country of origin of the insect demonstrates that the insect can be quickly, effectively and sustainably contained using classical biological control.

And whereas the paucity of knowledge of classical biological control is of concern and considering that the capacity of the countries in the region is substantially very low in dealing with the problem individually, the expert consultation recommends the following common strategies for the sustainable management of the coconut chrysomelid hispine beetle in the Asia-Pacific region:

1. Adopt a regional approach to develop a programme of coconut beetle management for the Asia-Pacific with FAO providing a coordinating forum to enable the experiences of the individual member countries, as well as neighbouring non-member countries, to plan and strengthen an ecologically sound IPM programme for the palm industry (including coconut). To further this objective, it is imperative that FAO, the Asian and Pacific Coconut Community, donor communities (including the Common Fund for Commodities) and member countries of the Asia-Pacific Plant Protection Commission work together to develop a comprehensive programme to ensure that the coconut industry will continue to be a symbol of a tropical agro-biodiversity haven that mirrors sustainable development for poverty alleviation through farmer education using an FFS approach.
2. It is duly noted by the meeting that a regional programme will speed up classical biological control implementation, reduce the cost of controlling the outbreak and enhance sustainability through optimizing resources, sharing of experiences and knowledge, avoiding pitfalls, exchanging biological control agents and promoting a better understanding between countries in Asia and Pacific.
3. The meeting further recommends that individual countries should strengthen their own database of crop pests and natural enemies, conduct independent impact assessments to facilitate an enabling environment for both biological control and IPM and further strengthen the regulatory framework of plant quarantine and pesticide management with concurrent activities for enhancing the capacity of extension staff.

4. The meeting appreciates the discussion on the rearing techniques for the biological control agent of *Brontispa longissima* and confirms compliance with the guidelines of the ISPM #2 and #3 and the guidelines for the rearing and release of *Asecodes hispinarum*. The need for greater awareness by the public and participation of farmers in classical biological control is highlighted. The meeting further concurs with the need to study the ecology of both insects to ascertain the impact of this biological control effort in each country, and that the results be incorporated in an overall regional IPM programme that may follow.

Opening address
by
He Changchui
Assistant Director-General and Regional Representative
for Asia and the Pacific

Chairperson

Distinguished experts and FAO colleagues:

On behalf of the Director-General of the Food and Agriculture Organization of the United Nations (FAO), Jacques Diouf, and on my own behalf, I have the honour and pleasure to welcome you to Bangkok for the expert consultation on the control of coconut beetle outbreak in APPPC member countries. I am delighted that as many as 17 representatives from 11 countries, namely Cambodia, China, Indonesia, Lao PDR, Malaysia, Maldives, Myanmar, Pakistan, Sri Lanka, Thailand and Viet Nam. An international expert from Fiji and FAO technical officers are participating in this important consultation.

The main objective of this consultation is to exchange experiences and lessons learned among the APPPC member countries that are facing the outbreak.

Coconut is an important source of food, fuel and wood for people living in the tropics. In recent times, with increased global travels, swaying coconut palms symbolizes exotic holidays and indeed tourism is a very important source of income for many tropical countries. However, the beautiful coconut palm is now under threat from an invasive pest that has moved from its centre of origin in Indonesia to other parts of the tropics and sub-tropics where it did not exist before. In its native country, this insect is often under natural biological control. When it spreads to another country, usually this insect arrives without its natural enemies and is able to multiply in large numbers unchecked. Besides reducing production or often killing palms, insect pests could possibly affect tourism as such symbols that foreign tourists seek are destroyed.

The insect that is of much concern is the coconut beetle that has spread to several countries, including Thailand. Such an introduction has affected the livelihood of people who depend on their livelihood on agriculture and tourism. Often, it is unsustainable to rely on chemical insecticides to reach the pest especially when tall palms are involved. In the past, whenever the coconut beetle arrived in a new country in the Pacific, the populations were successfully controlled by introducing effective parasitic insects that kill the pest. This ecologically sound approach does little harm to the environment and helps restore the balance that makes coconut a part of the ecosystem. In the last three years, the coconut beetle is on the march again and this is probably due to the frequent air travels between countries. Despite plant quarantine measures, invasive pests do get into the countries undetected. When this happens, it is important for the countries affected or will be affected to work together. In this respect, FAO stands ready to facilitate this cooperation and provide technical assistance to build capacity to tackle this invasive insect.

This approach is particularly important, for FAO has designated 2004 as the year of Biodiversity for Sustainable Development. This ecologically sound approach fits very well in the theme for protection of biodiversity, especially agro-biodiversity. FAO recognizes the problems of invasive species and indeed, in a biological control approach, we have put forth specific guidelines to ensure successful and specific action of introduced species to control the invader pest. The FAO looks forward to the concurrence from member countries to implement this code of conduct for importation of beneficial organisms. I am delighted to learn that as part of this expert consultation, the participants from all 11 APPPC countries will discuss this code of conduct. To enhance effective plant quarantine that will support successful introduction of beneficial organisms, FAO places much interest into the capacity building of expertise to handle classical biological control.

In the past, this coconut beetle has been successfully controlled by introduction of biological control agents that attack only the coconut beetle. Successful biological control has been reported from Solomon Islands, French Polynesia and Micronesia. In the Asian region, success appears to be in sight in Viet Nam and the experiences in Viet Nam will be shared with participants from other countries in today's expert consultation. I note that in this consultation, there is an element of Technical Cooperation between Developing Countries (TCDC) that Viet Nam is helping Lao PDR and Thailand in the biological control of this coconut beetle underlines the importance of working together and FAO is pleased to provide the umbrella for such collaboration.

Dear participants, I hope that this expert consultation is not focused only on the biological control of just this one pest. Indeed, I am confident that this experience will galvanize the member countries to consider working in a regional programme to prepare for the possible invasion of other pests and on other crops too. FAO has been successful in developing the IPM Farmer Field School (FFS) approach to help farmers manage their agro-ecosystem and this outbreak presents a unique opportunity for countries to recommit their agricultural development towards farmer education to sustain rural development and reduce poverty. In this respect, it is hoped that the consultation will come out with recommendations that will assist in a regional activity that will safeguard member countries from sudden and devastating invasion of pests.

