BIOLOGICAL CONTROL OF THE COCONUT HISPID (BRONTISPA LONGISSIMA) AND A SURVEY OF FRUIT FLIES IN AMERICAN SAMOA

by

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Noumea, New Caledonia
December 1978

1665/78

Following a request by the Governor of American Samoa, a suggestion was made by the South Pacific Commission to send an entomologist from the ORSTOM Centre in Noumea to that territory for two specific purposes: firstly, to attempt to curb the spread of Brontispa and, secondly, to survey the various species of fruit flies present, on the main island of Tutuila.

I visited this archipelago from 6 to 19 June 1978 to look into both these matters and made use of my brief stay to supplement data collected during a previous visit (1976) on other plant pests.

1. BIOLOGICAL CONTROL OF BRONTISPA LONGISSIMA GESTRO

1.1. Damage caused and brief background

All stages of Brontispa longissima Gestro (Coleoptera, Chrysomelidae, Hispinae) infest unopened coconut fronds as they emerge from the heart. They feed on the parenchyma and the characteristic damage becomes apparent when the young fronds open.

This insect is especially prevalent in Java, the Celebes, New Guinea and the Bismack Group. It was reported from the Solomon Islands in 1929 by Tothill and from the New Hebrides in 1937 by Risbec who , in 1942, affirmed that it had been present in New Caledonia for several years. It seems to have been introduced into Tahiti around 1960 (Cohic, 1961).

B. longissima can be controlled to a certain extent by insecticide applications to young palms, which are particularly vulnerable.

As the palms grow, chemical control becomes difficult and is usually too expensive to be worthwhile.

A certain number of predators confine B. longissima to the unopened leaves. Risbec noted long ago the active role played by an earwig (Chelisoches morio F. Dermaptera, Chelisochidae), which is commonly found on coconut crowns in many South Pacific Islands.

Biological control has been conducted mainly using a parasite collected on B. longissima in Java: Tetrastichus brontispae Ferrière (Hymenoptera, Eulophidae). Although only 24 percent of the pupae at the very most are parasitized in nature (Cochereau, 1969), the action of this hymenoptera, when combined with that of predators, is nevertheless useful.

T. brontispae was successfully introduced to the Celebes and then to the Solomons, after an initial failure (Lever, 1936), to New Guinea (O'Connor, 1940), to the Mariana Islands (Lange, 1950), to Tahiti (Cohic and Millaud, in Cohic, 1961), to New Caledonia and to the New Hebrides (Cochereau, 1964 , 1970). Breeding of the parasite under laboratory conditions is relatively easy, but its establishment in the natural environment generally calls for the undivided attention of an entomologist for several months or years.

The difficulties reported by Lever in the Solomon Islands were also encountered by Cochereau in New Caledonia. The first attempt, in December 1963, had to be repeated three times (in May 1964, December 1965 and June 1966) before successful establishment was achieved.

1.2 The situation in American Samoa

1.2.1 From 1972 to 1978

B. longissima was probably introduced into Pago Pago from Tahiti. Swan detected the first symptoms of B. longissima infestation in 1973 and Cochereau, an entomologist with the ORSTOM Centre in Noumea, immediately sent him a small consignment of Tetrastichus - infested Brontispa pupae collected in New Caledonia.

During a brief four-day in July 1973, Cochereau brought to Pago Pago 133 infested Brontispa pupae collected in the New Hebrides:

- 28 died or were discarded for various reasons
- 86 produced parasites which were released on two coconut palms growing inside Pago Pago, totalling approximately 1,300 Tetrastichus.
- 19 were used for breeding purposes.

From 16 to 27 September 1974, P.G. Long, in his study of Brontispa control methods on Tutuila, found no trace of Tetrastichus. The 55 Brontispa pupae he collected from coconut palms in Tafuna all produced healthy adults.

In October 1974, Swan received another batch of parasitized pupae collected in the New Hebrides from G. Fabres, and more were supplied in May 1975.

During my visit to American Samoa at the end of May 1976, I found some Brontispa on all the coconut palms examined in Vailoatai, 'Amanave, Pago Pago and Aua. Their pupae appeared to be quite healthy. Since I had officially come for a different purpose I could not go into this matter more thoroughly. Since then, infestation has spread to the Manu'a Islands, which are the easternmost of the Samoan Islands. Western Samoa is still as yet free of this pest.

1.2.2. June 1978

As regards the Hispid, my aim was threefold:

- to determine the extent of infestation
- to check whether T. brontispae had become established
- to build up existing populations or to attempt a further introduction of the parasite.

