AN ASSOCIATION BETWEEN THE CRAZY ANT *ANOPLOLEPIS LONGIPES* (JERDON) (HYMENOPTERA: FORMICIDAE) AND THE COCONUT SPATHE MOTH, *TIRATHABA RUFIVENA* (WALKER) (LEPIDOPTERA: PYRALIDAE) ON COCONUT PALMS IN THE MOROBE PROVINCE OF PAPUA NEW GUINEA.

1. SURVEYS TO DETERMINE THE EXTENT OF CROP LOSS AND THE INCIDENCE OF NATURAL ENEMIES OF THE MOTH.

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ABSTRACT

Coconut palms infested with crazy ants, Anoplolepis longipes, *showed losses of up to 77 percent in production on a coconut block in the Markham Valley, Morobe Province, Papua New Guinea. The losses were a result of abnormal shedding of female flowers and immature nuts due to attacks by the larvae of the coconut spathe moth,* Tirathaba rufivena. *Palms infested with crazy ants had higher moth populations as well as higher rates of parasitism of moth eggs, larvae and pupae than palms without the ants. The rate of pupal parasitism was relatively high, while larval parasitism was low in palms occupied by the ant. It was concluded that reduced larval mortality was responsible for high spathe moth populations and that* A. longipes *reduced the effectiveness of larval predators, although it was not known how the ant inhibited the foraging activities of predators. The earwig,* Chelisoches morio, *and other species of ants were considered the most important potential predators of spathe moth larvae.*

Key words: Anoplolepis longipes, *crop loss, natural enemies*

INTRODUCTION

The coconut palm is monoecious and a branched inflorescence or spadix is produced in the axil of each leaf. A new inflorescence appears every 20 to 25 days. The inflorescence develops within a double sheath or spathe, which splits at maturity releasing the inflorescence. Each branch carries the more numerous male flowers apically and female flowers on the basal part. Male flowers open progressively from the apical end of each branch over a period of 15 days. Generally, all male flowers have fallen off several days before female flowers become receptive to pollen, so that pollination occurs from a succeeding inflorescence. The fruit is fully grown 6 months after pollination, but requires a further 5 to 7 months to maturity (Lever 1969; Child 1974).

Tirathaba rufivena (Walker) (Lepidoptera: Pyralidae), the coconut spathe moth, is distributed from Sri Lanka, Thailand, Laos, the Malay peninsula, Borneo and Indonesia through to Papua New Guinea (PNG), northern and north eastern Australia, Solomon Islands, Vanuatu and New Caledonia (Lever 1933, 1969; Whalley 1964; Dean 1978; Waterhouse and Norris 1987; D. Chin personal communication).

The principal host plants of *T. rufivena* are the coconut palm, *Cocos nucifera*, and the swamp palm, *Nypa fruiticans*, (Lever 1933). Other host plants recorded include the palms *Areca catechu, Roystonea elata,* and *Elaeis guineensis* (Lepesme 1947). The biology of the moth on coconut palms has been described by Corbett (1932) and Lever (1933; 1969). The eggs are usually laid in batches on unopened male coconut flowers. After hatching

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the first instar larvae feed on male flowers which are the preferred food. However, when the supply of male flowers is exhausted, the female flowers and young nuts are attacked (Corbett 1931, 1932; Lever 1933). The palm sheds female flowers and young nuts that have been bored by larvae (Corbett 1931). The coconut palm is unable to nourish to maturity all female flowers which set on an inflorescence (Lever 1969; Waterhouse and Norris 1987). This results in natural nutfall, and excess young nuts are usually shed in the 2 months from the opening of the spathe (Lever 1969). Although, Child (1974) quoted work showing substantial nutfall between 2 and 6 months but this was probably due to drought or waterlogged soil. Corbett (1931) found that insect damaged nuts were shed before undamaged ones and the palm compensated for high levels of insect damage by decreasing natural shedding. Additionally, he concluded that *T. rufivena* larvae would have to bore 58% of female flowers before causing a reduction in the yield of mature nuts (Corbett 1931, 1932). Waterhouse and Norris (1987) maintain that the moth has little effect on coconut yield over most of its geographical range.

Anoplolepis longipes (Jerdon) (Hymenoptera: Formicidae), the crazy ant, is thought by some to be a native of the south east Asian mainland (Baker 1972; Haines and Haines 1978 a), although Way and Khoo (1992) maintain that the species probably originated in Africa. The ant is widespread throughout Asia, East Africa and the Pacific, being particularly prevalent in disturbed habitats. In PNG *A. longipes* is found from sea level to at least 1900 metres.