I wish you a successful meeting and I look forward to the proceedings of the expert consultation.

Thank you.

List of participants

Hean Vanhan
Chief
Plant Protection and Phytosanitary Office (PPPSO)
Ministry of Agriculture, Forestry and Fisheries (MAFF)
#14, Monireth Street, Toul Svay Prey II
Chamkar Mon
Phnom Penh

Cambodia

Tel: (+855) 23218494
Mobile: (+855) 12818216
Fax: (+855) 23216655
E-mail: vanhan@mobitel.com.kh

Fu Yueguan
Environment and Plant Protection Research Institute
Chinese Academy of Tropical Agricultural Sciences
Dangzhou City
Hainan province 571737

China

Tel: (+86) 898 23300352, 138 07552781
Fax: (+86) 898 23304892
E-mail: fygcata@163.com

Xiong Yankun
Agronomist
National Agro-Technical Extension and Service Centre
730 Building 20, Maizidian Street, Chaoyang district
Beijing 100026

China

Tel: (+86) 10 64194524
Fax: (+86) 10 64194726
E-mail: xyk@agri.gov.cn

Wilco Liebrechts
Managing Director
P.O. Box 5406, Raiwaqa P.O.
Suva

Fiji

Tel/Fax: (+679) 3322607
E-mail: ecoconsult@connect.com.fj

Meldy L.A. Hosang
Senior Researcher
Indonesian Coconut and Other Palmae Research Institute
P.O. Box 1004 Manado 95001

Indonesia

Tel: (+62) 0431 812430, 0431 811426
Fax: (+62) 0431 812017
E-mail: meldyhosang@yahoo.com

Ir. H. Riyaldi, MM
Director of Estate Crop Protection
Directorate General of Estate Crop Protection
Kanpus Departemen Pertanian Gedung C
Jalan Harsono RM 3, Ragunan
Jakarta Selatan

Indonesia

Tel/Fax: (+021) 7815684
E-mail: riyaldi05@yahoo.com

Ir. Elvina Irawati, MM
Estate Crop Protection
Kanpus Departemen Pertanian Gedung C
Jalan Harsono RM No. 3
Ragunan
Jakarta, Selatan 12550

Indonesia

Tel: (+021) 7815684
Fax: (+021) 7815684
E-mail: elvina@deptn.go.id

Vilaysouk Khennavong
Director of Plant Protection Centre
Department of Agriculture
Ministry of Agriculture and Forestry
P.O. Box 811
Vientiane

Lao PDR

Tel: (+856-21) 812024, 812164
Fax: (+856-21) 413949
E-mail: doag@laotel.com

Mat Hassan Othman
Assistant Director
Crop Protection and Quarantine Division
Department of Agriculture
Kuala Lumpur

Malaysia

Tel: (+603) 26977130
Fax: (+603) 26977205
E-mail: mathassan@pqdoa.moa.my

Aminath Shafia
Director
Ministry of Fisheries, Agriculture and Marine Resources
Ghazee Building
Male'

Maldives

Tel: (+960) 336830
Fax: (+960) 326558
E-mail: aminath.shafia@fishagri.gov.mv

Kyu Kyu Swe Tin
Deputy Supervisor
Myanmar Agriculture Service
Ministry of Agriculture and Irrigation
Yangon

Myanmar

E-mail: ppmas.moai@mptmail.net.mm

Iftikhar Ahmad
Deputy Director General/National IPM Coordinator
National IPM Programme
National Agricultural Research Centre (PARC)
P.O. Box 1031
Islamabad

Pakistan

Tel: (+92-51) 9255043, 9255063
Fax: (+92-51) 9255036, 9244034
E-mail: iftahmad@isb.paknet.com.pk
Iftikhar102@hotmail.com

M.A.K. Wijesinghe
Research Officer
RARDC, Department of Agriculture
Makandura
Gonawila (NWP)

Sri Lanka

Tel: (+00 94) 31 2299625
Fax: (+00 94) 31 2299707
E-mail: avanthiwije@yahoo.com

Chalerm Sindhusake
Senior Entomologist
Plant Protection Research and Development Office
Department of Agriculture (DoA)
Phaholyothin Road
Chatuchak
Bangkok 10900

Thailand

Tel: (+662) 9405651
Fax: (+662) 9405650
E-mail: chalerm@asiaaccess.net.th

Amporn Winothai
Senior Entomologist
Biological Control Section
Entomology and Zoology Research Group
Plant Protection Research and Development Office
Department of Agriculture (DoA)
Chatuchak
Bangkok 10900

Thailand

Tel: (+662) 5797580 ext. 135
Fax: (+662) 9406895
Mobile: (+661) 9150615
E-mail: amporn@doa.go.th
winotai@yahoo.com

Patcharee Menakanit
Director of Pest Management Division
Bureau of Agricultural Product Quality Development
Department of Agricultural Extension (DoAE)
Bangkok 10900

Thailand

Tel: (+662) 9428541, 5790280
E-mail: patcharee@doae.go.th
mena@inet.co.th

Areepan Upanisakorn
Pest Management Division
Bureau of Agriculture Product Quality Development
Department of Agricultural Extension (DoAE)
Bangkok 10900

Thailand

Tel: (+662) 5795178
Fax: (+662) 5790280
E-mail: biology03@doae.go.th
Areepan03@yahoo.com

Varee Charuenpol
Pest Management Division
Bureau of Agriculture Product Quality Development
Department of Agricultural Extension (DoAE)
Bangkok 10900

Thailand

Tel: (+662) 5795178
Fax: (+662) 5790280
E-mail: agri02mab@yahoo.com

Tran Tan Viet
Vice Chairman of Plant Protection Department
Deputy Dean of Faculty of Agronomy
Nong Lam University
Linh Trung Ward, Thu Duc District
Ho Chi Minh City

Viet Nam

Tel: (+848) 7220259
Fax: (+848) 8960713
E-mail: trantanviet@hcm.vnn.vn

FAO Regional Office for Asia and the Pacific

Piao Yongfan
Plant Protection Officer
FAO Regional Office for Asia and the Pacific
Maliwan Mansion
39 Phra Atit Road
Bangkok 10200

