DIVERSITY AND ABUNDANCE OF STORAGE PEST IN RICE WAREHOUSES IN KLANG, SELANGOR, MALAYSIA

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ABSTRACT

Insect's pest infestation on rice product cause a serious damage either in quantitative or qualitative aspect. This paper assesses the abundance and diversity of insects pest of stored products in rice warehouses, through a study in three rice warehouse (Jasa, Tenggara, Target Lane) in Klang Selangor, Malaysia. Investigations recorded four main insect species in all the warehouses are *Oryzaephilus surinamensis*, *Tribolium castaneum*, *Sitophilus oryzae* and *Cadra cautella*. *Oryzaephilus surinamensis* showed the highest abundance in all warehouse with total 47403 individuals (97%), *T. castaneum* with 431 individuals (0.88%), *C. cautella* with 760 individuals (1.56%) and *S. oryzae* with the lowest abundance (11 individuals; 0.02%). The Shannon-Weiner index shows that highest insects diversity was in Tenggara warehouse (Shannon's, H' = 0.28), while Target Lane were the lowest (Shannon's, H'=0.11). The information on insect's pest diversity in rice warehouses is very useful to implementation of management and controlling insect's pest infestation in stored rice grains.

Keywords: storage pests, rice, diversity, abundance, infestation

ABSTRAK

Serangan serangga perosak terhadap beras telah mengakibatkan kerosakan yang serius secara kualiti dan kuantiti. Objektif kajian ini adalah untuk melihat kelimpahan dan kepelbagaian serangga perosak di tiga buah gudang beras di Klang, Selangor, Malaysia iaitu Jasa, Tenggara dan Target Lane. Hasil kajian merekodkan terdapat empat spesies utama yang hadir iaitu *Oryzaephilus surinamensis*, *Tribolium castaneum*, *Sitophilus oryzae* dan *Cadra cautella*. *Oryzaephilus surinamensis* menunjukkan kelimpahan yang paling tinggi di antara kesemua gudang dengan jumlah individu sebanyak 47403 (97%), *T. castaneum* sebanyak 431 individu (0.88%), *C. cautella* sebanyak 760 individu (1.56%) dan *S. oryzae* mencatatkan kelimpahan paling rendah dengan 11 individu (0.02%). Ujian indeks Shannon-weiner menunjukkan kepelbagaian serangga yang paling tinggi adalah di Tenggara (Shannon's, H=0.28), sementara Target Lane mencatatkan nilai terendah (Shannon's, H'=0.11). Maklumat berkenaan kepelbagaian serangga perosak ini amat berguna dijadikan sebagai pengurusan kawalan serangga perosak di gudang beras.

Kata kunci: perosak bahan simpanan, beras, kepelbagaian, kelimpahan, infestasi

INTRODUCTION

Rice, *Oryza sativa* L. (Graminae) is the second most important crop in the world after wheat (Banik 1999) with asia being the largest producer and consumer (Gumma et al. 2011). As a staple food for Malaysian people, it is very important to have a continuity in rice production and supply since it is in high demand. Beside pest infestation, the challenges in maintaining the productivity of rice by the high postharvest losses. Rice grain become exposed to risk of qualitative and quantitative losses posed by physical, biological and chemical of the production, processing, storage and handling environments.

Insects infesting stored foods are one of the most destructive and common problems which turn out to be very serious if leave untreated. Khobdeel (2011) said that agricultural products were destroyed 10-20% annually and even worse in the improper management or warehouse to keep this product. Weifen et al. (2003) also reported the losses of storages about up to 13%. The varieties of the insect pest that damage the product reduce the quantity and quality of the food minimizing the chances of the product itself to be well mannered and stay in a good condition for a long period. The infestation may happen at the processing warehouse, in transit, at the storage store or even at home (Ogebegbe & Edoreh 2014). The duration in the field, the rice varieties, polishing and post polishing processes, have been identified as factors that affect grain susceptibility to insects pest The level of insect infestation is an important quality factor of food grains and represents a serious and continuing problem for the grain and milling industries (Campbell 2008).