The crazy ant may be regarded as a pest or a beneficial species on coconuts, depending on the pest species with which it is associated. For example, Brown (1959) found it to be beneficial in protecting coconuts from attack by *Amblypelta cocophaga cocophaga* China (Hemiptera: Coreidae) in the Solomon Islands. Way (1953) showed that *A. longipes* did not prevent *Pseudotheraptus wayi* Brown (Hemiptera: Coreidae) from damaging developing nuts in east Africa. O'Sullivan (1973) noted a positive association between *A. longipes* and high populations of the coconut spathe bug *Axiagastus cambelli* Distant (Hemiptera: Pentatomidae) in the Lihir Islands, PNG.

Premature nutfall on coconut palms infested with crazy ants has been reported from PNG by J. Szent-Ivany (personal communication) at Aroa plantation, Central province, PNG and K. Tomlin (personal communication) at Alotau, Milne Bay province, PNG.

During 1975 a sharp decline in nut production was reported from a block of 14 year old coconuts at Maralumi estates, Markham valley (T. Leahy, personal communication). The palms concerned, had recently become infested with *A. longipes* and it was suggested that the ant was responsible for the decline in production. As a result it was decided to investigate whether *A. longipes* was involved in the crop loss.

Maralumi estates has a rainfall of 1,140 mm per year with most falling in the months of August and December to March.

OBSERVATIONS AND RESULTS

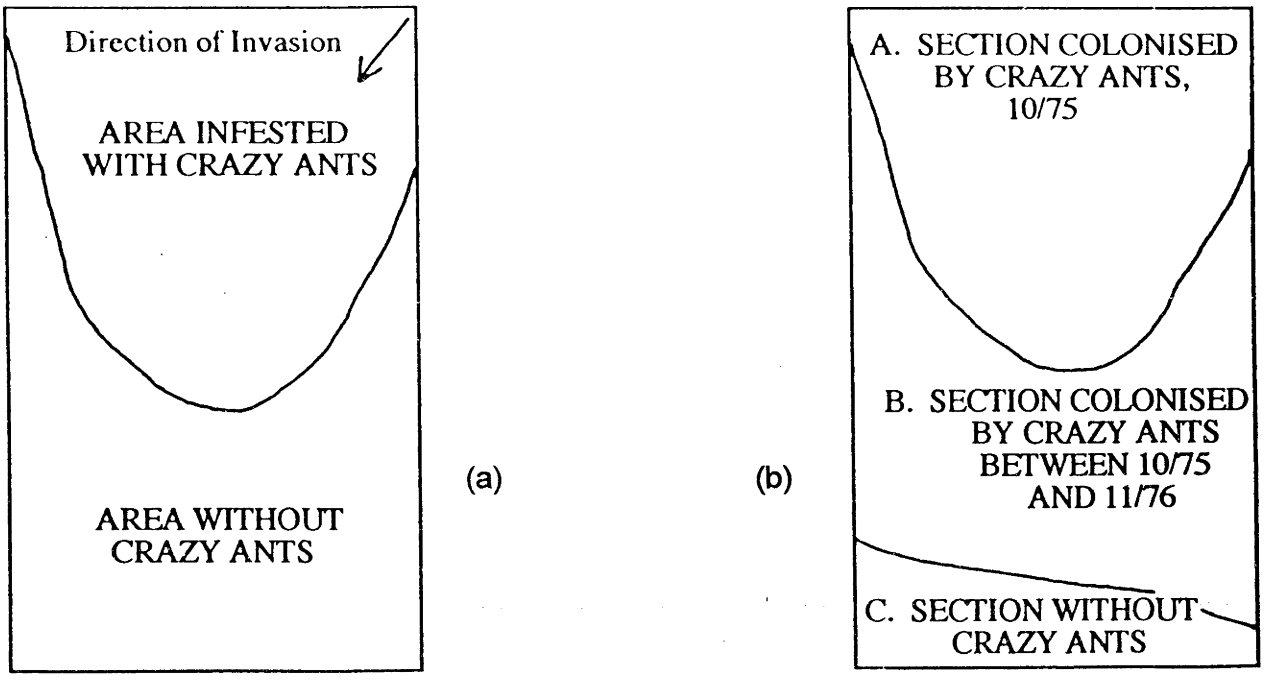
First survey

An initial survey of the block of 6,125 palms was made during October 1975. Employees of Maralumi estates said that crazy ants recently invaded the block from a nearby stand of abandoned cacao. *A. longipes* was the dominant ant species in approximately 50 percent of the palms and on the ground beneath the palms (Fig. 1 a). The number of mature nuts carried by palms, with and without crazy ants was estimated from the ground using binoculars. Palms infested with crazy ants were estimated to carry 70 percent less mature nuts than those without the ant. Additionally shed nutlets found beneath infested palms often contained late instar pyralid larvae, while nutlets found beneath palms without crazy ants showed no sign of insect attack. The pyralid larvae were returned to the laboratory and reared to adults which were subsequently identified as *T. rufivena*.