Thailand

Tel: (+662) 6974268
Fax: (+662) 6974445
E-mail: Yongfan.piao@fao.org

Peter Ooi
Chief Technical Adviser
Integrated Pest Management for Cotton in Asia
FAO Regional Office for Asia and the Pacific
Maliwan Mansion
39 Phra Atit Road
Bangkok 10200

Thailand

Tel: (+662) 6974102
Fax: (+662) 6974402
E-mail: Peter.Ooi@fao.org

Gerd Walter-Echols
Cotton IPM Environmental Impact Analysis Specialist
Integrated Pest Management for Cotton in Asia
FAO Regional Office for Asia and the Pacific
Maliwan Mansion
39 Phra Atit Road
Bangkok 10200

Thailand

Tel: (+662) 6974101
Fax: (+662) 6974402
E-mail: Gerd.walterechols@fao.org

Prapin Lalitpat
Senior Administrative Assistant
Integrated Pest Management for Cotton in Asia
FAO Regional Office for Asia and the Pacific
Maliwan Mansion
39 Phra Atit Road
Bangkok 10200

Thailand

Tel: (+662) 6974162
Fax: (+662) 6974402
E-mail: Prapin.lalitpat@fao.org

Chris Brown
FAO consultant
Forest Policy and Information
FAO Regional Office for Asia and the Pacific
Maliwan Mansion
39 Phra Atit Road
Bangkok 10200

Thailand

Tel: (+662) 6974000
Fax: (+662) 6974445
E-mail: Chris.Brown@fao.org

Timetable and Agenda

Tuesday 26 October 2004

08.30-09.15 hours	Registration
1. Opening session	
09.15-09.30 hours	Opening address He Changchui, ADG/RR
2. Resource persons presentation	
09.30-10.00 hours	Biological Control of <i>Brontispa</i> by Wilco J.M.M. Liebregts
10.00-10.30 hours	IPM of coconut pests by Peter A.C. Ooi
10.30-11.00 hours	Coffee break
3. Country report on <i>Brontispa</i> outbreak and management	
11.00-11.15 hours	Cambodia
11.15-11.30 hours	China
11.30-11.45 hours	Indonesia
11.45-12.00 hours	Lao PDR
12.00-12.15 hours	Malaysia
12.15-12.30 hours	Maldives
12.30-14.00 hours	Lunch
14.00-14.15 hours	Myanmar
14.15-14.30 hours	Sri Lanka
14.30-14.45 hours	Thailand
14.45-15.15 hours	Viet Nam
15.15-15.45 hours	Coffee break
4. Working session	
15.45-17.00 hours	Discussion on identifying guidelines for biological control of <i>Brontispa</i> and recommendations
17.00-18.30 hours	Discussion on strategy for coconut <i>Chrysomelid</i> beetle management and recommendations

Wednesday 27 October 2004

5. Reading, discussion and adoption of recommendations

08.30-09.15 hours	Reading of recommendations
09.15-10.30 hours	Discussion of recommendations
10.30-11.00 hours	Coffee break and revision of final recommendations
11.00-11.30 hours	Adoption of recommendations
11.30-12.30 hours	Lunch
12.30-18.00 hours	Visit to the laboratory for rearing parasitoids of <i>Brontispa</i> , the Department of Agriculture

Technical papers and presentations

**Impact and control of the coconut hispine beetle,
Brontispa longissima Gestro (Coleoptera: Chrysomelidae)***

Wilco Liebrechts** and Keith Chapman***

**Figure 1: *Brontispa* damaged coconut palm in southern Viet Nam****Abstract**

The coconut hispine beetle, *Brontispa longissima* Gestro (Coleoptera: Chrysomelidae) is one of the most damaging pests of coconut and a range of ornamental palm species. Both larvae and adults of the beetle feed on tissues of developing, unopened leaves of the trees. The beetle can cause significant production losses, and high infestation levels may result in tree death. With assistance from FAO, the natural enemy *Asecodes hispinarum*, a larval parasitoid, has been collected in Samoa and introduced into affected countries in Southeast Asia and the Pacific to act as a biological control agent. The parasitoid has become established in Maldives and Viet Nam, and initial results indicate that pest populations and damage levels are declining.

* Parts of this paper were presented during the XLI coco technical meeting and coconut festival, 5 to 9 July 2004, Santo, Vanuatu, Asia and Pacific Coconut Community, Jakarta, and subsequently published in the report of the meeting.

** Biological Control Specialist, Eco-Consult Pacific, P.O. Box 5406, Raiwaqa PO, Suva, Fiji Islands; e-mail: ecoconsult@connect.com.fj

*** Plant Production Officer (Industrial Crops), FAO Regional Office for Asia and the Pacific, Maliwan Mansion, 39 Phra Atit Road, Bangkok 10200, Thailand; e-mail: keith.chapman@fao.org

Introduction

The coconut hispine beetle, *Brontispa longissima* Gestro (Coleoptera: Chrysomelidae) is one of the potentially most serious pests of coconut palms. Both larvae and adults of the beetle inhabit the developing, unopened leaves of the coconut palm where they feed on leaf tissues. Where an attack is severe, complete defoliation of the palms may result. Prolonged attack, particularly to palms that are young or suffering from poor growing conditions, may result in death of the tree. With other palms productivity is severely affected by sub-lethal attacks.

