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.

2. THE EFFECT ON YIELD AND NUT SHEDDING OF ANT AND MOTH EXCLUSION.

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ABSTRACT

A trial was carried out on a block of coconuts at Maralumi Estates to test the effect, on yield and nut shedding, of excluding the crazy ant, Anoplolepis longipes, *and the coconut spathe moth,* Tirathaba rufivena, *from palms crowns. There were four treatments, three in the part of the block infested with crazy ants and one in the part without the ant. In two treatments with crazy ants, palm trunks were banded with Osticon [R] to prevent ants moving to and from the crowns. Palms in one of the banded treatments were trunk injected with monocrotophos to kill spathe moth larvae feeding on the inflorescences. The third crazy ant treatment was a control with no attempt to exclude either the ant or spathe moth. Estimates of female flowers and immature nuts shed as well as yield were made at the start and conclusion of the trial. In the treatment without the crazy ant, shedding was less than 40 percent throughout the trial. This figure represented the level of natural shedding. Where crazy ants were not excluded from palm crowns shedding was 75.9 and 68.9 percent respectively at the start and conclusion of the trial. These figures represented natural shedding plus shedding due to spathe moth attack. Banding of palms did not decrease shedding, however injection with monocrotophos decreased shedding by 34.6 percent. Initially, the estimated yield in the treatment without crazy ants was twice that of the other treatments. However by the end of the trial, yield in this treatment had declined so that there were no significant differences between any of the treatments.*

Key words: Anoplolepis longipes, *yield, spathe moth, Morobe Province.*

INTRODUCTION

The shedding of female flowers and immature nuts by the coconut palm is a complex phenomenon, which is broadly covered by the term nutfall. There are two categories of nutfall. Natural nutfall occurs as a result of factors such as; the palm being unable to nourish all the fruits that set, drought, waterlogged soil, or mineral defficiencies. The other category is abnormal nutfall resulting from attacks by pathogens, insects or rats (Lever 1969; Child 1974). Corbett (1931) maintained that the palm was only able to retain a set number of female flowers through to fruit set and ultimately to mature nut formation. He found that when shedding due to attacks by the coconut spathe moth, *Tirathaba rufivena* (Walker) (Lepidoptera: Pyralidae), was reduced, natural shedding increased until the optimum number of set fruits was reached. Corbett concluded that *T. rufivena* would have to bore 58 percent of female flowers before causing any reduction in yield, whereas he found the moth only bored an average of 9.4 percent. Lever (1933) recorded an average of 6 to 8 percent of female flowers bored by *T. rufivena* in the Solomon Islands. T.Ovasuru (personal communication), working with emasculated inflorescences in Papua New Guinea found that *T. rufivena* laid eggs on female flowers and branches of the inflorescence.

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He observed that only 8 to 12 percent of female flowers were attacked by moth larvae in the month after removal of the spathes and male flowers. In the Philippines Cock *et al.* (1985) simulated *Tirathaba spp* damaged by removing nutlets at the age the insect normally attacked them. They found that *Tirathaba spp* could cause short term yield reduction and that the palm compensated poorly for simulated damage, the compensation being worst at low levels of damage and best at high levels. According to Waterhouse and Norris (1987), *Tirathaba spp* only causes sufficient shedding to effect production in the Philippines, elsewhere the moth has little effect on yield.

During 1975 a sharp decline in production was recorded from a block of coconuts at Maralumi Estates, Morobe province, Papua new Guinea (Young, 1996). Young (1996) showed that the decline in production coincided with high populations of *T. rufivena* in palms infested with the crazy ant, *Anoplolepis longipes* (Jerdon) (Hymenoptera: Formicidae). Crazy ants had progressively invaded the block from a nearby stand of abandoned cacao. It was found that nut production was lowest in the part of the block first invaded by crazy ants. Production increased across the block with decreasing ant nest density.

The results presented by Young (1996) seemed to conclusively implicate spathe moth and crazy ant in the loss of production. In order to positively establish this relationship, it was decided to test the effect on yield and nut shedding of excluding the ant and the moth from palms.

METHODS AND MATERIALS

A pre-trial survey of the block was made during June 1977 to estimate crazy ant nest density using twenty 4 m X 4 m quadrats, taken along two transects across the block. Additionally, palms were climbed to determine the proportion of palms infested with the ant.

