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Research Article

Monitoring of Khapra Beetle in Jakarta, Tangerang, and Bekasi as Part of Khapra Beetle Free Area Maintenance Program in Indonesia

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ABSTRACT

Khapra beetle, *Trogoderma granarium* Evert (Coleoptera: Dermestidae) is the most important stored pest and was first discovered in Jakarta grain storages in 1972. Since then, quarantine procedures have been massively carried out to prevent khapra beetles to spread in Indonesia. In 2009, Indonesia has been declared as free area from Khapra beetle. However, Indonesia still import grain from non-Khapra beetle free countries and supervision must be carried out continuously to prevent Khapra beetle reinfestation. This survey was conducted at warehouses in five areas of Jakarta, Tangerang, and Bekasi from October 2016 to February 2017 with high risk due to its role as one of the main entry ports and storage of imported grains. Observation was done using probe sampling, direct observation, and traps with attractant. Results showed that several insects were found from imported seeds in the surveyed area, but no Khapra beetles were found. It showed that non-Khapra free countries have implemented the required Sanitary Phytosanitary. In addition, it implies that survey methods using attractant traps could complement the probe sampling methods and direct observation that are currently used.

Keywords: attractant lured trap; detection survey; direct observation; Khapra beetle; probe sampling

INTRODUCTION

Khapra beetle (*Trogoderma granarium* Everts; Coleoptera: Dermestidae) is among the 100 worst invasive species worldwide and has been recognized as the A2 quarantine organism. World Trade Organization (WTO) Committee on Sanitary Phyto-sanitary (SPs) issued a prohibition on importation of cereals, oilseed commodities and similar grains and seeds to prevent the spread of this pest (Khalique *et al.*, 2018).

Khapra beetle optimally grow at 35°C and have lifespan of 26–220 days. Khapra beetle will diapause when temperature decrease below 25°C (Burges, 2006). Temperatures in Indonesia are optimum for Khapra beetle growth. Khapra beetle can cause approximately 30–70% damage to stored grain, and the larva is the most active feeding stage. The damage will decrease seed quality and weigh in the storage (Stibick, 2007; USDA-APHIS-PPQ, 1983).

The Khapra beetle spreading was boosted by "roll-on & roll-off" (Ro-ro) transportation systems, that make it hard to control the trading commodities intensively (Ahmedani *et al.*, 2007; Suryani, 2017).

Since the first report of the Khapra beetle detection in Indonesia, the government has enforced tight quarantine procedures to prevent the spread of this beetle in Indonesia. Fumigation, eradication, and other appropriate strategies have been applied, and as a result, in 2009 the beetle was declared absent in Indonesia (*Badan Karantina Pertanian RI*, 2009). To fulfil the national grains consumption, Indonesia imports grains from several countries and the number is increasing year to year (Table 1). Unfortunately, not all origin countries of these imported grain have been declared as khapra free areas (Table 2).

Table 1. Commodities, imported volume of seed commodities, and origin countries entering Tanjung Priok Port

Comodity	Volume/Period (Ton)			Country of Origin
	2013	2014	2015	
Wheat	1,850,609.00	2,680,768.00	2,558,487.92	Australia, Ukraine, United States, New Zealand
Soybeans	115,078.08	161,285.00	328,452.57	United States
Rice	103,503.99	278,187.14	292,697.00	Vietnam, Pakistan
Groundnut kernel	96,716.62	118,267.00	59,309.51	India, China, Sudan
Glutinous rice	59,329.00	77,236.00	33,323.00	Pakistan, India
Green Mungbeans	45,228.00	47,242.00	22,097.00	Myanmar, Ethiopia, Australia
Cacao beans	11,645.00	75,788.75	35,424.09	Cameroon, Ecuador, Kenya, Papua New Guinea, Nigeria
Corn	9,068.00	3,166.69	491.00	Thailand, United States, Argentina
Barley	8,964.00	15,849.17	12,802.00	Australia, France, Belgium, Netherlands

Source: E-Plaq System *Badan Karantina Pertanian* (2009)

Table 2. Status of Khapra beetle in grains origin countries

Country	Khapra beetle status
Australia	Absent
United States	Absent
New Zealand	Absent
Vietnam	Absent
Pakistan	Present
India	Present
China	Absent
Sudan	Present
Myanmar	Present
Ethiopia	Absent
Cameroon	Absent
Ecuador	Absent
Kenya	Absent
Papua New Guinea	Absent
Nigeria	Present
Thailand	Present
Argentina	Absent
France	Absent
Ukraine	Present
Belgium	Absent
Netherlands	Absent

Due to efficiency and vessel traffic control, short dwelling time is very crucial and pre-border inspection in Tanjung Priok Port have to be done quickly but accurately mainly to prevent the re-entering of Khapra beetle.