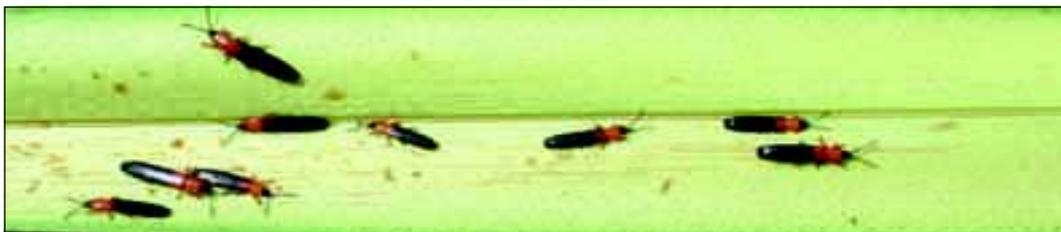


Figure 2: *Brontispa* adults on young coconut leaf

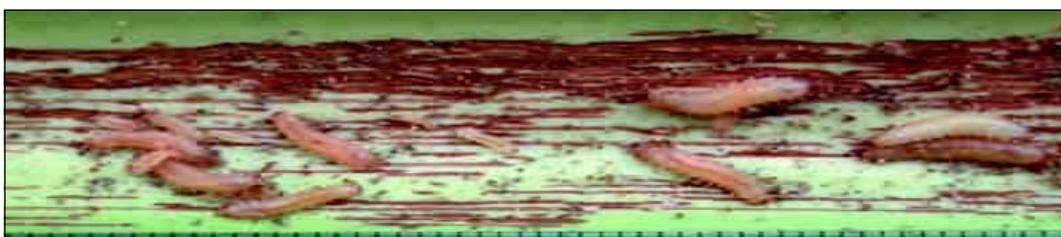


Figure 3: *Brontispa* larvae and feeding damage on coconut leaf

Brontispa longissima is believed to be endemic to Indonesia and possibly also to Malaysia, Papua New Guinea and the Solomon Islands. In the twentieth century the beetle was accidentally introduced in several other countries in Southeast Asia and the Pacific, and as a result has now become widespread there. The pest however was not recorded from continental Southeast Asian countries until the late 1990s when it was first detected in the Mekong Delta in Viet Nam.

Specialists suspect that this species was introduced into southern Viet Nam in shipments of ornamental palms. The pest spread rapidly northward and westward, causing significant losses to the coconut industry. The introduction of the beetle in Hainan Island in southern China, is believed to have occurred in a similar way with a shipment of ornamentals from the mainland or from Taiwan province. At around the same time, the pest was introduced into the Maldives. The pest was first noticed in Thailand in February 2004, and a few months later in Lao PDR and Myanmar. Singapore has also reported damage by the pest, but it is unclear if this is a new incursion. Although the pest has not yet been recorded from Cambodia, it is highly likely that the pest has reached these countries as well.

Importance of the coconut industry in recently affected countries

There are about 173 000 hectares of coconut grown in Viet Nam, that directly support about 70 000 families. Coconut is an important source of income for many households. Depending on the product, additional household incomes from the production of high-value products ranges from US\$1-2.33 per person per day, US\$34.50-62.10 per person per month, or US\$42.20-55.25 per household per month. This income, in addition to the income from the coconut endosperm (kernel), can lift the coconut growing family above the poverty line. Since coconut oil is used domestically as cooking oil and as a raw material for oleochemicals, and the fiber and shell products are exported, coconut reduces vegetable oil imports and generates foreign exchange. Thus, loss of coconut palms may have serious macroeconomic and environmental impacts, as well as a microeconomic impact at the level of smallholder households as all family members get involved in producing the many coconut derived products.

Thailand's coconut industry consists almost exclusively of smallholders with just over 50 000 farmers involved; most of these farmers have an area of about 2.5 ha of palms. Yields are low at around 6.6 MT per hectare and incomes are low as the price per kg is only about TB 8. The total area under coconut is estimated at 328 000 hectares which produces about 1 146 million nuts or about 344 000 MT in copra equivalent, representing a total value of TB 902.16 million domestically and with exports of TB 512 330 million (TB 41 = US\$ 1). The crop not only provides an important contribution to the economy and livelihoods of thousands of small holders, but provides a very significant land cover for poor coastal soil areas, and is a major feature of the country's tourist industry.

In Hainan province, China, the pest seriously affects coconut farmers, but also the rapidly developing tourism industry. In support of that industry, the island province has commenced a beautification campaign which includes the planting of coconuts and many ornamental species in cities and along major roads. Most of these palms have been affected by the beetle. In an attempt to control the pest and prevent it from spreading, host plants have been removed from a zone of 2 km around infested areas. In these areas, broad spectrum insecticides are applied to the crown, and sometimes injected in the trunk, but this appears to have had little effect in preventing further spread of the pest.

In the Maldives and Nauru, the coconut is perhaps the single most important plant and crop, as on these resource-poor atolls it is truly the 'tree of life', as it provides food, timber, and housing materials to the islanders. In the former, the tree is the most significant to the all-important tourist industry, which accounts for a large proportion of GDP.

Taxonomy

Species belonging to the genus *Brontispa* are mainly found in Southeast Asia and the western and northern Pacific. A number of species have been described, although several revisions of the genus have seen a considerable reduction in the number of species. The latest major revision of the subfamily *Hispinae*, to which the genus *Brontispa* belongs, was in 1957 and no further studies on the taxonomy of the genus *Brontispa* have been implemented since. The sudden and rapid spread of the pest into Southeast Asia, and the fact that there is considerable intra specific variation in

colour patterns within the species *B. longissima*, has caused confusion among plant protection specialists in the region, and now urgently warrants a revision of the genus *Brontispa*.

Impact of the pest in Southeast Asia and the Pacific

In 2001, a few years after its incursion into southern Viet Nam, surveys estimated that *Brontispa* affected some one million coconut palms in 150 000 ha of coconut in all 21 southern provinces. The beetle since advanced rapidly into the central provinces and in August 2002 was distributed over 30 provinces, where it infested an estimated six million coconut palms over a much larger area. Survey reports suggest that damage can be serious but that it varies among provinces, with the most severe damage recorded in Ben Tre province. It is now considered that some ten million trees are affected, and that the pest has reached the northern provinces, including the capital Hanoi.

In the Maldives, an archipelago of some 1 000 islands south of India, the pest was first noticed in December 1999 on Sun Island resort on the island of Nalaguraidhoo in south Ari Atoll. It is likely that the introduction of the pest occurred with the importation in 1999 of ornamental palm trees from nurseries in Indonesia and Malaysia when developing the resort. The pest has since spread to nine nearby islands in the atoll, and was recently (April 2004) discovered at Hulhule Island, near Male. An eradication campaign is underway, and there are indications that it may be successful.

In Thailand the beetle was first reported from the southern provinces Prachuap Khiri Kan, Surat Thani in February 2004. Surveys showed that the pest was present in the southern provinces of Chumphon, Songkhla, Narathiwat and Pattani, as well as Bangkok. It is probable that the pest originated from Malaysia, and not from Viet Nam. The pest incursion shows considerable similarities with the one that occurred in Viet Nam, indicating that it will spread over the mainland and eventually to nearby islands.

