ABSTRACTS (PH D THESIS)

Studies on mass culture and aggregation pheromones in the exotic powderpost beetle, *Lyctus africanus* Lesne (Coleoptera: Lyctinae)

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Lyctus africanus, a powderpost beetle belonging to Lyctinae subfamily in Bostrichidae family, is an important pest owing to its migration into new countries, and it has been considered to be one of the major pests threatening timber and wood products, including plywood, dried roots, seeds and tubers. Lyctine damage is mostly identified belatedly by reason of poor knowledge and skill to locate and monitor the infestation. Unfortunately, there is still no device for detecting and monitoring Lyctine beetles in the field due to the lack of sufficient data on their ecological features. Thus, strategies for monitoring and controlling this beetle by examining the Lyctine ecology are urgently needed. To accomplish the study, establishment of the mass culture of *L. africanus* was also elaborated. This study aims at the establishment of the mass culture and monitoring system for *L. africanus*.

To establish the mass culture of *L. africanus*, the significance of artificial diet quality toward fecundity and also population of the *Lyctus* were evaluated to find standard diet for rearing *L. africanus* in laboratory before conducting further study on aggregation behavior of *L. africanus*.

In experiment, the usefulness of some artificial diets with different fillers were evaluated to improve the growth of *L. africanus*. *L. africanus* were raised in three types of diets (wood- [Diet 1], and celluolose- [Diet 2 and Diet 3] based diet). A group of five females and males *L. africanus* were liberated onto the diet and allowed to complete the life cycle. The new generations were harvested and then subjected to several experiment, such as oviposition test, total population measurement and also determination of sex ratio and body weight of the beetle.

The number of laid eggs and survived adults after oviposition test were observed. The results revealed that combination of starch and sugar acted as oviposition stimulant for *Lyctus* adults emerged from Diet 1, Diet 2, and Diet 3. The adults emerging from cellulose-based diets (Diet 2 and Diet 3) were likely to oviposit more eggs than what Diet 1-emerged adult did, which indicated that cellulose might support the oviposition ability of *L. africanus*. However, all adults emerging from three diets survived in the same values after laying eggs on both oviposition sites.

Furthermore, the newly emerged beetles were harvested and observed the total population of larvae, adults, as well as sex ratio and body weight measurement. The results on larval number indicated that total larvae was similar among the three diets. For adult stage, sex ratio and body weight of *L. africanus* were similar among the three diets, however, the total adults was significantly lower in the Diet 3 than the other diets (Table 1). It was suggested that the amount of vital nutrient (starch) in the diet is not the only important factor to be considered when selecting a diet for *L. africanus*. The filler should also enhance oviposition potential and larval development. Hence, Diet 1 and Diet 2 could be used alternately for rearing *L. africanus* in laboratory.

Then, the aggregation behavior of *L. africanus* to develop a monitoring technique for the beetle was investigated by chemical approach through comprehensive screening of the potential compound produced by *L. africanus*. The whole body extractions using hexane solvent on newly emerged beetles were performed. The aggregation activity of crude extract of *L. africanus* beetles was conducted by dual-choice bioassay. Then, it was followed by chemical analysis, isolation, identification and syntheses of the chemical compounds. The results revealed three esters as an aggregation pheromone produced by male *L. africanus* beetle. The esters were recognized as a major compound **2** (3-pentyl dodecanoate) and two minor compounds **1** and **3** (2-propyl dodecanoate and 3-pentyl tetradecanoate) based on its quantitative amount in the crude extract (Figure 1).

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Table 1. Development of *L. africanus* in three artificial diets

Artificial diet	Total adults	Sex ratio (M/F)	Body weight (mg)
Diet 1	206.0 ± 49.37[a]	0.94 ± 0.06[a]	1.98 ± 0.04[a]
Diet 2	188.9 ± 30.60[a]	0.80 ± 0.05[a]	1.87 ± 0.06[a]
Diet 3	55.9 ± 16.18[b]	0.76 ± 0.08[a]	2.01 ± 0.21[a]

Note: a.b significantly different in the same column by Tukey-Kramer HSD test ($P < 0.05$).

To justify the significant role of the synthetic esters to *L. africanus* the aggregation activity of either single or blended esters was evaluated. The bioassays were conducted in laboratory by dual-choice test against *L. africanus* beetles. The results indicated that the single compound was not sufficient to induce the aggregation behavior of *L. africanus*. Furthermore, the natural blended compound increased the aggregation responses of *L. africanus*. There was a synergistic effect was found among the three synthetic esters.

A semi-field test was carried out in order to initiate a pheromone-based monitoring program in the future. The optimum dose of three-ester blend was determined using dual-choice test. The blend of three synthetic esters were prepared to determine the minimum dosage that elicited the maximum level of response from both female and male *L. africanus* beetles. Consequently, the optimum dose inducing greatest aggregation response on *L. africanus* was applied for wind-tunnel bioassay.

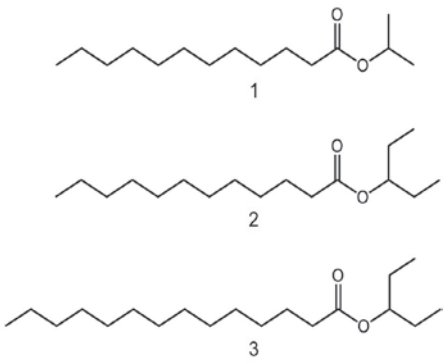

Figure 1. Chemical structures of compounds
(1) 2-propyl dodecanoate;
(**2)** 3-pentyl dodecanoate ; and
(**3)** 3-pentyl tetradecanoate

Results of dual-choice bioassays indicated that 50 BE induced the greatest response of aggregation behaviour of *L. africanus*. Furthermore, the wind tunnel bioassays revealed that both female and male beetles showed arousal response toward the natural blend of esters, however the male were less responsive than the female *L. africanus* beetles. The aggregation pheromone might efficiently perform on female rather than male *L. africanus* beetles.

These results indicated the potential ability of ester compounds as aggregation pheromones of *L. africanus* to be developed as an attractant in insect monitoring. Additional studies are still necessary to strengthen the performance of synthetic esters for establishing the monitoring system of *L. africanus*.