Investigation Of Earwigs As A Biological Control Agent Of *Tirathaba Mundella* (Lepidoptera: Pyralidae)

Adi Sumantri, Hanifah Mutia Z. N. Amrul

Abstract

Infestation of developing oil palm bunches by Tirathaba mundella is common in most young plantings in South East Asia, especially in extensive new development areas. In severe infestations, abortion of fruit bunches has been recorded. Further, the pest may cause fruitlet to fall prematurely, or to develop with a hollow centre instead of a kernel. Such losses can be of economic significance. In the past, control has been achieved by application of insecticides. Tirathaba is subject to a number of insect natural enemies, earwigs that are commonly found in bunches. The present study has noted a correlation between caterpillar and earwig numbers per bunch, $R^2 = 0,5$. It is reasonable to assume that the earwigs are predatory on Tirathaba and play a part in their regulation at low numbers, even though cause and effect may be difficult to prove. A trial showed a negative correlation between earwigs numbers and percentage of palms positive for signs of Tirathaba incidence, and a positive correlation of earwigs to Tirathaba numbers in infested bunches. An investigation into introducing earwigs to young palms indicated that the decline in Tirathaba numbers with increasing palm age can be speeded up, and, by implication, that the decline itself may be due to earwigs. Removal of developing bunches around six to twelve months before opening up for commercial harvesting ("castration" or "ablation") is sometimes practised. Generally, the intention is to remove bunches that are failing in association with Tirathaba presence. A trial indicated that this does break the Tirathaba cycle of re-infestation, but did not suggest a major effect on bunch fruit set characteristics, by the time of harvesting.

***Keywords**: Tirathaba, earwigs, predator, natural enemy*

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Introduction

Tirathaba mundella can be found in most oil palm plantings, in both Malaysia and Indonesia. The caterpillars feed in the developing fruit bunches. It is usually at levels below economic threshold, but it sometimes becomes numerous mostly in immaturity and in the first year of production, but older plantings can also be badly infested. *Tirathaba* caterpillars are light to dark brown in color, becoming a lighter brown through late instars and it grows to 30-40 mm long. The life cycle takes about 1 month to complete. Eggs are laid in masses of 4 to 20 on the female and male inflorescences or on reproductive parts of other food plants. They hatch in about 4 days, and then enter a larval phase for 14 to 21 days. The pupa is brownish black and takes place inside in the bunch in silky cocoons covered with feces and plant debris. This stage takes 10 to 12 days to complete. Adults are basically silvery-grey and with a slight greenish tinge, with a wing span of 20 to 25 mm. The male is slightly smaller than is the female (Wood and Ng Kwang Yew, 1974, Susanto, et all 2011).

Normally only outer parts of the fruit (the epidermis) are eaten but sometimes the caterpillar, especially on young fruits, can reach and destroy the kernel. Severe attacks in the kernel can lead to fruit bunch abortion or the fruit no longer having a kernel. It is very easy from the damage to recognize the symptoms of bunches infested by *Tirathaba.* Both inflorescences and fruit bunch have masses of debris present, which has a reddish to brown color. This is produced by the larvae and comprises a mixture of feces, insect secretions, and accumulation of plant fibres, giving very characteristic appearance. Confirmation of *Tirathaba* infestation can be made by cutting a suspect bunch to check for the caterpillars.

Chemical control is relatively easy but with the cost and the risk of side effects, it is preferably avoided. The latter includes the possibility of adversely affecting the various insect natural enemies (parasites and predators) of the pest. It was observed that at the time when *Tirathaba* might be building up, there is a corresponding increase in the number of earwigs in the bunches. This is a predatory insect. In laboratory observations it was recorded that earwigs would kill and consume up to three caterpillars per day. The hypothesis was tested that earwigs are involved in regulating *Tirathaba* field populations and three field trials were established to investigate.

Literature Review

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Research Methodology

This trial were located in Lonsum's plantations in South Sumatra (2-3º S, 103-104º E) and further observation on ablation of developing bunches in North Sumatra. This was conducted in 20 rows x 27 or 28 palms plots (4 ha) in a 75 ha field which had *Tirathaba* infestation without any control measures, to investigate the effect of earwigs predators on *Tirathaba* infestation in palms in the first 3 years of maturity i.e. years 3 to 5 after field planting. It was carried out in a randomized block design. The number of *Tirathaba* and earwigs was counted on selected bunches by cutting off the bunches which normally are ready to harvest 6 months after anthesis. Trial bunches were cut at 2 months. The bunches were taken from 15 well separated plots. The assessment plots comprised 2 adjacent palms rows of 27 and 28 palms respectively. A census was carried out every month and the number of palms with *Tirathaba* infestation symptoms was recorded.