In the Pacific, no further incursions of *Brontispa* occurred in the years following its establishment in (Western) Samoa in the early 1980s, until the beetle was detected in Nauru in April 2001. A brief survey suggested that the main infested areas were around the Buada lagoon, Ijuw, Anabar, Anabare and Yaren districts, where a considerable number of coconut palms showed heavy damage by the beetle.

The significant risk of the pest spreading to nearby countries such as India, Sri Lanka, Myanmar, Bangladesh is of major concern. These countries are at considerable risk, since the beetle will not be stopped at land borders: only natural barriers such as oceans and mountain ranges may halt the natural dispersal. For these countries, which have significant coconut industries, the pest incursion would be catastrophic. Quick action will see not only the reduction of damage levels, but also a slower rate of dispersal of the pest. Moreover, the natural enemies, once established, will follow



Figure 4: *Brontispa* damage on young leaves
(Photo credit: Tran Tan Viet)

any further outward migration of the beetle, thus reducing the need for continuing releases in areas newly infested by the pest.

Control measures

With no viable alternative methods available, Viet Nam embarked on a massive campaign whereby the use of chemical pesticides was subsidized in an attempt to control the beetle outbreak and reduce its rate of spread. This campaign, and those implemented by provincial governments in the Mekong Delta already cost some US\$300 000 by the end of 2002. In addition, it is estimated that farmers have spent a similar amount in pest control measures. That year, subsidy levels reached an estimated US\$0.33 per coconut tree. With the invasion of the central provinces, the impact becomes even more serious as coconut palms are not cultivated intensively there, and farmers are much poorer than their southern colleagues, and are not able to pay for any chemical protection of their trees.

In the Maldives, management of Sun Island resort in June 2000 commenced a control programme that involved application of insecticides to the crown as well as stem injection of infested trees. In addition, seedlings were removed and destroyed on all islands. Estimates of direct economic losses between June 2000 and February 2003 amount to US\$237 350 – for labour and insecticide application costs. In addition, losses in revenue from coconut sales, and coconut purchases for ‘welcome’ drinks for resort guests were estimated at US\$32 800. The control programme, however, could not prevent the spread of the pest to nine neighbouring islands, and there continues to be a serious risk of further spread of the pest to other islands in Ari Atoll, and to other atolls in the country.

The use of pesticides in coconuts raises serious concerns about the health risks of the farmers, families and consumers. Coconuts generally sell for a low price, and pesticide application to trees for coconut beetle control is particularly hazardous. The trees are tall; applicators must climb up to the crown, and workers ask a high price for this dangerous task. They typically work without protective clothing, and are exposed to pesticide through the skin and via inhalation as they struggle to keep their balance while spraying beetle larvae in folded young leaves. Moreover, coconut plantations are often situated near homes, so that detrimental effects on the health and environment of households, fish ponds gardens and domestic animals due to pesticide exposure must be seriously considered.

Biological control

Complete control of *B. longissima* with high cost/benefit ratios has been achieved in several countries by importing and establishing parasitoids that attack immature stages of the pest. These successful locations include various Pacific and East and Southeast Asian countries. Known egg parasitoids include *Haeckeliana brontispa* Ferriere and *Trichogrammatoidea nana* Zehntner (Hymenoptera: Trichogrammatidae), and *Ooencyrtus* sp. (Hymenoptera: Encyrtidae). Several parasitoids in the wasp family Eulophidae attack the larval and/or pupal stages of *Brontispa*, including the larval parasitoid *Asecodes* sp. and the pupal parasitoid *Tetrastichus brontispa* Ferriere. A strain of the entomopathogenic green muscardine fungus *Metarhizium anisopliae* was isolated from *B. longissima* in China and formulated as a bioinsecticide. The fungus was also used in the 1980s in Samoa to control the pest on young coconut



Figure 5: The parasitoid *Asecodes hispinarum*

(Photo credit: Tran Tan Viet)



Figure 6: *Asecodes* parasitising *Brontispa* larva

(Photo credit: Tran Tan Viet)

seedlings in the field and in nurseries, but its application to larger, established trees was problematic and unfeasible.

FAO assistance

On request of the individual countries, the Food and Agriculture Organization of the United Nations (FAO) provided assistance to help developing control strategies of the pest in the affected countries. Bilateral Technical Cooperation Projects (TCP) to a value of more than US\$650 000 are currently underway in Viet Nam (2003-2005), Maldives (2003-2005) and Nauru (2003-2004). Similar project proposals have been prepared for Thailand and PR China; a fast-track TCP was approved for the former in October 2004. Furthermore, technical assistance has been provided to Sri Lanka to increase awareness of this important pest. All projects seek to establish sustainable control of *Brontispa* through the development of an IPM programme based on classical biological control. For most countries, a public awareness campaign on the pest and the risk of it spreading further is also part of the project.

The larval parasitoid *Asecodes hispinarum* was collected in Samoa in 2003 and introduced, reared and released in Viet Nam, the Maldives and Nauru to combat the beetle. Although the parasitoid is established in the two former countries with promising prospects for achieving control of the beetle there, it is yet too early to determine its success in reducing beetle populations to sub-economic damage levels, as pest-parasitoid interactions and population dynamics fluctuate considerably in the first few years following introduction of the natural enemy. The effectiveness of the parasitoid is likely to be affected by environmental conditions, particularly in the various climate zones, and its impact on the pest may vary accordingly. In view of this, FAO recognizes the need for additional natural enemies to strengthen the biological control programme, and is seeking support for the implementation of exploratory surveys in Indonesia, Papua New Guinea and the Solomon Islands. The project also includes a taxonomic revision of the genus *Brontispa*.

Preliminary results

Results from Viet Nam confirm the establishment of the parasitoid in those provinces where it was released, and observations at and near release sites indicate that beetle damage has reduced considerably. It is expected that damage levels will be reduced to levels similar to those seen in Samoa, where *Brontispa* damaged palms are quite uncommon. Surveys have shown that the dispersal rate of the parasitoid from the release sites is some 5-8 km per two months.