Extent of damage

Brontispa were present on all the coconut palms I examined, not only in the vicinity of Pago Pago harbour but also at Aua, Faga'alu, Tafuna, Vailoatai, and'Amanave.

All leaves showed signs of attack, but the Hispids themselves were only found in fronds emerging from the central shoot. A count of Brontispa present on young coconut palms gave an average of ten to twelve adults, three or four young larvae and one pupa or one old larva per palm. Most adults can be easily seen by separating the folioles of very young fronds, whereas the larvae are only found in very-tightly folded leaves with little or no pigmentation.

After the "population explosion" reported by Cochereau in 1973, it would appear that the situation is far less alarming now, and in fact is comparable to the one I observed in 1976.

The various predators which are present in large numbers in the coconut palm crowns - earwigs, ants and even geckos - certainly play an important part in control of the pest.

Together with Mr. Sipaia Fatuesi, I again noticed that a pathogenic fungus (cf. Metarrhizium) was destroying a considerable number of Brontispa larvae and even adults. In Si'ufaga, near Pago Pago, after heavy rains, a third of the larval population was killed by this fungus.

Presence of Tetrastichus brontispae

With the help of Mr. Fatuesi and two farm workers kindly placed at our disposal by the Head of the Department of Agriculture, I collected 67 Brontispa pupae in the vicinity of Pago Pago. These were placed in rearing containers and yielded 64 healthy adults (the 3 losses being due to fungi). This substantiates the Long report (1974) and indicates that T. brontispae was not established on Tutuila in June 1978.

Attempt at a further introduction

When I left for American Samoa I took with me 20 parasitized Brontispa pupae collected in New Caledonia, and during my stay in Pago Pago I received 113 additional pupae, kindly collected in the New Hebrides especially for me by Mr. de Taffin of IRHO, Santo.

The 20 pupae were used for production of Tetrastichus and subsequent contamination of Brontispa larvae collected in the field. Together with staff from the Department of Agriculture, I collected almost 300 Brontispa larvae which were placed in strips of coconut leaflets 20 cm long, arranged in 5 plastic boxes (size: 260 x 130 x 77 mm). The boxes were ventilated through two circular apertures in the lid measuring 50 mm in diameter and covered with fine wire gauze. Four parasitized pupae were then put in each box. The Tetrastichus which emerge feed on strips of filter paper soaked in a honey solution, and mate. In the following days the females hide away between the leaflets and parasitize the Brontispa larvae.

From the 113 pupae received from the New Hebrides:

- 15 were dried out
- 24 were not parasitized and produced adults
- 17 released their parasites during the journey or shortly after arrival and produced approximately 250 Tetrastichus adults
- 57 were still hosting Tetrastichus.

The 250 Tetrastichus (approximately) were released on 14 June on two coconut palms in the Vaipito Valley after they had been fed with a honey solution. This valley, situated at the bottom of Pago Pago Bay, was chosen for the operation because it is densely planted with coconut palms and is very well sheltered. The two palms on which the release was made were close together and harboured few ants.

The 57 parasitized pupae were distributed among the 5 breeding boxes.

Three further releases of 200 adults each were carried out on 15, 17 and 18 June.

On 17 and 18 June, prior to my departure, I placed about 20 imported parasitized pupae and 300 presumably parasitized local larvae btween leaflets on the two selected palms. All the larvae were old and some of them were already in the pupal stage. Larvae and pupae were carefully positioned between very young, tightly folded leaflets so as to be protected from predators.

Weather conditions were propitious for these releases, with an average daily temperature of 25.5°C, an often overcast sky, light drizzle and moderate easterly winds.

To sum up the operation: 850 adult parasites were released in a very confined area. In addition, assuming that there were roughly 15 Tetrastichus per Brontispa pupa, and assuming that only half of the "planted" larvae and pupae were parasitized, the number of Tetrastichus that emerged during the following days can be estimated between 2,000 and 3,000.

1.3 Conclusions

The Brontispa populations which have become established on the island of Tutuila in American Samoa are already being controlled to some extent by several natural enemies. Their numbers could be brought down further through the action of the Eulophid Tetrastichus brontispae. Several introductions of this parasite have been made since 1973 on Tutuila, but it is virtually certain that it had not become established in June 1978.