The trial investigated supplementary natural control of *Tirathaba* by releasing earwigs in early mature palms at 3 planting years (36 months). It was carried out in a randomized block design in two locations, one surrounded by early mature palms (36 months), and the second surrounded by mature palms (60 months), with 4 replicates at each site and two treatments, each plot of 4 ha, total area 64 ha. The treatment was to release 15 earwigs per palm in both sites. The bunch sample and palms census was the same as in the Trial 1.

This observation of earwig distribution and the effect of ablation on the incidence of *Tirathaba* in new (development) plantings, especially in remote areas, was carried out in palms at 2 years after planting.

The treatments were as follows:

- ablation of developing bunches at 20, 22 and 24 months after planting
- ablation once, 24 months
- no ablation (untreated control)

Layout : 35 x 30 palms (7.3 ha), with 3 replicates, 3 palms guard rows, in 60 palms per plot

Monitoring :

- infestation details: a random sample of ten bunches were collected with a clear indication of *Tirathaba* infestation
- monthly recording in each plot

Bunch characteristics: 10 bunches harvested from a random sample of palms in each plot , to assess % fruit set, % infertile flowers, and % parthenocarpic fruit.

Results and Discussion

The results from the three trials are summarized in Figures 1, 2, 3 (trial 1), Figures 4, 5 (trial

2) and Figures 6,7, 8 (trial 3).

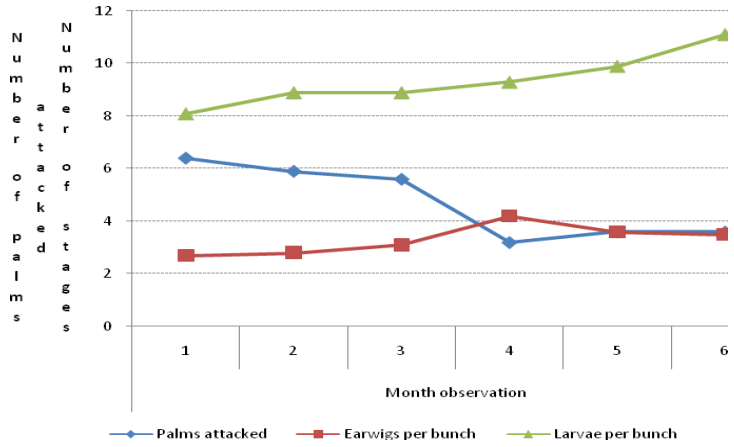

Figure 1: Relationship between number of palms infested by *Tirathaba* larvae and earwigs per bunch during a six months observation on three year old palms

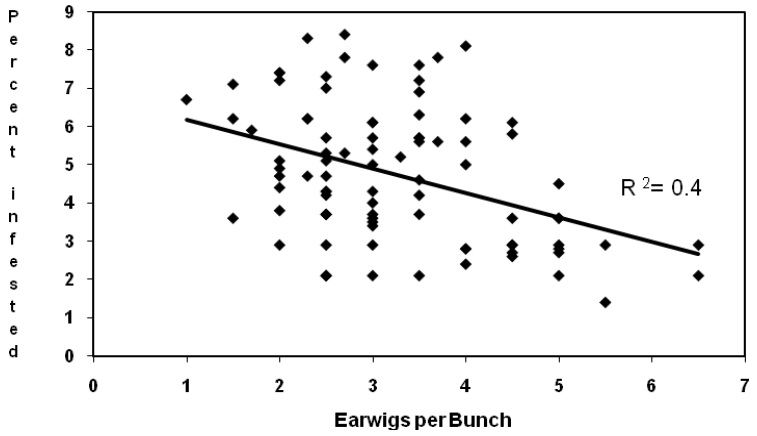

Figure 2: Correlation between percentage of palms infested by *Tirathaba* with earwigs per bunch in three year old palms

