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Comparative synergetic effect of coconut palm (Cocos nucifera L.) slices and bunches residue of oil palm (Elaeis guineensis JACQ.) associated with two kinds of pheromone traps on Oryctes monoceros OLIVIER trapping in Côte d'Ivoire.

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***Abstract*—*Oryctesmonoceros* (Coleoptera, Dynastidae) is one of the most dangerous pests of coconut palm and oil palm plantation in Côte d'Ivoire. In order to create a method to reduce these pests' populations, a trapping trial with the pheromone was carried out for 4 months in the seed garden of the station "Robert Michaux" from the CNRA (Centre National de RechercheAgronomique). Two kinds of traps (PVC tube and buckets), using pheromone 4-methyloctanoate ethyl associated with coconut palm slices or bunches residue of oil palm as attractive materials were tested. Coconut stem slices were used two and half months after felling the palms. The bunches residue of oil palm where taken one week after the machining. To assess the daily and monthly quantities of diffused pheromone, diffusers were weighed at the setting up of the experiment, then every month for 4 months. The traps were observed every 3 days by collecting the captured *Oryctes*. The number of the *Oryctes* captured in PVC tube varied from 15 to 18 as against 12 in buckets during the first three months, whatever the associated synergetic material. Coconut palm slices must be recommended to farmers, because associated with pheromone, they allowed the capturing of more *Oryctes* than bunches residue of oil palm. The replacement of the pheromone must take place every 3 months. Beyond such a delay, pheromone diffusers empty. The mass capture with pheromone allowed the effective controlling *Oryctes* in coconut farms.**

Keywords*—Aggregation pheromone, coattractant, coconut palm, mass trapping, *Oryctes

I. Introduction

In Côte d'Ivoire, coconut palm (*Cocosnucifera* L.) is cultivated about 50 000 hectares and produces on average 45 000 tons of copra per year and an unknown but large amount of fruits for local consumption (Ouvrier, 1995). The coconut crop represents the main source of income of populations living in coastal region. Moreover, its expansion is limited by diseases and pests of which the most dangerous is *Oryctesmonoceros*. This one is very aggressive on young plants of less than 5 years old (Julia and Mariau,1976 a,b). The damages caused by this pest express by the digging of galleries on young leaves basis. Its attacks either delay the young plants development or cause some losses greater than 30 % (Julia et Brunin, 1974; Mariau, 1974; Mariau, 1981). To control this insect pest, one of the traditional farming techniques is to remove old felled trunks by burying, collecting or incinerating. Incinerating by fire has a harmful effect on the soil. Another farming technique to control *Oryctesmonoceros* consists in setting the leguminous plant *Puerariajavanica* that could recover the old felled trunks (Julia et Mariau, 1976 a,b). This method is very difficult to apply on quaternary sands, poor in organic matter and nutrients. Other control methods such as the digging of grub lodging, manual collecting of insect pests on attacked young plants and biological control by virus *Rhabdionvirusoryctes* were proposed (Julia et Mariau, 1976b; Vayssier, 1966).

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Likewise, the frequent use of non systemic insecticides is not always efficiency because of their short action duration in rainy season (less than one week). In the same way, these insecticides pollute the environment (Mariau, 1981).

The application of these methods is very expensive in relation to the cost of labour related to the high planting density of coconut palms (143, 160 or 205 trees.ha^{-1} for talls, hybrids or dwarfs). Often, the expected result is not reached.

Thus the replanted plots are severely threatened by *Oryctes monoceros* because of the presence of old coconut palm trunks left in decomposition in fields.

Other research ways were looked for to solve the problems caused by this insect pest. Thus, the olfactory trapping with ethyl chrysantemate (Rhinolure) was the first undertaken by Julia and Mariau (1976b). The application of this method was not entirely satisfactory because the number of captured insect pests is remained weak (Allou*et al.*, 2002). Another compound, 4- ethyl methyloctanoate (4-moe) was discovered in 1990 (Rochat*et al.*, 1993 ; Morin *et al.*, 1997 ; Rochat*et al.*, 2004). The effectiveness of this compound was tested in Indonesia by Morin (2001 a;b), in Côte d'Ivoire by Allou*et al.* (2006 a ; 2008). The association of 4-moe with bunches residue of oil palm allowed the improving of the mass trapping of *O. monoceros* in Côte d'Ivoire (Allou*et al.*, 2000 a,b ; Allou*et al.*, 2002). In contrast, the scarcity of bunches residue of oil palm in coastal area has constrained the researchers to find substitutes such as coconut palm slices for *O. monoceros* mass trapping with pheromone. No study has been conducted about the effect of the combining of pheromone 4-moe with coconut palm slices as well as trapping type. The use of coconut slices could improve the capture of this insect pest.