This infestation can double up the economic losses due to the insects ability to infest rice in a short time without been detected. The common insect pest on rice are *Sitophilus oryzae* (rice weevil), *Oryzaephilus surinamensis* (saw-toothed grain beetle), *Tribolium castaneum* (Red Flour Beetle), and *Plodia interpunctella* (Indian Meal Moth). The combination of primary and secondary pests in one commodity enhancing the rice infestation. *Sitophilus oryzae* could be the major primary pest in storage product with the ability to eat on the whole grain. While the *O. surinamensis* and *T. castaneum* act as a secondary pest by feed on the grain previously infested by other pest and cause the contamination of the stored products not only due to the feeding but also with the dead bodies and fecal pellets.

Sitophilus and *Tribolium* genus are the most destructive tropical species for cereals (Belloa et al. 2000). *T. castaneum, S. oryzae and O. surinamensis* are not only infested rice products, but they also known as a flour pest (Ogedegbe 2014), and the major one is *T. castaneum* (Lyon & William 2008). Other than that, *S. oryzae* also found to be one of the insects pest on corn in tropical region (Lucas & Riudavets 2000) which destroy the seed completely from inside and seed viability is lost (Hill 2002). Arbogast and Chini (2005) study showed the abundance of *C. cautella* in maize stored on South Carolina farms was affected by abiotic factors.

Many control methods have been reported for storage insect pest (Muir 2000; Roesli 2003). Fumigation is said to be a major role in the control of insect pest stored products such as phosphine and methyl bromide. Now, due to Haritos and Dojchinov (2003), they use a carbonyl sulphide, ethane dinitrile and ethyl bromide. According to Wallbank and Collins (2003), insect's pest was resistance to the several insecticides and make it harder to control them by chemical approach. Due to the high resistance of insects, insecticides need to be pest specific, unharmed to other organism, biodegradable, and less expensive (Isman 2006).

Identifying the specific insect's pest found in rice products is very important because insects have different activities, biologies, behaviours, reproduction and different ways to damage the goods (Mason & Mcdonough 2012). The necessity of identification of the insects may lead to the controlling and management of the insect's pests. Hence this study was conducted to determine the diversity and abundance of the insect's pest in rice warehouses in Klang, Selangor.

MATERIAL AND METHODS

This study was conducted at three different rice warehouses in Klang, Selangor, Malaysia which is Jasa, Tenggara and Target lane that was chosen by the BERNAS and indicated as a storage place for the local and imported rice from various state such as Vietnam, Thailand, Cambodia, India and Pakistan. A total of 24 sticky traps were placed in each rice warehouses to intercept the insect's pest. Each trap was placed on the floor in a four transect line with every line consist of six traps with five-meter interval. The traps were left for 24 hours (9.00 a.m – 9.00 a.m) and three replications of this sampling method were conducted. Sampling were done starting from June 2016 until July 2017 with sampling interval between 30-35 days.

To record the sampling data from each trap, the sorting and identification of all species was conducted under stereo-microscope according to the key of Rees (2004) until genus and species level. All samples were brought to the laboratories and individuals that were trap and stuck on the sticky trap were counted for further analysis. Shannon-Weiner index and one-way ANOVA and two-way ANOVA analysis was conducted to rule out the diversity index and significant of abundance insects pest between all the warehouses.

RESULTS AND DISCUSSION

In this study, a total of 48605 individuals of insect's pest were collected in three Klang warehouses. It consists of four main species which is *Oryzaephilus surinamensis* Linnaeus, *Tribolium castaneum* Herbst, *Sitophilus oryzae* Linnaeus and *Cadra cautella* Walker (Figure 1).

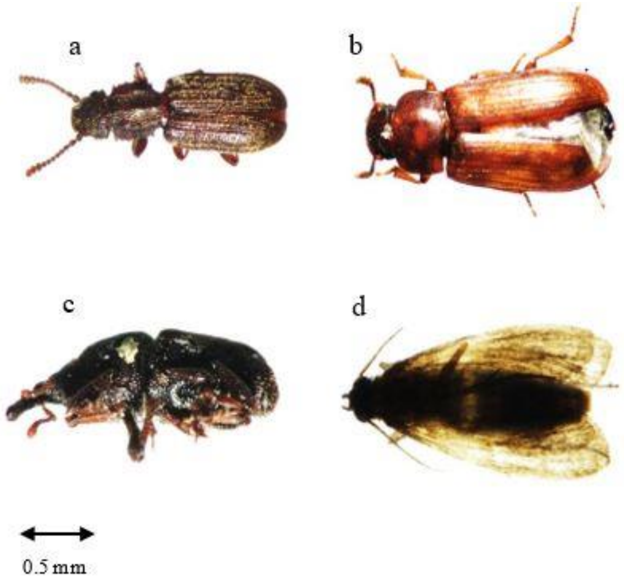

Figure 1 Insect species a) *Oryzaephilus surinamensis*, b) *Tribolium castaneum*, c) *Sitophilus oryzae* and d) *Cadra cautella.*