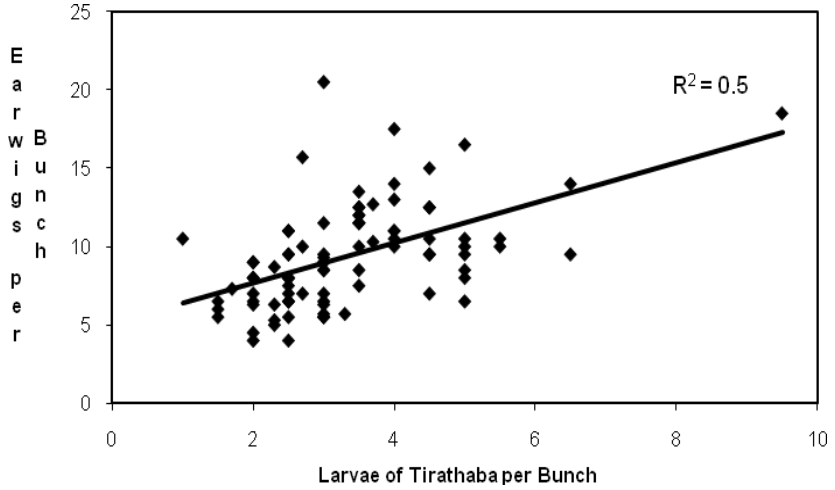

Figure 3: Correlation between number of earwigs and *Tirathaba* larvae per bunch in three year old palms

The results in Figure 1 show that the infestation of *Tirathaba* decreased over 6 months observation in the field without any control measures and during which time the population of earwigs per bunch increased. Observation showed that the population of larvae and earwigs per bunch fluctuates, and indicates that the population of earwigs per bunch during that time decreased or increased more at less in line with changes in the number of caterpillars. There was also a clear correlation between the number of earwigs and *Tirathaba* larvae (figure 3). This suggests that the earwigs are attracted to the bunch if there are plenty larvae of *Tirathaba* available in the bunch. The populations of earwigs have spread to all fields and this may explain how the *Tirathaba* is kept under control. The relationship between numbers of palm infested was confirmed by a significant negative correlation between number of earwigs per bunch and number of palms infested (figure 2). Shows that earwigs a potential predator to control *Tirathaba* infestation in new mature oil palm.

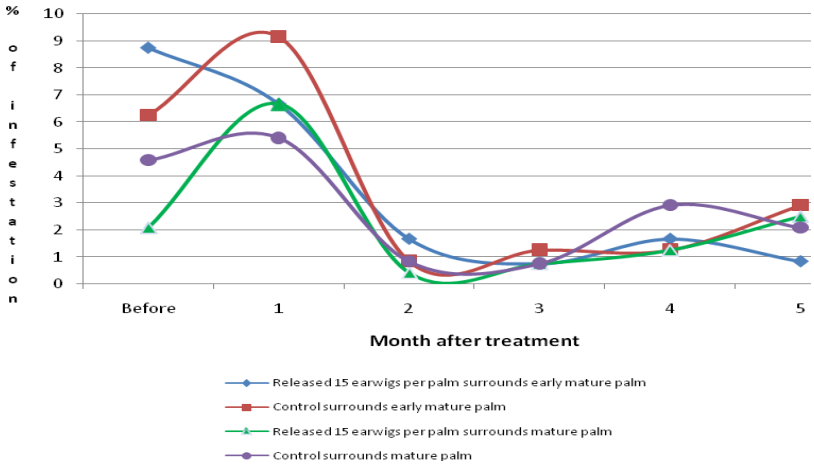

Figure 4: The percentage of palms infested by *Tirathaba* after introducing earwigs in the location both surrounded by early mature and mature palms up to 5 months

As indicated in figure 4, there was a lower percentage of *Tirathaba* infestation in the sites surrounded by mature palms rather than early mature palms at two up to four months after treatment; although the difference is not statistically significant.

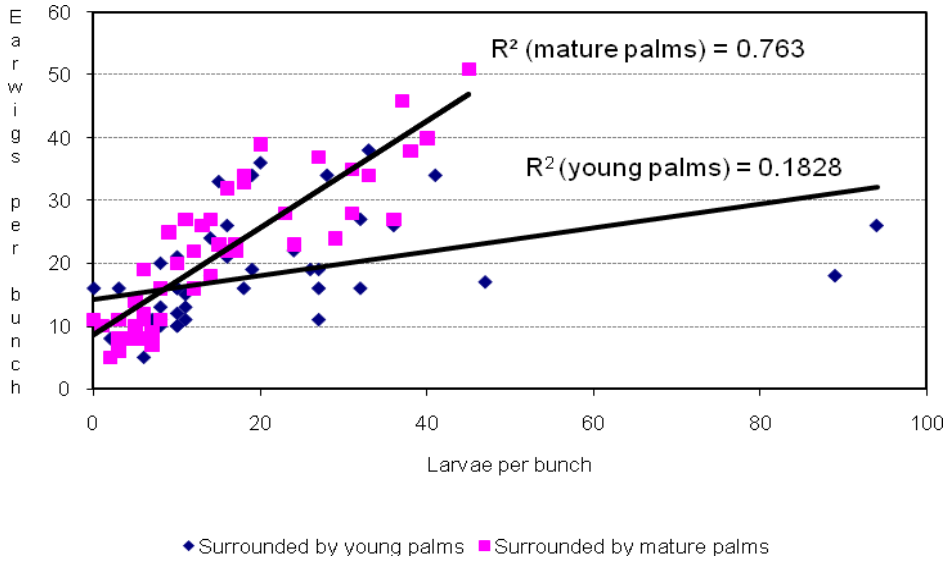

Figure 5: Correlation between number of earwigs and *Tirathaba* larvae per bunch in two locations respectively surrounded by mature and young palms

