

Classical Biological Control of the Coconut Hispine Beetle (*Brontispa longissima* Gestro) in Viet Nam

Tran Tan Viet

Nong Lam University in Ho Chi Minh City, Viet Nam

Email: trantanviet@hcm.vnn.vn

ABSTRACT

The coconut hispine beetle *Brontispa longissima* is a very serious insect pest of coconut palms in the Asia and Pacific region. It invaded Viet Nam in 1999. Since then it has spread over the country. The importation of parasitoid *Asecodes hispinarm* in 2003 from Western Samoa into Viet Nam to control the pest was done in 2003. The parasitoid was established after one year and it suppressed the pest sustainably in a large area of Mekong Delta. The recovery of coconut palm trees was complete with no significant re-infestation.

INTRODUCTION

The coconut hispine beetle, *Brontispa longissima* Gestro (Coleoptera: Chrysomelidae), is a serious insect pests of coconut palms. Its larvae and adults feed on tissues of the developing leaves of the coconut palm. Where an attack is severe, leaves are dried. If palm are young or suffering from poor growing conditions, they may die. Otherwise, palm productivity is severely reduced by sub-lethal attacks.

The beetle was first reported from the southern provinces of Viet Nam in 1999. Since then it has spread over the country with an estimate of 10 millions trees infested. With no other methods available, the Government of Viet Nam has embarked on a massive campaign whereby the use of chemical pesticides is subsidized in an attempt to control the beetle outbreak and reduce its rate of spread. This is an addition to continuing regional initiatives by the provincial governments in the Mekong Delta which have already spent in excess US\$200,000 on insecticide application in 2002. The heavy infested area is the Ben Tre province in the Mekong Delta where it is estimated that farmers have spent a similar amount in pest control measures, in addition with the US\$67,000 spent by the province as subsidies to poor households for the costs of the pesticides. Current subsidy levels are estimated at US\$0.33 per coconut tree.

Then, the beetle has spread over central provinces where coconut palms are not cultivated intensively and farmers are much poorer than their southern farmers. They can not afford to any chemical protection of their trees.

The use of insecticides in coconut raises serious concerns about the health risks of the farmers, families and consumers. At that time market price of coconut was low, farmers did not spend much costs for protection of their farms.

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 Celebes (Indonesia), Tahiti, Solomon Islands (Stapley, 1973), and Western Samoa (Voegelé, 1989; Voegelé, Klingauf and Enghardt, 1989). Known egg parasitoids include *Haeckeliana brontispa* Ferriere and *Trichogrammatoidea nana* Zehntner (Hymenoptera: Trichogrammatidae), and *Ooencyrtus* sp. (Hym.: Encyrtidae). Several parasitoids in the family Eulophidae attack the larval and/or pupal stages of *Brontispa*, including the larval parasitoid *Asecodes* sp. and the pupal parasitoid *Tetrastichus brontispae* Ferriere (Eulophidae)

With the support by FAO, a project on intergrated pest management of the coconut hispine beetle using the exotic parasitoid *Asecodes hispinarum* (Hymenoptera: Eulophidae) was succeeded. Results summarized below demonstrate the success of the program and show that a properly conducted biological control remains an excellent pest management option.

Survey on the pest status

Following the first report of the coconut Hispine beetle incursion in Dong Thap province, the Ministry of Agriculture and Rural Development (MARD) requested provincial officers report of the present and damage level of the pest. Following the first record on appearance of *B. longissima* in Dong Thap province, it has continuously spread the Delta of Mekong River, causing the outbreak since 2001 and later in Central provinces in 2002. The industry has suffered serious losses, including: the loss in coconut production and its derivatives, the number of dead young trees, number of damaged ornamental palm trees, and the cost incurred by using pesticides

Table 1. Cost incurred due to the pest invasion

Items	Value
Fruit production loss	30%
Cost due to damage to dead trees	US\$17.88 mns
Cost due to damage to ornamental palm trees	US\$ 838,000 US\$ 722,323
Cost for insecticides applications	

Source: PPD's report July 24, 2002; Feb. 18, 2003, MARD's Announcement March 11, 2003

Several measures have had been applied since the pest incursion on mass scale. The insecticides used during the campaign were Diaphos, Furadan 3G, Padan 95 SP, Basudin 10H, Actara (trunk injection). Chemical insecticides have been instantly effective with the active period up to 3 months. The use of insecticides had been claimed costly, labor consuming, dangerous or ineffective. In addition, not only the limit effect of the insecticides, the pest re-infestation was high, leading to higher rate of infested trees in some places.

Parasitoid Importation and Rearing

In June 2003 the parasitoid *A. hispinarum* was collected, quarantined at Western Samoa for two generations before importing into Viet Nam. After importation the parasitoid was subjected into quarantine procedures for two more generations before releasing it to the field. A total 113 mummies (dead larval *B. longissima* containing developing parasitoids) was imported to Viet Nam producing 3,981 adult parasitoids. No hyperparasitoids were found.