Tenggara warehouse showed the highest abundance of pest was *O. surinamensis* (7855; 93.45%) out of all other species, followed by the *T. castaneum* with 177 individuals (5.05%), *C. cautella* 91 individuals (1.29%) and *S. oryzae* with 6 individuals (0.22%) (Figure 2). In Jasa, highest abundance also showed by *O. surinamensis* with 2089 individuals (96.63%). However, *C. cautella* recorded second highest abundance in this warehouse with 113 individuals (2.18%) and followed by *T. castaneum* 29 individuals (1.12%) and *S. oryzae* with 5 individuals (0.07) (Figure 3). Last warehouse which is Target Lane also showed the same result in the main insect's pest which is *O. surinamensis* with 37459 individuals (97.56%). The second highest was *C. cautella*, 556 individuals (1.45%), followed by 225 for *T. castaneum* (0.59%) and none recorded for *S. oryzae* (Figure 4).

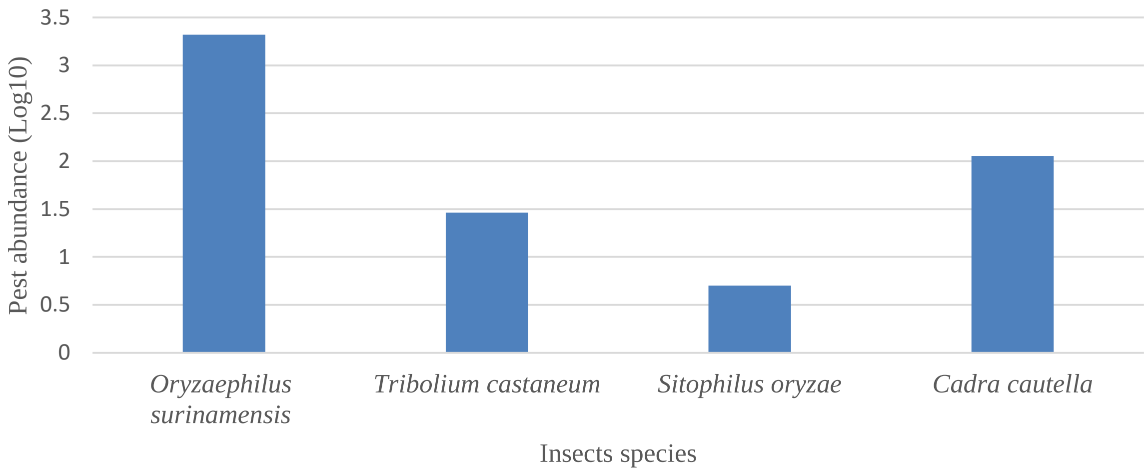

Figure 2 Species composition of insect's pest in Tenggara.