The trial was established with four (4) treatments. Treatment 1 was situated in the part of the block without crazy ants and treatments 2, 3, and 4 in the part infested with the ant (Table 1). During July 1977, 10 healthy palms were selected for each treatment. Counts of nuts estimated to mature in the next 6 months were made from the ground using binoculars. Female flowers and developing nuts shed per palm were estimated by cutting inflorescences aged between 15 (when all the male flowers had fallen) and 60 days after the spathe had opened. The inflorescences were lowered to the ground so that counts could be made of the number of female flowers and developing nuts shed or retained. Female flowers and immature nuts retained on the inflorescence, but which contained *T. rufivena* larvae, were counted as shed.

When the estimates of yield and percent shedding were completed, the palm trunks in treatments 3 and 4 were banded with 30 cm wide sticky bands of Osticon® to prevent crazy ants climbing the trunks into the palm crowns. The fronds of neighbouring palms were trimmed to prevent the ants moving from unbanded to banded palms.

Palms in treatment 4 were trunk injected with 60 percent monocrotophos in an attempt to exclude *T. rufivena* larvae from the inflorescences. A hole 1.8 cm in diameter and 10 cm deep was drilled at a downward angle of 45 degrees into the base of the trunk and 8 g ai monocrotophos was injected into the hole. Six weeks later a second hole was drilled and a further 12 g ai monocrotophos injected.

It was intended to continue the trial for 2 years making estimates of yield and shedding every 6 months. The second estimate was made during January 1978.

RESULTS

The pre-trial survey of the block during June 1977 revealed that 90 percent of the palms were infested with crazy ants. Thirty metres behind the invasion front the density of nests was found to be 3,125 to 5,000 per hectare. The nests were mainly under fallen fronds and coconuts on the soil surface as well as in the roots and crowns of palms.

The pre-treatment estimate of shedding recorded a mean of 33.6 percent for the treatment without *A. longipes* and 75.9, 67.1 and 78.5 percent, respectively, for treatments 2, 3, and 4 which were infested with the ant (Table 1). The estimate of yield for the treatment without *A. longipes* was 41.4 nuts, while the treatments with the ant recorded 18.0, 16.8 and 16.3 nuts.

The post-treatment estimates, for the treatment without *A. longipes*, were 39.4 percent shedding and the yield decreased to 22.5 nuts. The unbanded palm with *A. longipes* recorded 68.9 percent shedding

Table 1: *Effect on yield and percent shedding of excluding crazy ant by Osticon bands and spathe moth by monocrotophos trunk injections.*

Treatment	Crazy ants present	Chemical application	Percent shedding per palm 1/		Estimate of No. of nuts to mature in the next 6 months	
			Pre-treatment	Post-treatment	Pre-treatment	Post-treatment
1	-	Nil	35.4 a (33.6)	38.9 a (39.4)	41.4 a	22.5
2	+	Nil	60.6 b (75.9)	56.1 b (68.9)	20.0 b	18.0
3	+	Osticon	55.0 b (67.1)	56.5 b (69.6)	19.8 b	16.8
4	+	Osticon + monocrotophos	62.4 b (78.5)	41.5 a (43.9)	21.2 b	16.3
Mean			53.4	48.2	25.6	18.4
Sed			4.10	4.74	3.46	2.99
Significant effect			$p<0.001$	$0.001 \leq p < 0.01$	$0.001 \leq p < 0.01$	n.s.

1/ Percent shedding analysed as angular transformation, back transformed values are shown in brackets. Treatments within each column followed by the same letter do not differ significantly at $p < 0.01$. Means compared by Duncan's multiple range test.

with a yield of 18.0 nuts. Banded palms with *A. longipes* recorded 69.6 percent and a yield of 16.8 nuts. Banded palms with *A. longipes* and injected with monocrotophos recorded 43.9 percent shedding, a decrease of 34.6 percent, with a yield of 16.3 nuts.

The results of the first and second estimate were analysed by analysis of covariance (Table 1). The first estimate of percent shedding of female flowers and young nuts showed that the treatment without crazy ants was significantly different to the treatments with crazy ants. The second estimate showed that the monocrotophos treatment decreased percent shedding by 34.6 percent and did not differ significantly from the treatment without crazy ants.

The first estimate of yield showed the treatment without crazy ants was significantly different to treatments with the ants, however second estimate counts did not differ significantly from one another.