In this research, survey on several stored imported grains at Jakarta, Tangerang, and Bekasi were conducted using three observation methods: Probe test, direct observation, and attractant traps.

MATERIALS AND METHODS

Locations of Survey

Grain storage warehouses in Jakarta, Tangerang, and Bekasi were selected as survey locations because 70% of imported grains entered from Port of Tanjung Priok then stored in Jakarta, Tangerang, and Bekasi before distributed to market in Jakarta-Bogor-Depok-Tangerang-Bekasi.

One warehouse each in Tangerang and Bekasi, and three warehouses in Jakarta were selected for the survey sites, and the commodities were varied including rice, wheat, pepper seed, green beans (Table 3). The selection of these five warehouses were based on their trading volume and frequency of imported grain commodities traffic.

Condition of Warehouse

The selected warehouses were observed for their commodity types, package, and pallet conditions. Sanitation and all activities intended for maintaining the product quality were observed by interviewing the workers. Furthermore, the temperature and relative humidity were also recorded, from October 2016 to February 2017 with seven-days interval.

Surveillance

Survey of Kaphra beetle was carried out using visual observation by direct observation. Visual observation was intended to check on the area of warehouse where Kaphra beetle would most likely be present (Wuryaningsih *et al.*, 2009). Direct observation of pest beetles around commodities in the

Table 3. Selected warehouses in Jakarta, Tangerang, and Bekasi for survey between October 2016 and February 2017

No.	Region	Warehouse	Commodities present*
1.	Jakarta	PT Food Station Tjipinang Jaya	Broken rice and Rice
		PT Bulog Divreg Jakarta and Banten	Rice
		PT Indofood Sukses makmur	Wheat and wheat flourmills
2.	Tangerang	CV. Putra Nusa	Pepper seeds, Green beans and Groundnut kernel
3.	Bekasi	CV. Sumber Roso Agromakmur	Rice, Green beans, Groundnut kernel and flourmills

*All were imported product, except for flourmills

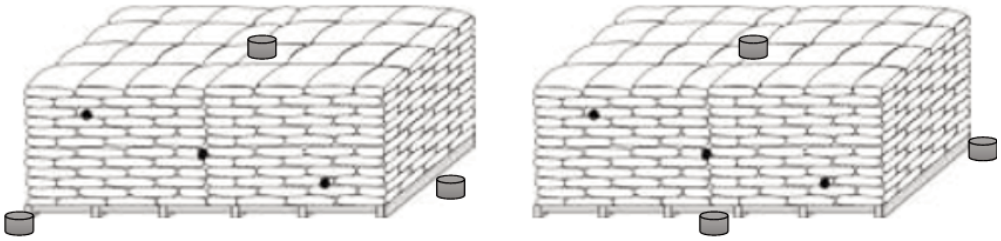

Figure 1. Scheme of dome traps (⛁) placement surrounding the stored products and the probe inspection sites (•)

storage warehouse was done using to observe directly the infestation of pest beetles around piles of commodities. Observations were done together pheromone traps and food attractants instalment. Observation points were located on the sides of the staple or pile of commodities, by looking at the condition of the sack or package of the commodity to be applied. The observed specimens were collected in sample plastic bags for further identification using a compound microscope.

The Attractant Traps

Survey using pheromone traps and food attractant were carried out by following procedure from McMaugh (2007). Dome traps (TORGARD^R, Trece Incorporated, Oklahoma, USA) have been previously used by Wuryaningsih *et al.* (2009). Sex pheromone and food attractant used simultaneously were more effective compared when used individually. The apheromone attracts male adults, and the food attractant is effective for male and female adults as well as larvae (Cox, 2004).