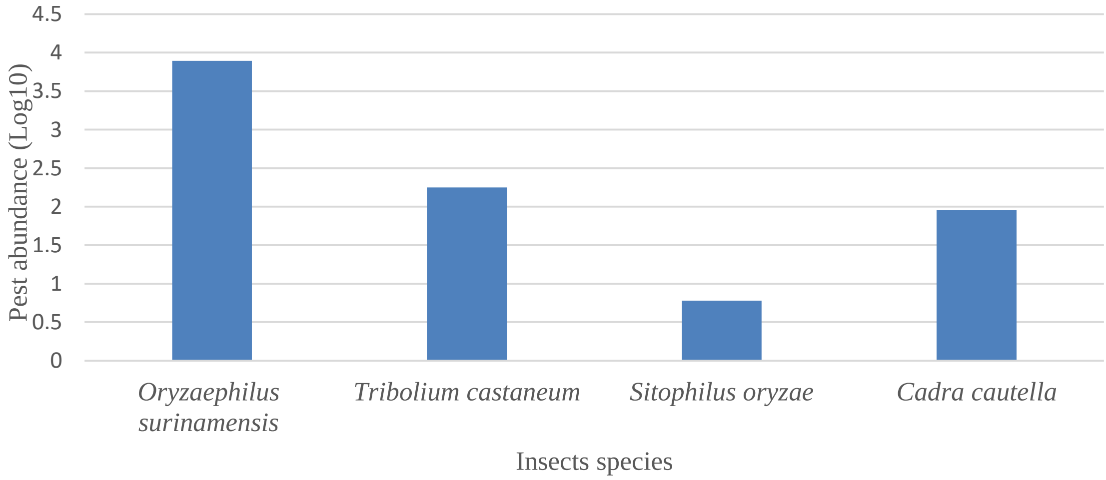

Figure 3 Species composition of insect's pests in Jasa.

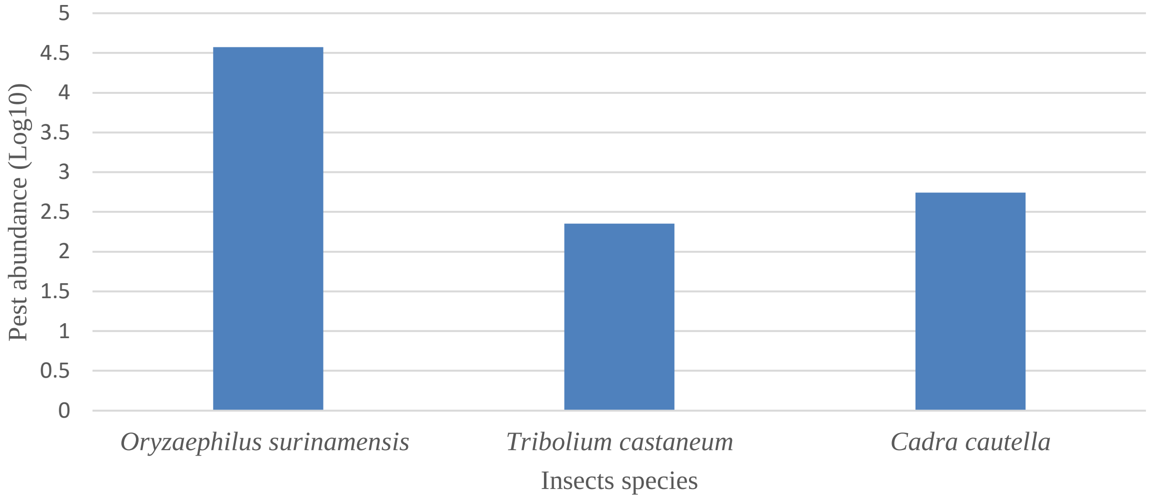

Figure 4 Species composition of insect's pests in Target Lane.

Table 1 showed the p-value of one-way ANOVA which correlate between abundance of pest species for each warehouses. One-way ANOVA showed significant different on the abundance of *O. surinamensis* (F= 13.04; P< 0.05) only in Jasa warehouse. Likewise, the test also indicates significant different between the abundance of *T. castaneum* in Jasa (F= 8.94; P< 0.05) and Target Lane (F= 9.68; P< 0.05). Whereas, *S. oryzae* only significantly different in Target lane (F= 12.0; P< 0.05) and *C. cautella* were highly significant different in Jasa (F= 12; P< 0.05) and Target lane (F= 21.7; P< 0.05).

Of the three warehouses, Tenggara has the highest diversity (H'= 0.28), although Target lane has the most collected number of individuals (H'= 0.11). This is because the difference between highest and lowest species in Tenggara were low which is *O.surinamensis* is 2089 and *S. oryzae* is 5. Compared to Target lane, the lowest diversity index showed due to the high difference in between *O. surinamensis* (37459) while there is no *S. oryzae* collected in this warehouse.