The present work both aimed to test the effectiveness of bunches residue of oil palm substitution by coconut palm slices in *O. monoceros* olfactory trapping with the pheromone 4-moe and determine the lifetime of the latter in field in order to optimize the insect pests capture.

II. Materials and Methods

A. Study site and plant material

The experiment was carried out from March to July 2008 at the station "Robert Michaux" from the CNRA (Centre National de Recherche Agronomique) located at Dabou (Côte d'Ivoire). Its latitude is 5°12' North and longitude 3°34' West. This station is 65 km apart from Abidjan. Its area is 4000 hectares planted with oil palms in which exists the seed garden of coconut palms. The yearly mean rainfall is 1750 mm for these 10 last years. The mean temperature and relative humidity varied from 26 to 30°C and 77 to 88 %, respectively (Allou, 2008).

The coconut plantation studied is a seed garden planted in 1997 with the variety Malayan Yellow Dwarf as mother tree (Bourdeix*et al.,* 2005). It covers 19 ha with a planting density of 205 trees.ha^{-1}. Two plant materials were tested in trappings. First, bunches residue of oil palm and coconut palm slices conditioned according to Allou's method (2006 a, b and 2008). Bunches residue of *Elaeisguineensis*Jacq., were obtained after the machining. They were one week old and occupied 15 l volume per trapping. Second, coconut slices obtained after felling of coconut palm. They were dissected into slices of 6 cm thickness and exposed in field on the ground, in natural condition for 2.5 months. These slices were watered during the relatively dry days without rain. Every fragment was dissected into 4 parts placed in a volume of 15 l for each trapping.

B. Attractive chemical and trappings design

The pheromone ethyl 4- methyloctanoate (4-moe) was used. This natural pheromone produced by abdomen of the male pest was synthesized by EGNO-Chimie at Tancarville in France (Gries et al., 1994). It is contained in polyethylene bag at high density (PEHD) measuring 25 x 50 mm and conditioned in Alphast film of 200 µm thickness. Its weight varied from 1.03 to 1.45 g after decanting the pheromone in diffuser of trap. Its chemical formula is CH3-(CH2)2-C2H4 –COO-C2H5. As for trapping, two capture material types were tested: 1) Plastic buckets of 30 l capacity equipped with a cover measuring 5 cm diameter and perforated of 5 holes (figure1). They were suspended on bamboo stems at 1.5 m from the ground (figure 2), and 2) PVC tubes of 2 m height and 16 cm diameter, of which the basis was placed in buckets of 20 cm diameter and 40 cm height (figure 3). These PVC tubes have 2 windows measuring 20 cm x 10 cm and are not covered at apex. A diffuser was placed within buckets and PVC tube by means of a wire. It was protected by plasticized cardboard (figure 4).

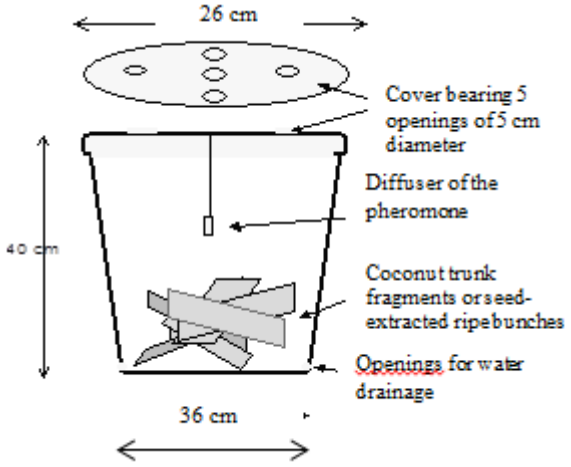

Figure 1: Trapping consisting of bucket of 30 l volume containing coconut trunk fragments or seed-extracted ripe bunches in rotteness.