Second survey

In order to get a more accurate estimate of the loss of production and to further investigate the relationship between *T. rufivena* and *A. longipes*, a second survey was made in November 1976. By this time *A. longipes* had advanced across the block to occupy 85 to 90 percent of the palms. For the purposes of the survey the block was divided into 3 sections. Section A was the part occupied by crazy ants up to October 1975, section B was the part colonized between October 1975 and November 1976, while section C was not occupied by crazy ants (Fig 1 b). A systematic sample was taken from each section by observing every 5th palm. Counts of nuts estimated to mature within the next 6 months were made from the ground using binoculars. Labourers

Figure 1. *Proportion of palms infested with* A. longipes *in (a) October 1975 and (b) November 1976.*



climbed the palms and searched old and new inflorescences for *T. rufivena* larvae and pupae as well as potential predators. Samples of ants were also collected from the crowns of the palms. The insects were placed in plastic bags and lowered to the ground. Spathe moth larvae and pupae were held in the laboratory for parasite emergence. The density of crazy ant nests in sections A and B was estimated by using 4 m X 4 m quadrats in each section. One nest was counted when an infested palm fell within a quadrat, while 0.5 of a nest was counted when the quadrat border intersected an infested palm or a ground nest.

Production of nuts in sections A and B was down by 77 and 44 percent respectively when compared with section C (Table 1). Most of the larvae collected were late instars. Counts of larvae and pupae were highest in section A and lowest in section C. No parasites were reared from the larvae collected, however 4 species emerged from the pupae. The parasites in order of abundance were; *Bachymeria nostoi* (Habu), *B. lasus* (Walker) (Hymenoptera: Chalcidae), *Trichospilus pupivorus* Ferrier (Hymenoptera: Eulophidae) and an undetermined species of Tachinidae. Apart from ants, *Chelisoches morio* F. (Dermaptera: Chelisochidae) was the only potential predator collected and it was observed foraging on the inflorescences at a mean density of 3 per palm in section C, 0.4 per palm in section B and was absent from section A. The dominant ant species on sampled palms in section C were *Oecophylla smaragdina* F., *Crematogaster sp.* and *Iridomyrmex sp.* (Table 1). Other ant species on section C palms were *Paratrechina longicornis* (Latreille) and *Polyrachis spp.* The only ant on palms in sections A and B, apart from *A. longipes*, was *Monomorium destructor* (Jerdon).

The density of crazy ant nests ranged from 5 to 8 per quadrat (3,1255 to 5,000 per hectare) in section A, while section B had 0.5 to 1.5 per quadrat (310 to 740 per hectare). *A. longipes* was mainly nesting under debris (fallen fronds and coconuts) on the soil surface, in the roots and crowns of palms and more rarely in soil. The largest nests were under debris in 1 m tall grass. While soil nests were only found in a limited number of areas with very short grass or bare soil.

Third survey

The second survey did not sample spathe moth eggs and early instar larvae or the natural enemies of these stages. In order to get an overall estimate of the influence of *A. longipes* on natural enemies of moth stages, from eggs to pupae, a third survey was carried out during April 1978. Twenty five healthy palms were sampled from each of the areas with and without crazy ants.

Inflorescences up to 8 weeks old were cut and lowered to the ground. The male and female flowers as well as the immature nuts were removed and examined under a stereomicroscope for the

Table 1. *Second Survey; the production of nuts per palm, density of* T. rufivena *larvae and pupae and the dominant ant species in three sections of the coconut block at Maralumi estates.*

	Mean No. of nuts to mature in the next 6 mnths	Mean larvae /palm	Mean pupae/ palm	Percent pupal parasitism	Dominant ant spp & No. of palms occupied
Section					
A	7.1 ± 1.22	21.5 ± 5.40	3.3 ± 0.92	22.9	*A. longipes, 25*
B	17.1 ± 2.59	11.4 ± 3.32	1.2 ± 0.53	3.2	*A. longipes, 25*
C	30.7 ± 3.21	1.0 ± 0.40	0	0	*O. smaragdina, 14; Crematogaster* sp., 9; *Iridomyrmex* sp., 2.
Analysis	*Anova	*Anova	*Anova	Not analysed	
Levels of significance	$p < .001$	$p < .001$	$0.01 < p < 0.05$		

* Data transformed log (x+1) for analysis.