In the Maldives and Nauru, field establishment of the parasitoid was confirmed after two and five months after initial field releases in February and November, respectively, but further recovery of the beneficials in Nauru has so far been irregular. In both countries, no significant reduction of damage has yet been observed that could be attributed to the impact of the parasitoid, although the newly emerging leaves appear to show less damage.

In Viet Nam, a recent study on the costs and benefits of the biological control programme has tentatively concluded, that by mid 2002, 9.4 million trees were infected by *Brontispa*. Up to mid 2004, the pest infestation has caused 30 percent fruit production loss, the death of 5 percent of trees (at an estimated cost of US\$23.8 million), and has damaged 13 000 ornamental palms (at an estimated cost of US\$838 000). The cost for pesticides applications amounted to approximately US\$715 000, which was borne by the federal and provincial governments. This does not take into account the expenses and labour costs borne by the farmers and volunteers involved in the control programme. Overall, the cost of the FAO TCP Project (US\$350 000) is very small in comparison with the losses caused by the pest. Using a unit price of US\$0.10 per coconut (including husk), a tentative analysis of economical data points at a return of one billion dollars over a 30-year period, or a return US\$2 000-3 000 for every dollar invested in the project. With prices currently near the US\$0.50 mark, these returns have increased five-fold. Taking into account that much of the groundwork for the collection, identification, rearing and importation of *A. hispinarum* was done under the FAO-Viet Nam TCP, the cost-benefits are many times higher when taking into account the coconut industries for other Southeast Asian countries.

Integrated Pest Management (IPM) of key coconut pests

Peter Ooi*

Integrated Pest Management of Key Coconut Pests

Peter A.C. Ooi

Presented for

Expert Consultation on the control of Coconut Beetle Outbreaks in ACP/PC countries, Bangkok, 26-27 October, 2006

IPM of Coconut Pests

1. What is IPM?
2. Coconut IPM
3. Chrysomelid beetles on coconut
4. Biological control of coconut pests
5. New Coconut Pests?

1 What is IPM?

WHAT IS IPM?

- Empowering farmers to become effective managers and decision-makers
- To be able to grow a healthy crop with the least disruption of the agro-ecosystem, thereby encouraging natural pest control mechanisms and minimizing pesticide usage and dependency
- **IPM BY FARMERS, NOT FOR FARMERS**



IPM IS KNOWLEDGE CAPITAL AND KNOWLEDGE MANAGEMENT

- BIOLOGICAL CONTROL AND ECOLOGICAL PRINCIPLES AS FOUNDATION
- FARMERS ANALYSIS AND DECISION-MAKING REVOLVE AROUND
 - Growing a healthy crop
 - Conserving natural enemies
 - Observing fields regularly



IPM IS HUMAN RESOURCE DEVELOPMENT: MAKING FARMERS EXPERT

- Develop critical and informed decision-making skills
- Develop new ways of thinking and problem-solving
- Help farmers organize themselves and their communities



* Chief Technical Adviser, Integrated Pest Management for Cotton in Asia, FAO Regional Office for Asia and the Pacific, Maliwan Mansion, 39 Phra Atit Road, Bangkok 10200, Thailand; e-mail: Peter.Ooi@fao.org

**KNOWLEDGE MANAGEMENT STRATEGY:
NON-FORMAL EDUCATION IN FFS**

- DISCOVERY-BASED LEARNING TECHNIQUES
- EXPERIENTIAL LEARNING METHODS
- COOPERATIVE APPROACHES



SUSTAINABILITY OF IPM

- STRONG TECHNICAL BASIS FOUNDED ON ECOLOGICAL PRINCIPLES
 - Farmers managing the ecosystem rather than controlling it
- PARTICIPATORY NF EDUCATION
 - Making farmers expert
- LOCAL COMMUNITIES OWNERSHIP OF IPM
 - Ensure communication, collaboration and continuous training

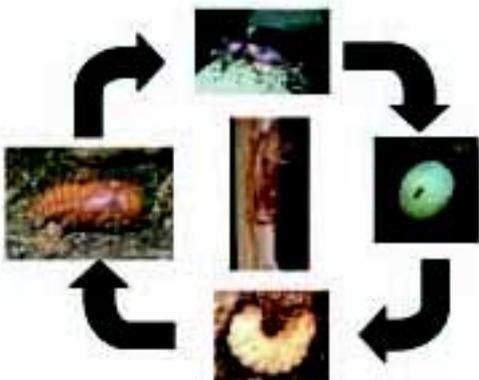


2 Coconut IPM

Case Study 1: *Oryctes rhinoceros*

- Coconut Rhinoceros Beetle is a native to Southeast Asia
- It is often kept in check by the action of natural enemies, primarily *Baculovirus* and *Metarhizium anisopliae*
- Outbreaks of rhinoceros beetle are often associated with plentiful breeding sites for the beetle that allowed populations to escape and multiply rapidly

Oryctes rhinoceros



Essentials of rhinoceros beetle management - 1

1. Identify breeding sites of rhinoceros beetles in the village
2. Remove/reduce the breeding sites
3. Avoid leaving old tree/palm stumps that may serve as breeding sites
4. If old trees/palms trunks cannot be removed, grow cover crops over them



Essentials of rhinoceros beetle management - 2

1. Set up traps using compost heap, old tree trunks etc.
2. Inoculate breeding trap with *M. anisopliae* and *Baculovirus*
3. Trap rhinoceros beetles, inoculate them with *Baculovirus* and release them
4. Continue to monitor incidence of damage



Case Study 2: *Artona catoxantha*

- This zygaenid moth is native to Malaysia and Indonesia and outbreaks seldom occur
- The insect is kept in check by the action of natural enemies, primarily *Bessa remota* (Tachinidae) and *Apanteles artonae* (Braconidae)
- Outbreaks of the coconut leaf moth are often associated with dry weather conditions and the onset of rain usually terminates such outbreaks.