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Figure 2: Trapping at bucket hung up on bamboo stem in field.

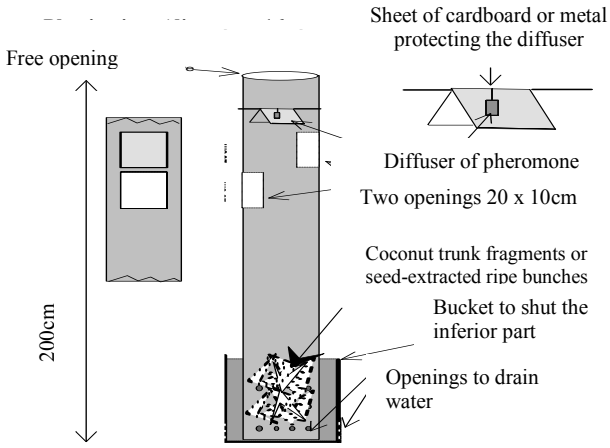

Figure 3: Diagram of trapping in plastic pipes containing the seed-extracted ripe bunches of oil palm or coconut trunk fragments in rotteness. To visit the trapping and collect the pests, we must pull out the pipe

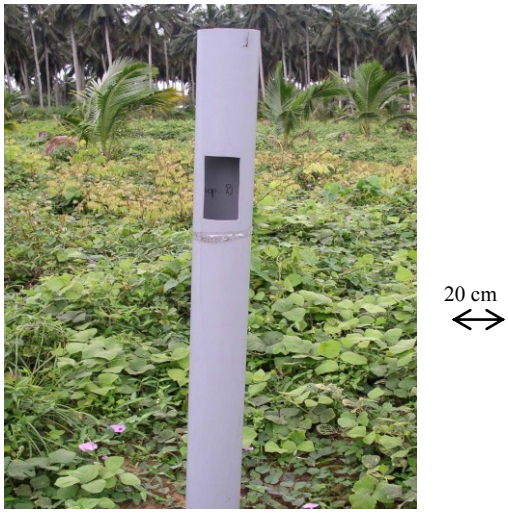

Figure 4: Trapping in plastic pipes set in field.

C. Experimental design and measured variables

A completely randomized design with 2x2 factorial scheme and 8 replications were built. In all, 32 treatments that is to say 32 traps were set up. The different variants of factors were combined to constitute the treatments as follows: T1, bunches residue of oil palm associated with pheromone 4-moe in buckets; T2, bunches residue of oil palm combined with pheromone 4-moe in PVC tube; T3, coconut palm trunk associated with pheromone 4-moe in buckets; T4, coconut palm trunk combined with pheromone 4-moe in PVC tube.

Trappings were far from 50 m and the distance between two replications was 100 m. Trappings were monitored every 3 days in the course of which the number of captured pests was scored. Each scoring was followed by a trappings randomization every 6 days to avoid their position effect. The diffusers were weighed at the beginning of the experiment and then every month.

D. Statistical analysis

The statistical analyses as a whole were carried out with the 5th edition of Genstat software. The collected data were processed by two-way ANOVA. The means were separate according to the Newman-Keuls test at 5% likelihood. Prior, the normality of measured distributions and equality of variances of studied sub-populations were verified.

III. RESULTS

A. Effectiveness of trapping according to synergetic material

Significant differences were recorded between the two synergetic materials at the first (P = 0.044) and the third month (P = 0.048). In contrast, no statistical difference was evidenced between the two materials at the second (P = 0.358) and the fourth month (P = 0.589). In the course of the first three months, the number of captured pests varied from 10 to 12 with bunches residue of oil palm, as against 16 to 20 with coconut palm slices. In the fourth month 7 pests were captured in bunches of oil palm trapping, while in that of coconut slices 5 were it (figure 5).