Over the 6 month period, from July 1977 to January 1978, cadavers of *A. longipes* workers accumulated on both the tops and bottoms of the sticky bands. By the end of October *A. longipes* colonies had become extinct in 3 palms in treatment 3 and 4 palms in treatment 4. However, within 8 weeks, 2 of the palms were recolonized by workers carrying brood and dropping from overhanging fronds of unbanded palms onto the fronds of banded palms, indicating that the trimming of fronds was not entirely effective.

The block was inspected during March 1978 revealing that banded palms were showing signs of phytotoxicity as a result of the Osticon treatments. There was shrinkage of the trunks where the sticky bands covered the bark and splitting of the bark adjacent to the bands. Additionally the watertable had risen after the damming of a nearby watercourse, causing waterlogging in parts of the block containing treatment palms. The trial was abandoned in view of the potential effect of these 2 factors on shedding and yield.

DISCUSSION

In the treatment without crazy ants, the first and second estimates showed shedding of female flowers and immature nuts to be 33.6 and 39.4 percent respectively. Assuming the population of *T. rufivena* to be as low as previously recorded by Young (1996), then these figures reflect the normal situation. That is most of the shedding was due to the palms not being able to nourish all of the fruits that set, rather than insect attack (Lever, 1969; Child, 1974). From the work of Corbett (1931), Lever (1993) and T. Ovasuru (personal communication), the insect damage component of shedding was probably less than 10 percent. Additionally, Corbett (1931) concluded that the palm compensated for *Tirathaba* damage by shedding less nuts due to natural causes. If this were the case at Maralumi, then the percent shedding due to *T. rufivena* in palms without crazy ants would have been effectively zero.

The first and second estimates of treatment 2 showed shedding of 75.9 and 68.9 percent respectively. These figures represent natural shedding plus shedding due to spathe moth attack.

Treatment 3 showed that preventing crazy ants from moving to and from the palm crowns did not significantly decrease shedding. Although, if the trial had continued for a longer period and *A. longipes* prevented from recolonizing the crowns, then the ant probably would have become extinct in all of the crowns. This may have led to a decline in spathe moth populations and a subsequent decrease in the amount of nut shedding.

While the sticky bands in treatment 4 had no effect on shedding, trunk injection with monocrotophos decreased shedding by 34.6 percent. Additionally the second estimate of shedding in treatments 1 and 4 were not significantly different, indicating that shedding in the second estimate of treatment 4 was due to physiological causes.

The normal level of shedding recorded in the trial was lower than the 58 percent recorded by Corbett (1931) in West Malaysia. Counts of shedding during the trial would have been an underestimate since younger inflorescences would give lower counts than older ones. Further, the level of normal shedding is probably dependent upon genetic, nutritional and climatic factors (Lever 1933; Child 1974).

The first estimate of yield in treatment 1 was approximately twice that of the other treatments. However the second estimate showed no significant differences in yield. The removal of inflorescences during the first estimate would have reduced the potential number of 6 month old nuts present at the time of the second estimate. If this were the case then the decrease in yield from the first to the second estimate would have been expected to be a similar percentage for all treatments. Instead the decrease in yield was 46, 10, 15, and 23 percent for treatments 1, 2, 3 and 4 respectively. The period between July and January includes some of the driest months of the year (Young 1996). Perhaps under the prevailing conditions, the second estimate yield ranging from 16 to 22 nuts was the maximum number the palms could nuture. Estimates of the proportion of female flowers that yield ripe nuts vary from 25 to 35 percent (Lever 1969; Child 1974). Child quotes the work of Abeywardena and Mathes in Sri Lanka, who showed that 24 percent of nuts that set fell after 2 months and a further 52 percent fell between 2 and 6 months. The second estimate yields for treatments 1 and 4 are probably the result of negligible shedding from insects attack in the first 2 months with the majority of nutfall occurring between 2 and 6 months from moisture stress and other physical factors. While the yield for treatments 2 and 3 were probably the result of a high level of shedding from *T. rufivena* attack in the first 2 months with little additional nutfall after this time.

Prior to the invasion of the block by crazy ants, the annual production was estimated at 60 nuts per palm (T. Leahy, personal communication). The yield results in the treatment without crazy ants roughly agrees with this estimate, that is 41 nuts during the wet season and 22 nuts during the dry season. From the available evidence in the 3 treatments with crazy ants, *T. rufivena* had a greater effect on yield in the wet than the dry season.

The extinction of crazy ant nests in the crowns of banded palms in treatments 3 and 4 shows that crown nests are dependent on food, probably protein, collected on the ground. Way (1953) also found that banding palms led to the extinction of *A. longipes* in the crown.

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