The results in Figure 5 show a significant difference between the number of earwigs and *Tirathaba* larvae in palms surrounded respectively by mature (5 years), and by young (3 years) palms. It further indicates that there is a strong positive correlation between the number of earwigs and *Tirathaba* larvae in palms surrounded by older palms, which suggests that earwigs have built up sufficiently in that situation.

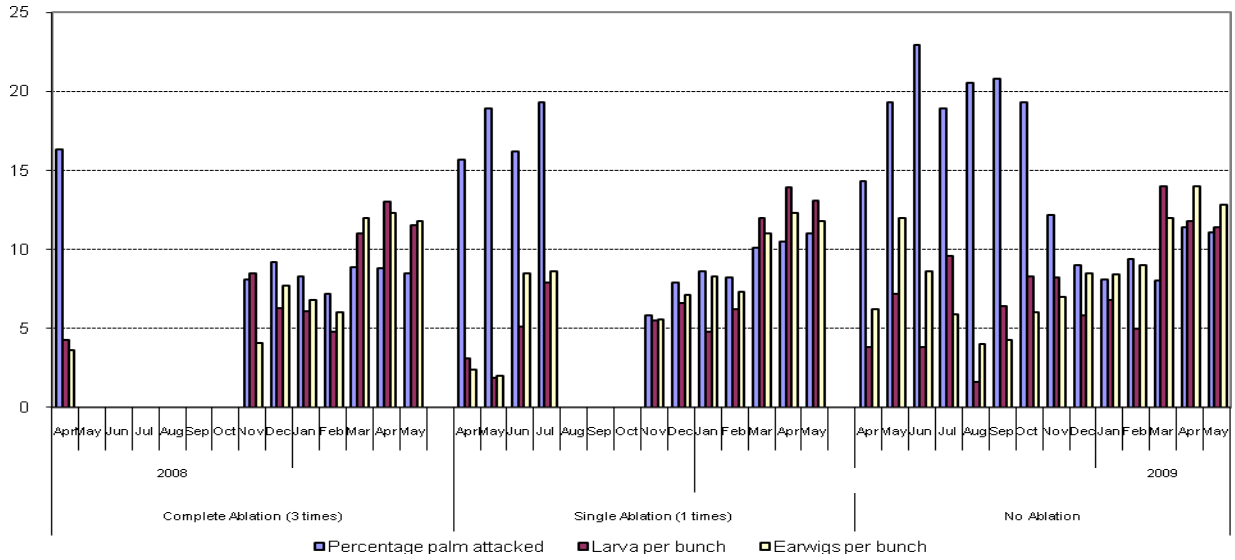

Figure 6: Percentage of palms infested, number of larvae, and earwigs per bunch in the ablation plots

The results in Figure 6 show that there are fluctuations in the percentage of palms infested, and in the number of larvae and earwigs per bunch, over seven months observation in the field. It seems that ablation (removal of female flowers and black bunches) can help to reduce infestation by removing source of *Tirathaba* infestation. All treatments showed that percentage of *Tirathaba* infestation is higher during periods of ablation, and all were in the same range after ablation.

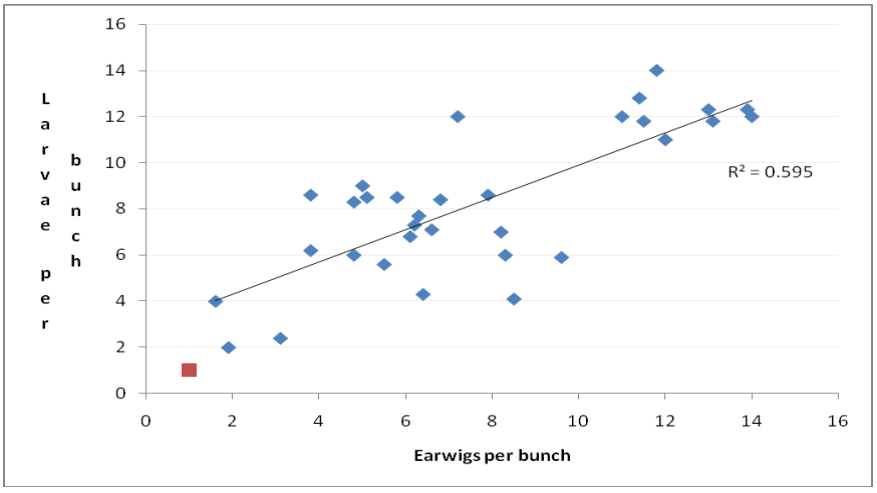

Figure 7: Correlation between number of *Tirathaba* larvae with earwigs per bunch in the ablation plots