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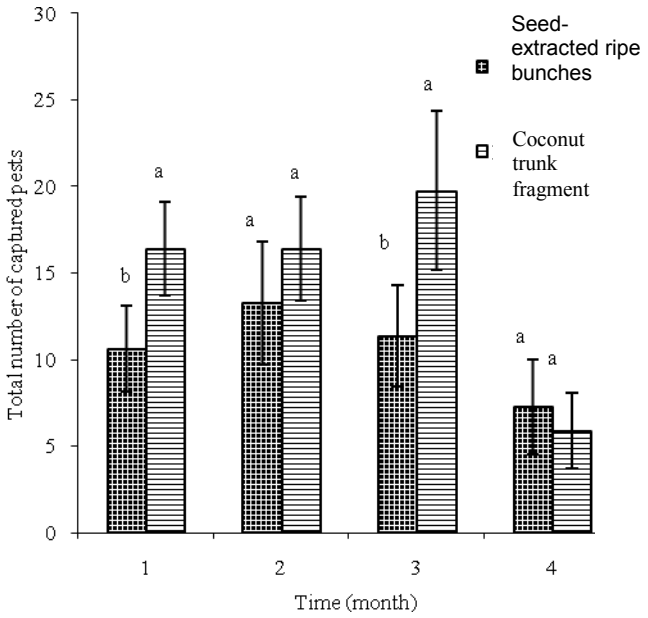

Figure 5: Capture of *Oryctes monoceros* as a function of synergetic material for 4 months.
The histograms bearing the same letters are not significantly different according to Newman-Keuls' test at 5% significance level

B. *Effectiveness of trapping according to the PVC tube or bucket*

Some significantly different captures were noted between the two trapping types in the second, third and fourth month, with probability 0.046, 0.038 and 0.035, respectively. However, no statistical difference was observed between the PVC tubes trapping and that of buckets in the first month.

Furthermore, in buckets the captures were comparable in the course of the first three months with 12 captured pests. For the PVC tubes, these captures oscillated from 15 to 18 pests. In the fourth month they diminished from 12 to 3 in bucket, whereas in PVC tubes such a diminishing was from 15 to 8 pests (figure 6).

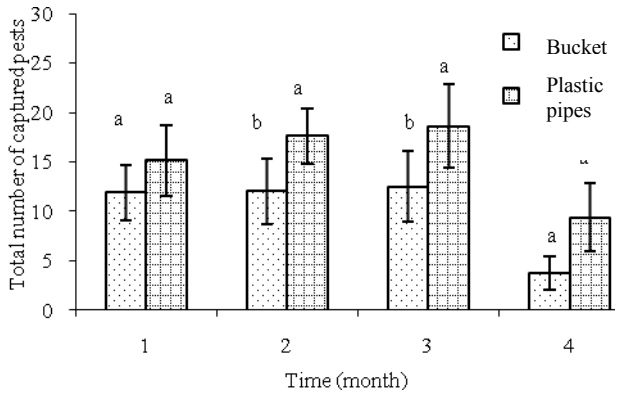

Figure 6: Capture of *Oryctes monoceros* as a function of trapping type for 4 months

The histograms surmounted by the same letters are not significantly different after Newman-Keuls' test at 5% likelihood.

C. *Maximum lifetime of the pheromone in the diffuser*

In the first three months, no statistical difference was noted in relation to the number of captured pests in the two trapping types. In this time interval, the quantity of the diffused pheromone decreased from 12 to 4 mg/day. The captured pests fluctuated from 27 to 31. In the fourth month the captures significantly decreased from 27 to 11 pests. This corresponded with diffusion of 0.12 mg/day (figure 7).

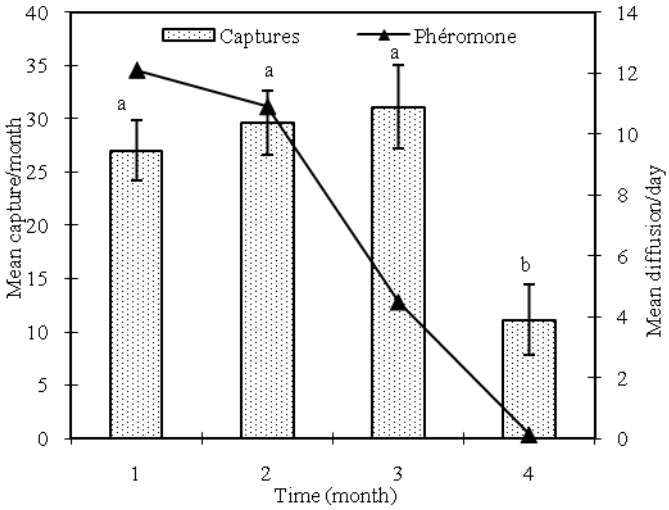

Figure 7: Capture of *Oryctesmonoceros* as a function of diffused pheromone quantity per day for 4 months.