Table 2. *Third survey; the density of* T. rufivena *eggs, larvae, and pupae, parasites and percent parasitism of moth life stages, on palms infested and not infested with* A. longipes.

Mean per palm	Eggs	Larvae	Pupae
Area with crazy ant			
Density	14,991 ± 3002.5	78.4 ± 20.39	4.3 ± 1.13
Percent parasitism	13.2	4.8	16.4
Area without crazy ant			
Density	2,244.8 ± 894.84	4.0 ± 2.5	0
Percent parasitism	7.6	0	0
Parasites recorded	*Trichogramma* sp.	*A. pertiades*	*B. lasus, B. nostoi & T. pupivora*

presence of moth life stages. In addition the axils of fronds, insides of old spathes and the bases of old inflorescences were also searched for life stages. The density of eggs, larvae and pupae was recorded per palm and the life stages held in the laboratory for parasite emergence.

The population density as well as parasitism of moth eggs, larvae and pupae was highest on palms infested with crazy ants (Table 2). No parasites were recovered from larvae and pupae collected from palms not infested with the ant. *Trichogramma* sp. (Hymenoptera: Trichogrammatidae) was reared from moth eggs, while *Apanteles pertiades* Nixon (Hymenoptera: Braconidae) was reared from the larvae. Pupal parasites in order of abundance were *B. lasus, B. nostoi* and *T. pupivorus*. The dominant ant species in the palms without crazy ants were *O. smaragdina* and *Crematogaster sp.* During sampling *C. morio* was recorded at a mean density of 8.6 nymphs and adults per palm on the inflorescences of palms without crazy ants. The earwig was absent from palms with crazy ants.

DISCUSSION

The first and second surveys showed that coconuts infested with crazy ants had up to 77 percent lower production than uninfested palms. Yield declined with increasing density of crazy ant nests. The loss of production was the result of premature nutfall which was caused by spathe moth larvae boring immature nuts.

The second and third surveys showed that palms infested with crazy ants had higher moth populations as well as higher rates of parasitism of moth eggs, larvae and pupae than palms without the ant. On both infested and uninfested palms the rate of pupal parasitism was higher than that of eggs or larvae.

The egg parasite, *Trichogramma* sp., is the first record of this genus from *T. rufivena*. H. Nagaraja (personal communication) has suggested that it may be the same species as has been reared from the eggs of *Ostrinia furnacalis* Guenee (Lepidoptera: Pyralidae) and *Chilo tenellus* Pagenstecher (Lepidoptera: Pyralidae). *A. pertiades* is probably the same species recorded from *T. rufivena* larvae in the Solomon Islands (Lever 1933; Waterhouse and Norris 1987). The absence of *A. pertiades* from larvae in the second survey is probably explained by the fact that the parasite attacks first and second instar larvae, few of which were collected in the second survey (Lever 1933). The pupal parasites, *B. nostoi* and *B. lasus*, have not previously been recorded from *T. rufivena*, while *T. pupivorus* is recorded from Indonesia and Malaysia as both a primary and hyperparasite of *T. rufivena* pupae (Waterhouse and Norris 1987). *B. nostoi, B. lasus* and *T. pupivorus* are recorded as pupal parasites from a broad range of Lepidoptera (Joseph *et al.* 1973; Greve & Ismay, 1983; Boucek 1988).

The low rates of parasitism of moth life stages and the broad host ranges of most of the parasites make it unlikely that any of the parasites recovered in the surveys have the potential to control spathe moth populations. In fact over the moth's geographical range only in Java do parasites exercise any control over moth populations (Waterhouse and Norris 1987). In Fiji a related species, *T. complexa* (Butler), was brought under control by parasites introduced from Java (Cock *et al.* 1985; Waterhouse and Norris 1987).

A. longipes is primarily a scavenger (J. Moxon, personal communication). Haines and Haines (1978 b) found the bodies of dead or dying invertebrates made up most of the solid food material collected by the ant. Way (1953) observed that the ant tolerated insect species which were neither hostile nor a hinderance. Therefore, it seems unlikely that the ant would attack any of the moth parasites found in the current study.

In view of the relatively high rate of pupal parasitism and low rate of larval parasitism in palms infested with crazy ants, it is probable that the ant inhibted the effectiveness of larval predators. In palms without crazy ants the only potential predators observed were other species of ant and *C. morio*. The earwig has previously been recorded feeding on coleopteran and lepidopteran larvae (Risbec 1935; Abraham and Chandy Kurian 1973; Young 1992). The means by which *A. longipes* inhibits foraging by *C. morio* or other larval predators remains unknown.

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