Observation on larvae and earwigs showed that the population of larvae and earwigs per bunch fluctuates, and indicates that the population of earwigs during that time showed that the population of earwigs per bunch decreased or increased more at less in line with changes in the number of larvae. There was also a clear correlation between number of Earwigs and *Tirathaba*

larvae. It suggests that the earwigs are attracted to the bunch if there are larvae of *Tirathaba* available in the bunch. It shows that the populations of earwigs have spread to all

fields - that may be the way the population *Tirathaba* is kept under control, including in the no ablation treatment plot.

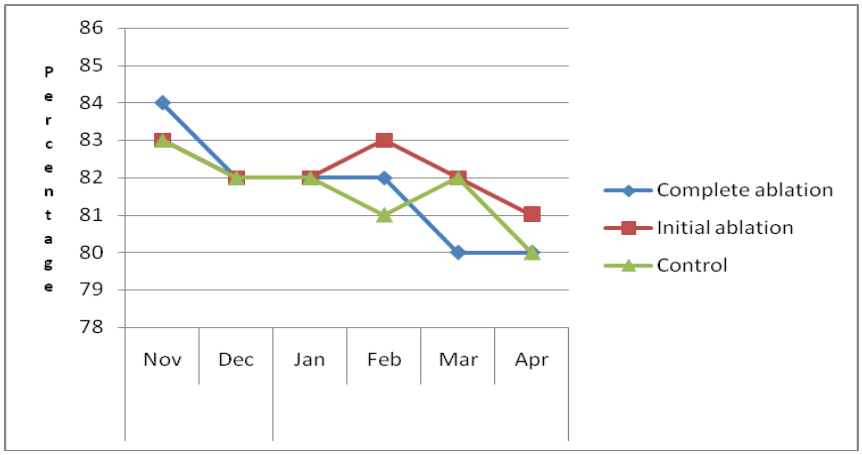

Figure 8: Percentage fruit set in different treatments for 6 months observation

It seems that the percentage of fruit set in the area between complete, single and no ablation is similar starting and the percentage of fruit set generally is adequate, at 80%. Similar results were shown for the ratio of infertile and parthenocarpic fruit among all treatments.

Further observation in North Sumatra for new replanting area for the ratio of infertile and parthenocarpic were shown adequate, more than 80%.

Conclusion

Earwigs are a potential predator to control *Tirathaba* infestation in new development plantings. There was a clear correlation between the number of earwigs and *Tirathaba* larvae per bunch, the earwigs are more common in bunches with larvae of *Tirathaba*.

It shows that the population of earwigs has spread to all fields, fresh damage and number of larvae were declined which is confirmed that earwigs play a crucial role as a natural control mechanism for *Tirathaba.* Future studies will compare the build up of earwig populations with and without *Tirathaba* in this location.

References

[1] Adiwijaya M S, Petunjuk Praktis Berkebun Kelapa Sawit. PT. Tunas Sawit Mandiri. Indonesia. P 107-110. 2012

[2] Khoo Khay Chong, Peter AC Ooi & Ho Cheng Tuck, Crop pests and their management in Malaysia. Tropical press Sdn. Bhd. Kuala Lumpur p 153-154. 1991.

[3] Sumantri A, Observation of Earwigs Distribution and the Effect of Castration on The Incidence of Tirathaba in New Development Areas. Annual Report Bah Lias Research Station Volume 1 p 339 – 341. 2008.
[4] Susanto A, Sudharto, Rozziansha Perdana TA, Penggerek Tandan Kelapa Sawit Tirathaba mundella Walker. Pusat Penelitian Kelapa Sawit. Vol H-0004. 2011
[5] Turner P D and R A Gillbanks, Oil palm cultivation and management (2 nd edition).
[6] The incorporated society of planter. Kuala Lumpur p 570-572. 2003
[7] Wood B J & Ng Kwang Yew, Studies on the biology and control of the oil palm bunch moth, Tirathaba mundella (Walker) (Lepidoptera:Pyralidae). Malayan Agricultural Journal, 49(3):310-331. 1974.