IV. DISCUSSION

The effectiveness of the trapping type, synergetic material and pheromone on the number of captured pests was investigated. In Indonesia, the Morin's works (2001a, b) have reported the effectiveness of the pheromone 4-moe associated with bunches residue of oil palm. In Côte d'Ivoire our works demonstrate the effectiveness of the coconut slices as substitutes for bunches residue of oil palm combined with the pheromone 4-moe.

Regarding the effectiveness of trapping type, the PVC tubes captured more of pests than buckets (Fig. 6). Sure enough, the general appearance of PVC tubes in relation to height, cylindrical form, vertical position and existence of openings does think of a young coconut palm. Concerning the height, it was the same for the two trapping types. Our results were similar to the ones reported in Allou et al. (2006 a ; 2008). Let us note that, the pest prefers attacking young coconut palms fewer than 5-year old of which the height is low. For this purpose, it seems to be attracted by coconut palms of which terminal bud is easily attainable.

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With respect to vertical position and trapping form, the PVC tube is like isolated and old trunk devoid of crown. It was proved that the old coconut trunks on foot better favour the reproduction of *Oryctes* than the cut down trunks (Morin et al., 2001a). As for the openings, those of PVC tubes are larger than those of buckets. Indeed, more than 3 pests can penetrate in PVC tube, while in bucket 2 already may hinder.

Moreover, it was also showed that the pest prefers debris from plants in decomposition. Such a preference finds an explanation in sexual reproduction of this pest. Indeed, the mating and egg-laying require a favourable host allowing the building of shelters and feeding of larva. In brief, the PVC tubes must be advised to farmers for olfactory trapping of *Oryctesmonoceros*.

As regards the synergetic material, the coconut slices favoured better capture than bunches residue of oil palm. The synergetic odour both resulting from 4-moe and coconut slices is better perceived by *Oryctes* than that of 4-moe associated with bunches residue of oil palm. A similar result was reported in Koue-bi (2006). So, the first above mentioned synergetic odour could release volatile substances more attractive than those of bunches residue aged 2.5 months (Allou et al., 2008). The odour from 4-moe combined with bunches residue of oil palm is like that of pungent urine less attractive and therefore would be less perceptible for *Oryctes*. It is possible that this odour have a link with the food that larva will eat. Likewise, rotting state exerts an influence on the pests capture. Sure enough, more the plant material is old and rotten, more it attracts *Oryctes* (Allou et al., 2008). So, the coconut slices must be recommended to farmers in association with 4-moe to protect their farms.

With respect to the maximal lifetime of the pheromone in diffuser at field with coconut slices, this one was 3 months. Beyond such a delay, we noted a decreasing of captured number of pests (fig. 5 and 6). Now, the sole effect of the 4-moe remained 2 months without synergetic material (Allou et al., 2006 b; Allou et al., 2008). We can admit that the synergetic material extended the effect duration of the pheromone. For diffuser containing 0.80 à 1 g pheromone, the mean daily diffusion is 12 - 4 mg/day for the first two months. Beyond, such a weigh decreased 0.12 mg/day. In short, in the associating with coconut slices, the pheromone 4-moe must be renewed after 3 months.

V. CONCLUSION

Our work consisted in testing the assumption according to which the coconut slices could be used as substitute for bunches residue of oil palm in trappings with pheromone 4-moe. This substitute was better than initial synergetic material consisting of bunches residue of oil palm. Our study showed that the PVC tubes captured more *Oryctes* than buckets.

So we recommended its use to coconut farmers. Likewise, the coconut slices aged at least 2 months allowed the capturing of more pests than bunches residue of oil palm. It can be used as substitute for the latter material if this one becomes scarce. Therefore, we advised its use in all cultivation areas of coconut palms. Furthermore, in the presence of synergetic material represented by coconut slices, the duration of pheromone effect extended 3 months instead of 2. Consequently, the pheromone must be renewed every 3 months in the association with synergetic coconut slices.

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