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Circadian Rhythm of *Liposcelis entomophila* and *Liposcelis paeta* in Paddy Warehouse

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Abstract

Booklice is a small but serious stored grain pest, and understanding the circadian rhythm of booklice help to control. In this study, circadian activity of booklice were monitored with sticky traps in the grain bulk surfaces of two warehouses stored paddy rice in two different provinces in China. The results showed that the species of booklice were different and were *Liposcelis entomophila*, and *Liposcelisp paeta* for Nanning's and Zhanjiang's warehouses respectively. In term of *L.entomophila*, its activity intensity gradually decreased from 0 am to 12 pm and reached the lowest level of daily activity at 12pm. After this, there was a steady and straight upward trend, and the peak of its activity intensity is reached at 8 pm. Its circadian activity trend can be represented as: $y = -0.971x^3 + 21.88x^2 - 139.5x + 353.4$(x: time; y: quantity of booklice). Over the same period, the activity intensity of *L.paeta* varied greatly. It gradually increased, reached a peak at 8 am, dropped dramatically at 12 pm and then climbed the second peak at 6 pm.

Keyword: sticky trap, monitor, *L.entomophila*, *L.paeta*, circadian rhythm

1. Introduction

In control of stored grain pests, insect population dynamics monitoring and density inspection are important. The species, density, distribution, and damage status data of grain stored pests in the grain bulk can be timely detected, predicting the development trend of insects, avoiding unnecessary prevention cost and the economic losses, and providing scientific strategy for insect control (Bai Xuguang, 2002).

At present, the pest detection technology is traditional screening method. There are many disadvantages, such as, labor intensive, low efficiency, and imprecise. Base on these, trapping detections are developed. They are convenient, fast, environmentally friendly, and highly automated（LI Zhishen, 2014）. Sticky board trapping is one of these technologies and has been widely used in the monitoring and control of agricultural and forestry pests. However, there are few reports in stored grain insect pests. In this study, the sticky board trapping technology was applied to monitor the population dynamics of the booklice in two paddy warehouses in Guangdong and Guangxi, southern China. The aim in work reported in this publication was to assess sticky board trapping as an alternative to detection.

2. Materials and Methods

2.1 Test Warehouse

No. 32 large warehouses in Nanning Shajing Grain Warehouse examined was a length of 26.69 m and a width of 19.73 m, storage ability 1250t. The stored grain is indica rice and has been stored since September 2013. The moisture content and impurity ratio of this grain is 12.8%, and 1%, respectively.

No.4 large warehouses （50 m ×20 m）in Guangdong Zhanjiang North Station Grain Warehouse was selected for trails. The indica rice in this warehouse had 10.5% grain moisture content and been stored since August 2013. .

Both warehouses had been fumigated with phosphine.

2.2 Application of sticky board trap

Sticky board traps (20 cm × 25 cm, Beijing Ikoman Bio-Technology Co., Ltd.) were applied different positions of the surface of indica rice in each of two warehouses, including corner, under the fan, window, and check door. The numbers applied were four. The position of the trap location in the real warehouse is shown in Fig. 1.

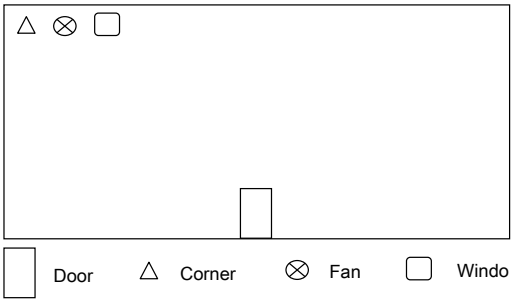

Fig. 1 sampling points in the warehouse

2.3 Observing the circadian rhythm of the booklice in warehouse

General procedures: the methods of assessment were based on procedures developed to measure booklice population on grain. The methods were:

- Counting of booklice in marked areas.
- Leaving sticky board traps for defined periods (2 hs), shaking out the booklices into trays and counting.
- Sampling grain with a bottom-opening probe, sieving (Φ 1.5 × 2.5 mm) and count insects.
- The whole test lasted for 24 hours.

The temperature and relative humidity of the pf the warehouses were monitored by Vaisala VAISALAHM34 High-precision Temperature and Humidity Table (VAISALA, Finland).