The most recent introduction led to an initial release of 850 adult parasites, followed by three separate operations producing a total of 2,000 to 3,000 individuals to strengthen the first batch. This was the largest release ever made on Tutuila in a single area, since previous laboratory-bred Tetrastichus had often been scattered. For this reasion, i.e. to avoid dispersion, no parasites were sent to the Manu'a Islands. This later introduction has a good chance of succeeding, but it is unfortunate that the Department of Agriculture of American Samoa no longer has an entomologist or even a technical biologist available, who could undertake or continue breeding of useful species; without such a person, one cannot be absolutely sure of complete success.

Summary bibliography on Brotispa longissima

COCHEREAU, P. - 1964 - Notes sur un essai d'acclimatation de Tetrastichus brontispae Ferrière en Nouvelle-Calédonie, sur l'hôte Brontispa longissima var. Froggatti Gestro. O.R.S.T.O.M., Nouméa : 1-8.

COCHEREAU, P. - 1969 - Installation de Tetrastichus brontispae Ferr. (Hymenoptera, Eulophidae), parasite de Brontispa longissima var. Froggatti Sharp (Coleoptera, Chrysomelidae, Hispinae) dans la presqu'île de Nouméa.

COCHEREAU, P. - 1970 - Introduction de Tetrasticus brontispae Ferr. (Hym. Eulophidae) parasite de Brontispa longissima Gestro (Coleoptera, Hispinae) sur la station de l'IRHO à Santo (Nouvelles-Hébrides). O.R.S.T.O.M., Nouméa : 1-20.

COCHEREAU, P. - 1973 - Lutte biologique contre Brontispa longissima Gestro aux Samoa américaines. O.R.S.T.O.M., Nouméa : 1-8.

COHIC, F. - 1961 - Outbreaks and new records. F.A.O. Plant Prot. Bull., 9 (6) : 110-111.

LANGE, W.H. - 1950 - The biology of the Mariana coconut Beetle, Brontispa marianae Spaeth on Saipan, and the introduction of parasites from Malaya and Java for its control. Proc. Hawaian ent. Soc., 14 (1).

LEVER, R.J.A.W. - 1936 - Control of Brontispa in Celebes by the parasite Tetrastichodes of Java. B.S.I.P. agr. Gazette supplement, 3 (4).

LONG, P.G. - 1974 - Report of investigations into the infestation of coconut palms in American Samoa by the coconut hispid beetle (Brontispa longissima) and recommendations on quarantine procedures for Western Samoa : 1-17.

O'CONNOR, B.A. - 1940 - Notes on the coconut leaf Hispa, Brontispa froggatti Sharp and its parasites. N. Guinea agr. Gazette 6 (2).

RISBEC, J. - 1942 - Observations sur les insectes des plantations en Nouvelle-Calédonie. Secrétariat d'état aux colonies, Paris : 1-128.

2. SURVEY OF FRUIT FLIES

The list of plant pests and diseases drawn up in 1964 by the Department of Agriculture of American Samoa gives four species of Tephritidae as being present:

Dacus (Notadacus) xanthodes (Broun)
Dacus (Strumeta) kirki Froggat
Dacus (Strumeta) obscurus Malloch
Dacus (Strumeta) distinctus Malloch

It was important to find out whether other species had not been introduced since then, particularly as regards:

- the Queensland fruit fly: Dacus (Strumeta) tryoni (Froggatt) reported in New Caledonia and in Tahiti.
- the Mediterranean fruit fly: Ceratitis capitata Wied. established in Australia and Hawaii.
- the Melon fly: Dacus (Strumeta) cucurbitae Coquillett introduced into Hawaii.
- the Oriental fruit fly: Dacus (Strumeta) dorsalis Hendel, also established in Hawaii.

In addition, the Department of Agriculture required information on fruit fly control methods, particularly against the species affecting pawpaw.

2.1 Existing species

The month of June was not very suitable for this investigation because, apart from pawpaws, very few fruits ripen at this time of year.

From 7 to 16 June, I set up two sets of five fruit fly traps in clumps of fruit trees in Tafuna (breadfruit, pawpaw) and Mapusaga (citrus, breadfruit, banana, pawpaw). Concurrently, I reared a batch of Tephritidae larvae collected in Tafuna from infested pawpaw trees.

Each set of five traps comprised two locally purchased "dak pots" and three Steiner (1957) type traps with the following attractants: "Cue-lure", methyleugenol and "Trimedlure".

Accoring to Hinckley (1964) and Cochereau (1970), Cue-lure, which is also the attractant in "dak pots", attracts male flies of the following species: Dacus distinctus, Dacus tryoni, Dacus cucurbitae, Dacus (Strumeta) curvipennis Froggatt, Dacus (Strumeta) passiflorae Froggatt and Dacus (Strumeta) psidii (Froggatt).