Placement of traps was guided by *Guidelines for Monitoring System and Instalation and Maintenance* (Trece Incorporated, 2007). Installation of dome traps was carried out on a pile of sacks (staples). In every single staple (approximately 10 m^2), five traps were placed surrounding the staple i.e., at each side and top (Figure 1). Fifteen dome traps were placed in each warehouse, depending on the size of the staple and the number of commodities. The traps were put on the floor under the pallet at safe points meaning there were no disturbances from warehouse activities, but easy to be observed. The traps were monitored every week.

Observation. The traps were checked every week and the trapped insects were collected for identification and counting. Due to the variation of trading frequency of the chosen warehouses, the number of observations varied from 3–7 times during the period of survey (5 month), except for Tangerang and Bekasi with two observations only. The most intensive observation was done in Jakarta.

RESULTS AND DISCUSSION

Condition of Warehouse

Conditions of warehouses varied from poor to excellent aeration, soil to concrete floors, and had insufficient lighting. The floor was made of cement, which is cracked in several places, and becomes a suitable place for Khapra beetle to survive. Collected data from grain storage warehouses in Jakarta, Tangerang, and Bekasi showed that the temperature varied from 26–35^{o}C with relative humidity was 54–85%. Most warehouses were well maintained: clean,

periodically sanitized, and fumigated once every six months. The warehouses which were used to store local agriculture products such as rice, were less maintained than those to store the imported products. The imported commodities found during the period of survey were groundnut kernel, green bean, rice, wheat, wheat flour, and pepper seeds.

Surveillance

During the survey, neither direct observation, probe sampling nor dome traps found the presence of khapra beetle (Table 4). The dome trap was effective in attracting insects that are commonly present in the warehouse as it shown by the number of trapped specimens (967 from total 2,015 specimens) and the diversity of species found during the survey (11 from total 12 species). It showed that dome traps were sufficient to be used in monitoring stored pest program together to support the currently used probes test and direct observations. This same trap has been reported effective in detecting khapra beetle in the imported commodity coming into USA (French & Vennette, 2005), Lithuania, China, and Saudi Arabia (CABI, 2006).

The dome trap developed by Trece Incorporated uses a combination of pheromone and kairomone attractant and is effective for many beetle species. This system attracts target insects not only for mating call, but also for feeding call and it attracts all active stages, as well as male and female (Norin, 2007). In conclusion, combination of pheromone and kairomone attractants in insect trap will be highly effective for controlling, disturbing male-female communication, and monitoring (Anderbrant *et al.*, 2007).

Table 4. Insects found in imported grains using dome trap, probe test, and direct observation

No.	Species	Dome trap	Probe	Direct observation
1	*Ahasverus advena*	16	14	3
2	*Attagenus fasciatus*	3	0	0
3	*Attagenus unicolor*	2	0	0
4	*Cryptolestes ferrugineus*	25	31	1
5	*Carpophilus hemipterus*	3	19	15
6	*Callosobruchus maculatus*	67	190	0
7	*Lasioderma serricorne*	6	4	3
8	*Oryzaephilus surinamensis*	143	226	107
9	*Rhyzoperta dominica*	3	10	3
10	*Sitophilus oryzae*	0	4	9
11	*Tribolium castaneum*	698	278	131
12	*Trogoderma variabile*	1	0	0
Total		967	776	272
Grand total				2.015

Nevertheless, continuous observations must be done to ensure that Indonesia remains in the current khapra free area status. Monitoring at stored grains warehouses collected and identified 12 insect species, most of them are commonly found in stored grain. No khapra beetle were found, indicating that grains origin countries especially that are not free of khapra beetle have made the required efforts before shipping to Indonesia. As well as Indonesia, exported product should not contain any dangerous organisms, especially quarantine organisms which has not yet been established elsewhere. If laws regarding this matter firmly regulate this condition are applied without reserve, Indonesia will place itself among the respected nation in the world in term of International Sanitary and Phytosanitary Measures (ISPM).

CONCLUSION

The absence of khapra beetle in Jakarta, Tangerang, and Bekasi could be used as a validation point to strengthen of the declaration of Pest Free Area (PFA). Continuous surveillance is required to comply with International Sanitary and Phytosanitary Measures (ISPM) No. 4 and ISPM No. 31. Validation on the status of khapra beetle PFA would provide benefit for Indonesia's crucial region in export-import of agricultural product sector such as Jakarta, Tangerang, and Bekasi.

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