The biology of *A. hispinarum* was also studied to get data to support for implementation of the project. Developmental time, adult longevity and the reproductivity of *A. hispinarum* when reared at 28°C: The developmental time from egg to adult emergence was 17.5 days. The adult longevity when fed with honey solution 30% for male and female was 3.4 and 4.1, respectively. A female produced 45.5 adult parasitoids in its lifetime in which 68.6% was female.

Table 2. Functional response of *A. hispinarum*

No. hosts	% parasitism	No.progeny produced/host	% female
1	100	58.7	54.9
3	33.3	61.7	87.1
5	20.0	53.7	91.1
7	14.0	50.7	91.3
9	14.4	56.7	88.7

When a female was given different number of the 4th instar larva of the host, it mostly attacked one host. The number of females in the progeny was high in most cases.

Table 3. Numerical response of *A. hispinarum*

No. parasitoids	No. progeny produced	% female
1	66.6	65.4
3	85.0	70.3
5	78.7	65.7
7	95.3	67.7
9	110.7	68.7

In this experiment, female parasitoids at different densities were given only one host (the 4th instar larva). The number of progeny produced was increased when density of parasitoids increased. The number of female in the progeny was similar for each density

Table 4: Host stage suitability of *A. hispinarum* (non-choice test)

Stage	N	% parasitism	No. parasitoids produced/host	% female
Eggs	30	0.0	-	-
1 st instar	30	13.3	4.0	50.0
2 nd instar	30	40.0	9.6	50.0
3 rd instar	30	93.3	25.6	66.7
4 th instar	30	96.7	60.9	75.0
Prepupae	30	20.0	40.8	83.3
Pupae	30	3.3	59.0	80.0

When given host at each stage, the female parasitoid can attack the 1st instar larval to pupal stage. However, the parasitism rate was highest for the 3 and 4th instar larvae. The suitable host stage of *A. hispinarum* was the 1-, 2-, 3-, 4-larval instar, prepupae and pupae. When was given a choice among the suitable host stages, the female preferred to attack the 3- and 4-instar larvae over other host stages.

Table 5: Host stage preference by *A. hispinarum* (choice test)

Stage	N	% parasitism	No. parasitoid emerged/host	% female
1 st instar	20	0	-	-
2 nd instar	20	5	5.0	60.0
3 rd instar	20	30	24.8	64.3
4 th instar	20	35	57.7	79.6
Prepupae	20	0	-	-
Pupae	20	0	-	-

Field release

After mass rearing in laboratory, the parasitoid was first released in Ben Tre province in August 2003 and then to other provinces of the Delta. The parasitoid was released as adult or developing stage (mummy). The introduction of parasitoids into the field in the mummy stage is the preferred option. The mummies were placed in a small bag made of mosquitoes netting. A cover made from a plastic cup or cardboard was applied on top of the bag to provide shelter from direct sunlight and rain.

The release was made based on a “grid” pattern. This method was developed after from findings the parasitoids dispersed at a rate of 5 to 8 km in 2 months from their release sites. A grid 10 by 10 km was used, with parasitoid releases made at a small number of sites within the central area of the square. The releases were carried out one time at each site. After two months of release, the investigation showed that the parasitized hosts were found at any release sites. The release parasitoids were stopped in October 2005 in almost provinces of Mekong River Delta as it was established.

Monitoring

Regularly monitor the impact of the parasitoid on the *B. longissima* population was made by looking at damage symptoms of the leaf spear and the young leaves in the central crown of the palm. In Ben Tre province, in the face of huge money and efforts spent, the number of infected had increased incredibly during 2001-2002 and stayed at high level, approx. 1.05 millions in mid 2003. The re-infestation was out of control. In Tra Vinh, the fight seemed desperate while the province spent more than US\$200,000 in 2002 but the infected number increased to more than 2 millions trees in August 2003 with the rate of re-infestation of 60%. From the moment when the parasitoid released (August 2003 in Ben Tre and September 2003 in Tra Vinh), the number of infested trees in each province had gone down sharply to approx. 300 thousand only (in April 2004), taking into account the fact that no more insecticides was applied since then. This implicates the invasion and especially the re-infestation is under efficient control. In Central province of Phu Yen, however, the effect is not so clear in terms of changes in infected number. The reason may be the affect of climate conditions which is dry and hot than that of Mekong Delta.

Trainings

Technicians of Plant Protection Department of provinces where the coconut beetle infested were invited to participate in training program on mass rearing, field release and monitoring of the parasitoid. These technicians were play important role in setting up rearing facilities release and monitoring of the parasitoid at their province.

From the successful in control the pest of the two first provinces, other provinces were followed in rearing and releasing parasitoids. The coconut palm trees are completely recovered. The re-infestation of the pest was very rare. In fact, it is not easy to find the damaged palm trees in Mekong Delta recently. The technology has been extended to other countries such as Maldives, Thailand, China (Hai Nam Island), Cambodia and Laos.

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