- Methyleugenol attracts male Dacus xanthodes, Dacus dorsalis, and Dacus (Strumeta) frenchi Froggatt.
- Trimedlure attracts male Ceratitis capitata.

Nothing was caught in the methyleugenol and trimedlure traps after nine days. Only the cue-lure, either in the Steiner traps or in "dak pots", attracted some Dacus distinctus, D. obscurus and D. kirki males. Results are shown on Table 1.

Table 1 : Number of Dacus males captured in Tafuna and Mapusaga from 7 to 16 June 1978 (D.d = Dacus distinctus; D.k. = D. kirki; D.o. = D. obscurus.

	TAFUNA			MAPUSAGA		
	D.d	D.k.	D.o.	D.d.	D.k.	D.o.
Steiner	4	0	4	4	1	4
Dak Pot 1	0	0	3	0	3	0
Dak Pot 2	2	1	2	2	0	0
Total	6	1	9	6	4	4

In addition, maggoty pawpaws yielded 110 Tephritidae pupae, from which I obtained 289 Dacus xanthodes, 4 Opius oophilus Full. (Hymenoptera - Braconidae) and 4 Opius sp. adults.

Despite the smallness of the sample, the following conclusions may be drawn from this operation:

- Dacus tryoni, Dacus cucurbitae, Dacus dorsalis and Ceratitis capitata have probably not been introduced into American Samoa.
- Damage to pawpaw trees is caused mainly by Dacus xanthodes.
- Since this fruitfly species is already being controlled by two hymenoptera established on Tutuila, there is no point in introducing other Opius species, especially as they are not very efficient.
- Cue-lure is a good attractant for Dacus kirki and Dacus obscurus males.
- Oddly enough, under the conditions of our investigation, methyleugenol did not attract Dacus xanthodes males as we had expected it to (Hinckley, 1964).

In all likelihood this was due to the fact that traps were only put out for a short period.

2.2 Recommendations

2.2.1 Control of Dacus xanthodes

If pawpaw orchards are to be successfully established, plantations of "ivi" (Inocarpus edulis, J.R. and G. Forster - Legumes) and "vutu" (Barringtonia edulis Seem. Lecythidaceae) plantations must be eliminated in the selected area, for their fruits serve as a natural host for this Dacus species.

Contaminated fruit must be picked regularly and fallen fruit must be collected daily or at intervals not exceeding three days. The fruit can be destroyed either by boiling in large drums, or by burying in soil at least 50 cm (20 inches) deep.

Before other, more convenient methods are developed, fruit at risk must be treated as follows:

- pawpaws, pineapples, breadfruit: spraying with 0.03% of dimethoate (Rogor or Cygon) or 0.03% fenthion (Lebaycid) 4 and 3 weeks respectively prior to harvest;

- citrus: spraying with 0.06% dimethoate or with 0.06% fenthion 8 and 7 weeks respectively prior to harvest.

2.2.2 Control of new introductions

Cue-lure fruitfly traps or dak-pots should be set up in orchards, captures collected each week, stored away from ants and mildew, and sent to an entomological laboratory every six months.

Cue-lure is marketed by:

Food Industries Limited
Bromborough Port
Wirral
Cheshire L 62 454
Great Britain

Dak-pots are marketed by:

Union Carbide Australia Limited
157-167 Liverpool Street
Sydney, N.S.W. 2000
Australia.

Summary bibliography for fruit flies

Agriculture Service, U.S. Samoa -1964 - List of insects and diseases SPC, Regional plant quarantine Conf., APIA, West. Samoa, 19-19 March, 1964 : 1-5.

COCHEREAU, P. - 1979 - Les mouches des fruits et leurs parasites dans la zone Indo-Australo-Pacifique et particulièrement en Nouvelle-Calédonie. Cah. ORSTOM, Sér. Biol., 12 : 15-50.

DREW, R.A.I. - 1972 - The generic and subgeneric classification of Dacini (Diptera : Tephritidae) from the South Pacific Area. J. austr. ent. Soc., 11 (1) : 1-22.

DREW, R.A.J. - 1972 - Additions to the Species of Dacini (Diptera Tephritidae) from the South Pacific area with keys to species. J. austr. ent. Soc., 11 (3) : 185-231.

HINCKLEY - 1964 - Fruit fly trapping in Fiji. J. ec. ent., 57 (2) : 297.