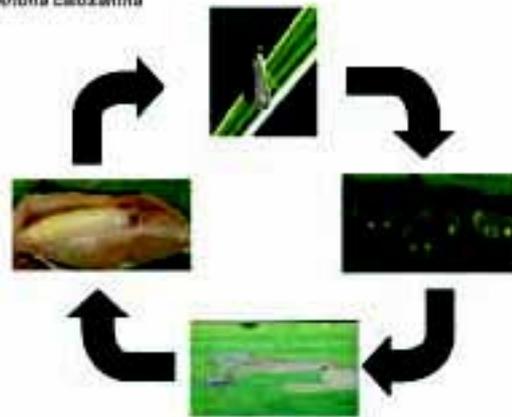
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Essentials of leaf moth management

1. Outbreaks signal the breakdown of natural biological control
2. This is often associated with a "single-phase" population development
3. Once overlapping generations of moths are re-established, biological control will be restored
4. Trunk injection with systemic insecticides may be used to hasten re-establishment of biological control



Artona catoxantha

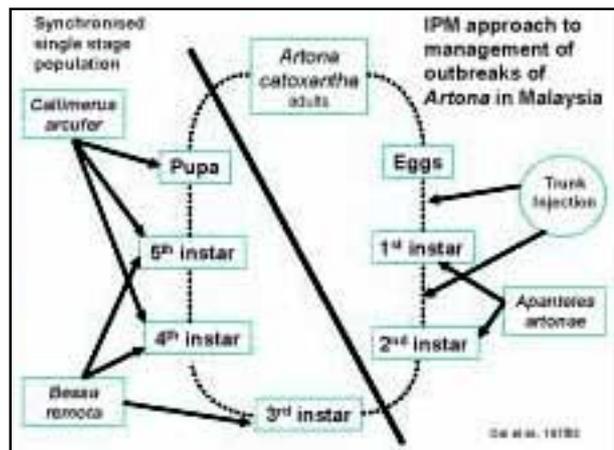


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Natural Enemies of *Artona catoxantha*



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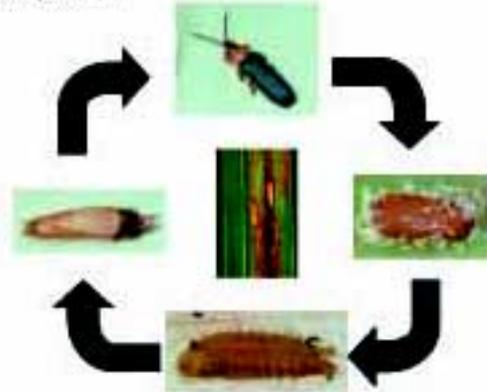


Dr. M. M. 1978

3 Chrysomelid beetles on coconut

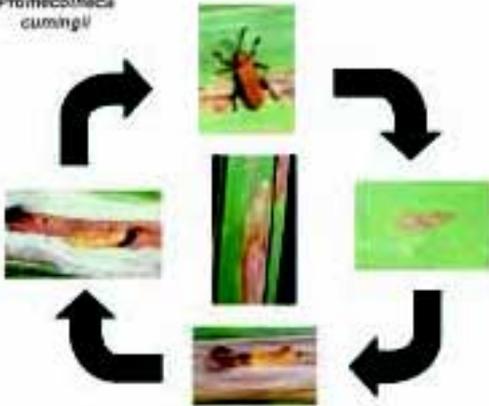
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Piezaspis reichel



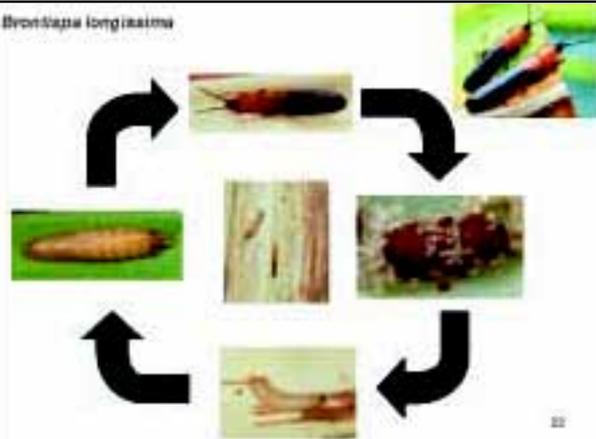
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Promecotheca cumingi



21

Brontaspis longissima



22

4 Biological control of coconut pests

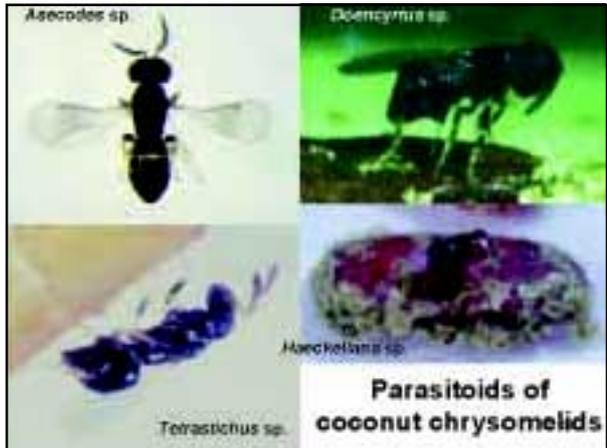
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General predators found in coconut palms₂₄



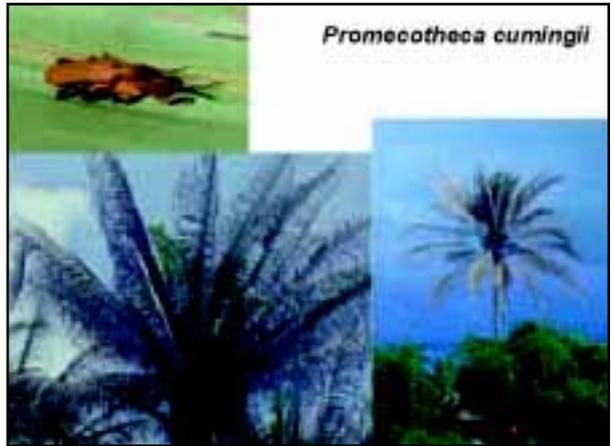
General predators found in coconut palms ²⁰



Parasitoids of coconut chrysomelids

5 New coconut insect pests?

21



Promecotheca cumingii



Artoria caloxantha

Rhynchophorus schaefferi

22

Coconut hispid beetle (*Brontispa longissima*): A new threat to coconut palms in Cambodia