Many pest of stored products were in the order of Coleoptera and the most destructive tropical species belong to the genus *Sitophilus* and *Tribolium* (Bello *et al.*, 2001). *S. oryzae* are the most common coleopteran pest of stored white and brown rice (Beckett, 1994). However, this experiment gives a different result. *O. surinamensis* became the most dominant pest in the rice warehouse and *S. oryzae* was the least. This result is due to the biology of the species which is *O. surinamensis* activities such as eating and mating were mainly at outside of the rice commodities. They also tend to eat the leftover grain which already been eaten by the primary pest, *S. oryzae*. Due to the development of *S. oryzae* must be taken inside a seed kernel, it has been known to spend most of the time deep in the grain itself. The female rice weevils eat a cavity into a seed and will deposit the eggs in the cavity (Arbogost 1991). The larvae feed on the germ of the grains and reduce the protein and vitamin content of the grain (Bello *et al.*, 2001). However, studies done by Beckel (2007), they concluded that the damage caused by the primary pest increase the potential for population of secondary pest. It can be assumed that the population of *S. oryzae* in this study were actually high because of the present of *O. surinamensis* were highest. According to Weston and Rattlingourd (2000), *O. surinamensis* showed a tremendous increase in progeny production on 6-month maize that already infested by primary species or mechanically damaged kernels.

Abundance of *T. castaneum* did not show high individual eventhough both of *T. castaneum* and *O.surinamensis* were secondary pest. In previous study on infestation of flour in Nigeria showed that this species being the major pest of wheat flour. Lyon and William (2008) also said that *T. castaneum* were the major insect's pest of wheat flour. Abundance of *Tribolium* species may not be the major pest in rice, since their preference more to wheat flour or other stored products. This species also was found in most of the traps, but it could lead to a least infestation compared to *O. surinamensis*.

Cadra cautella (Walker) were the only lepidopteran species found in this record. Previous study done by Ameyra (2013) on the same warehouse showed no present of *C. cautella* on that time, however the lepidopteran species found were *Sitotroga cerealella* that was assume as the host of *Habrobracon hebetor*. However, in the meantime, this species was exist in the same warehouse even though this species was said as the pests on maize and berries (Arbogast 2005).

The origin of this pest's species is not well known, since it involves a lots of process for the rice to be arrived and stored in the warehouse. It is not only the rice importation into our country could lead to the increasing of pest's infestation, but the management and hygiene level of the warehouse production also plays a role. Unclean storage containers or stack, unhygienic condition of warehouse and high moisture content will contribute to infestation too (Ogebegbe & Edoreh 2014)

Species abundance in all warehouses showed no significant different with Jasa (0.058), Tenggara (0.063) and Target Lane with 0.071 (Table 2). Amount of rice storage in Jasa and Target Lane were more than Tenggara due to the small size of Tenggara warehouse compared with the other two. Tenggara also stored only one type of rice which is Thai white rice, however Jasa and Target Lane have a varieties of rice such as Thai White Rice, Vietnam and Basmathi. This difference could lead to the variation of insect's infestation level. Warehouses with more rice varieties indicate more pest species that could lead to more activities between the pest in the warehouse and increase the chances of the infestation. The variety of rice could be related with the studies done by Cho et al. (1998) that showed weevil reproduction was higher and developmental period is shorter in brown rice compared to white rice. It shows that weevil have different preference on the type of rice that could explain the high increasing of weevil, greatest level of infestation and hence greater level of grain damaged.

Table 1 P-value of one-way ANOVA between abundance of pest species in each warehouse.

Warehouse/ species	*Oryzaephilus surinamensis*	*Tribolium castaneum*	*Sitophilus oryzae*	*Cadra cautella*
Jasa	0.023	0.040	1.000	0.026
Tenggara	0.147	0.280	0.859	1.000
Target Lane	0.056	0.036	0.026	0.010

Table 2 Two-way ANOVA of species abundance.

Warehouses	P- value
Jasa	0.058
Tenggara	0.063
Target Lane	0.071

CONCLUSION

Four major species of storage pests are harmful in all three rice warehouses. Three are coleopterans and one is lepidopteran species. Among three coleopteran species, *O. surinamensis* being the most abundant as a secondary pest and followed by the lepidopteran species which is *C. cautella.* The other two coleopteran species are *T. castaneum* and *S. oryzae* are both recorded the least abundance compared with others. The attack of this species in rice warehouse damages the quality of the rice and it is very crucial to have a knowledge into developing the control method with low adverse effect on human and environment.

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