STEINER, L.F. - 1957 - Low-cost, plastic fruit fly trap. J. ec. ent., 50 (4) : 508-509.

3. OTHER PROBLEMS INVESTIGATED

3.1. Army worm : Spodoptera litura (F.) (Lepidoptera : Noctuidae) on taro.

During this visit I noticed only a few Spodoptera litura caterpillars on an untreated taro field near Aoloafau.

As I pointed out in a previous report (1976), Spodoptera is controlled by a whole series of parasites in American Samoa.

According to Swezey (1941), the larvae are parasitized by a Euplectrus (Chalcidoidea, Elachertidae), and Dale and Herring (1958) reported the presence of a species of Apanteles (Ichneumonoidea, Braconidae). However, I have not yet been able to collect these hymenoptera.

The parasites I observed on Spodoptera eggs in Ta'ū in 1976 were examined by P. Dessart of the Institut Royal des Sciences naturelles de Belgique, and proved to be Telenomus sp. (Proctotrupoidea, Scelionidae).

The Tachinidae found on laboratory-reared caterpillars from Ta'ū and Tutuila were examined by L.P. Mesnil (C.I.B.C., Delemont) and proved to belong to the Drino genus, Prosturmia subgenus (Diptera, Tachinidae).

Caterpillar rearing also made it possible to detect another parasitic hymenopteron belonging to the Zele genus (Braconidae, Macrocentrinae) (ident. A. Delobel, ORSTOM, Noumea).

Lastly, in 1978 I noticed a large number of hymenoptera infesting eggs on Tutuila. These were Chelonus sp. (Ichneumonoidea, Braconidae) (ident. A. Delobel).

3.2 Predatory Coccinellidae

Five species of Coccinellidae (ladybird beetles) predatory on scale insects and aphids were collected in 1976 and in 1978 and identified by J. Chazeau (ORSTOM, Noumea):

- Cryptolaemus montrouzieri Muls.
- Chilocorus nigritus (F.)
- Coelophora inaequalis (F.)
- Chilomemes samoensis Arrow
- Scymnus (Nephus) fijiensis Sicard

They were taken from Artocarpus incisa and Plumeria sp. Chilocorus nigritus and Cryptolaemus montrouzieri were also collected on Cocos nucifera.

3.3 Plant-feeding Acarina

The list of plant-feeding mites collected on Tutuila in 1976 was supplemented.

- Tarsonemidae : Polyphagotarsonemus latus (Banks) on Hibiscus rosa-sinensis (L.)
- Tetranychidae: Oligonychus biharensis (Hirst) on Artocarpus incisa L.

  Tetranychus lambi Pritchard and Baker on Cocos nucifera L.

  Tetranychus marianae Mc Gregor on Hibiscus sp. and Musa sapientum L.

  Tetranychus neocaledonicus Andre on Alocasia macrorhiza Schott, Carica papaya L., Colocasia esculenta Schott, Manihot utilissima Pohl., Phaseolus vulgaris L.

  Tetranychus tumidus Banks on Solanum melongenum L. and Tagetes erecta L.
- Tenuipalpidae: Brevipalpus phoenicis (Geijskes) on Hibiscus rosa-sinensis (L.)
- Eriophyidae : Aberoptinae : Aberoptus samoae K. on Mangifera indica L.

  Eriophyinae : Eriophyes hibisci Nalepa on Hibiscus rosa-sinensis (L.)

  : n. genus (examined by H.H. Keifer) on Cocos nucifera L.

  Phyllocoptinae: Phyllocoptruta oleivora (Ashmead) on Citrus sp.

  : n. genus (examined by H.H. Keifer) on Mangifera indica L.

Predators of plant-feeding mites:

- Staphylinidae: Oligota (Holobus) flavicornis Boisd. (det. H. Coiffait)
- Thysanoptera : Scolothrips pallidus (Beach) (det. A.Bournier).

ACKNOWLEDGEMENT

I wish to express my thanks to Mr Pemerika L. Tau'ili'ili, Head of the Department of Agriculture of American Samoa, for his warm welcome and for all the facilities he placed at my disposal during my visit. His assistant, Mr. Sipaia Fatuesi, very kindly accompanied me and lent his assistance in the field throughout my stay.

Lastly, I am extremely grateful to my entomologist colleagues who were kind enough to examine the material I sent them, especially to Dr R.A.I. Drew of the Department of Primary Industries, Queensland, who checked the identification of the Tephritidae collected.