Hean Vanhan*



KINGDOM OF CAMBODIA
Notion Religion King

Ministry of Agriculture, Forestry and Fisheries,
Department of Agronomy and Agricultural Land Improvement,
Plant Protection and Phytosanitary Inspection Office

Cambodia Presentation
at The Expert Consultation on Coconut Beetle Outbreak among
APPPC Member Countries
Bangkok, Thailand (26-27 Oct. 2004)

SLIDE PRESENTATION AND PHOTOGRAPHY OFFICE, 2004 | 0007

Coconut Hispid Beetle
(*Brontispa longissima*)
A new Threat to Coconut Palms in Cambodia



by Dr. Hean Vanhan
Chief of Plant Protection and Phytosanitary Inspection Office
Mobile: 855 125182126
E-Mail: vanhan@mobitel.com.kh

SLIDE PRESENTATION AND PHOTOGRAPHY OFFICE, 2004 | 0008

Background

NATIONAL AGRICULTURE DEVELOPMENT POLICY

Acknowledging that the achievement of increased economic growth and a significant reduction in rural poverty depends fundamentally on improvements in the agricultural sector, the government has accorded high priority to this sector. Its strategy is aimed at:

- improving food security and reducing reliance on the outside world (food aid),
- making sure that displaced persons can farm safely,
- increasing amenities and earnings,
- improving agricultural outreach services and the availability of inputs,
- developing agricultural lending locally and centrally, and
- developing the services and managerial skills of rural development institutions.

SLIDE PRESENTATION AND PHOTOGRAPHY OFFICE, 2004 | 0009

Background

Overview of the Industrial and Agricultural Sectors in Cambodia (2002)

Contribution to the GDP, %
The estimated GDP real growth rate in 2003 was 5.5%.



SOURCE: Public Investment Program of the ROC 2003-2005

SLIDE PRESENTATION AND PHOTOGRAPHY OFFICE, 2004 | 0010

Background

Overview of the Industrial and Agricultural Sectors in Cambodia (2002)

Number of Employees in Main Sectors
(in total: 4,887,854)



SOURCE: Public Investment Program of the ROC 2003-2005

SLIDE PRESENTATION AND PHOTOGRAPHY OFFICE, 2004 | 0011

Background

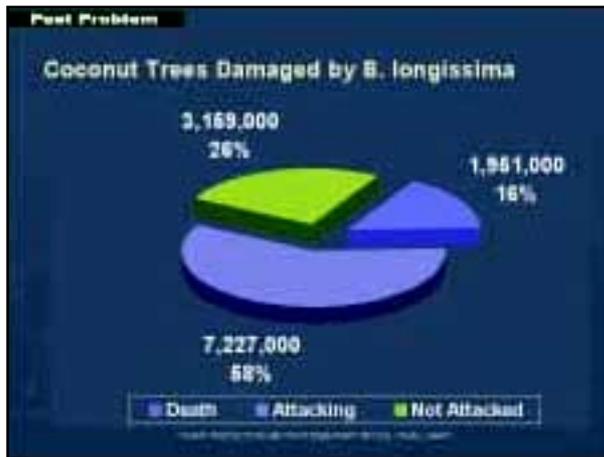
Major Products in Agricultural Sector

- Rice, Maize, Cassava, Sweet Potato, Vegetable, Mung Bean, Peanut, Soya Bean, Sugarcane, Sesame, Tobacco, Jute, Castor Oil, Fruit and Permanent Crop, Animal Husbandry, Fish Products, Forest Products, Rubber, Coffee, Tea.

The production of rice accounts for 13% of GDP

SLIDE PRESENTATION AND PHOTOGRAPHY OFFICE, 2004 | 0012

* Chief, Plant Protection and Phytosanitary Office (PPPSO), Ministry of Agriculture, Forestry and Fisheries (MAFF), Phnom Penh, Cambodia; e-mail: vanhan@mobitel.com.kh



- Control Measures**
- #### The Measures to Control in Cambodia
1. Phytosanitary Measure:
 - Reduce the spread potential of the beetle to other regions by controlling the movement (transport) of coconut seedlings, coconut leaves (or items made from them), or ornamental and other palms from infested areas;
 - Create national awareness on the pest and the danger of helping reach the beetle new areas.
- Ministry of Agriculture, Forestry and Fisheries
of Cambodia

Control Measures

The Measures to Control in Cambodia

2. **Chemical Control (on Young coconut palms)**

- Soluble powder of **Cartap and Nereistoxin** (11 g/300 g), packed inside filter paper bags of 30 grams, by putting on the top of trees, 1 bag per each tree, applied 1-2 times within 20-30 days.

Treatment	Effect (%) of Pesticides			
	10DAT	20DAT	30DAT	40DAT
Cartap	75.66	99.48	99.54	99.72
Nereistoxin	97.30	94.92	98.25	99.28

Source: HHS (2010) and HHS/FAO (2011) (HHS, 2010)

Control Measures

The Measures to Control in Cambodia

2. **Chemical Control (on Young coconut palms)**

- **Granule Formulation of Carbofuran 3G or Diazinon 10G**, by putting directly 30-40 gram or packed it inside tissue on the top of each trees, applied 1-2 times within 20-30 days.

Control Measures

The Measures to Control in Cambodia

2. **Chemical Control (on adult coconut palms)**



Actara 25WG (thiamethoxam): injected at 1 gram of product per palm, providing 100% control for up to 120 days and no residue are found in coconut milk at 7 DAT sampling (detection limit 0.01 ug/ml)



This will keep climbers away from danger, no poisoning for fishes in ponds, animal in surrounding farms and environmental pollution.

Source: HHS (2010) and HHS/FAO (2011) (HHS, 2010)

Control Measures

The Measures to Control in Cambodia

3. **Biological Control:**

- The Earwig as natural enemy, which native in Cambodia are under studying by plant protection and phytosanitary office.

Constrains & Perspectives

Constrains in Controlling

Constrains

- No experiences in controlling of *B. longissima* as new invasive alliance species;
- The infrastructure of natural enemies studies are not in place.

Perspectives:

To continue on-going extension programs on beetle controls and Safety and Responsible Use of pesticide.

Ask for collaboration and assistances from APPPC member countries, FAO and other donor agencies.