3. Results

3.1 Circadian rhythm of L.entomophila in paddy warehouse in Nanning Shajing Grain Warehouse

The species of booklice in Nanning Shajing Grain Warehouse was *L.entomophila*. Within 24 hours, the temperature ranged over time from 27.48 °C to 29.28°C and the humidity ranged from 68.95% to 73.05% (Fig. 2). The warehouse temperature showed an overall downward trend during the period from 12 am to 10 pm and a rise after 10 pm. During this period, the humidity showed an overall downward trend, except that it was an abnormally high point at 10 am. The trend continued until 2 pm. The quantity of booklice trapped generally decreased during the period from 12 am to 10 am, and reached a minimum at 12 pm. After 12 pm, the temperature in the warehouse experienced an increase, while this phenomenon appeared 4 hours later and 2 hours later in the humidity and the quantity of booklice trapped respectively. Therefore, the Circadian Rhythm can be inferred from the quantity of booklice attracted by the sticky trap at different time periods. The activity frequency of *L.entomophila* in the warehouse is correlated with the temperature and humidity in the warehouse. From early morning, the frequency of booklice gradually decreased, and booklice activities entered a relatively quiet period at 12 pm. After this, with the overall recovery of temperature and humidity, pest activity gradually became active again, and reached relative activity peak period from 6 pm to 2 am. The daily activity trend of *L.entomophila* can be expressed as $y = -0.971x^3 + 21.88x^2 - 139.5x + 353.4$ (x is the 24-hour time, and y is the quantity of booklice)

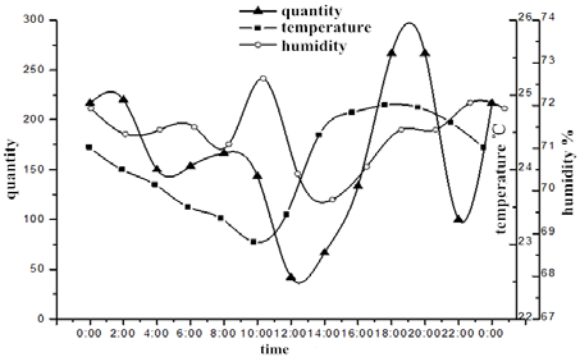

Fig. 2 Changes in Temperature, Humidity, and quantity of *L.entomophila* trapped with time in the warehouse of No. 32 Shajing Grain Depot

3.2 Circadian Rhythm of L.paetain Zhanjiang Warehouse

The species of booklice in Zhanjiang Warehouse is *L.paeta*. In Zhanjiang North Station State Grain Storage No. 4 warehouse, the temperature varied significantly with time, ranging from 27.30°C to 29.27°C. However, the humidity vary slightly with time, ranging from 74.40% to 79.27% and reached an unusually high point around 2 am. There was a certain correlation between the quantities of booklice and humidity after 10 am. The trend in Fig. 3 showed that the quantity of trapped *L.paeta* was relate to temperature. Interestingly, 12 pm was not the lowest temperature of the day, but the quantity of trapped *L.paeta* reached a minimum value as same as that of *L.entomophila* in Nanning Shajing. This might be caused by other factors expect temperature and humidity, such as insect daily activity rhythm. The peak activity of the *L.paeta* appeared at 2 pm.

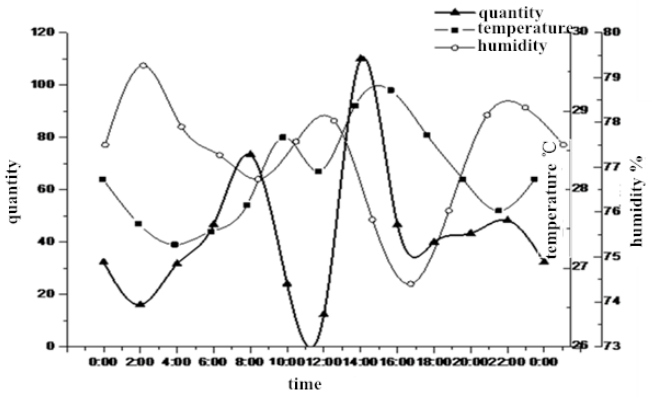

Fig. 3 Changes in temperature, humidity, and quantity of *L.paeta* trapped with time in Zhanjiang No. 4 warehouse

4. Discussion

In recent years, booklice has also became a new threat to global grain security (Zhang Shengfang, 1998), which is the problem that needs to be solved urgently (Muhammad Shoaibet al, 2010). The sticky trap in the study can be considered as a physical control method. It provides a new green and effective means for the prevention and treatment of booklice.

Since both the *L.entomophila* and *L. paeta* have obvious light-shielding properties (Yan Xiaoping et al, 2008), the principle of sticky trap remains to be further studied. It may be related to the fact that the *L.entomophila* prefers high humidity environment because of the stickiness. The glue on the glue sheet causes an increase in humidity.

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Development of a suitable rearing media for *Tribolium castaneum*

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Abstract

Tribolium castaneum is a serious pest of cereal flour and flour-based products, and thus a test insect in stored-product research. The composition of the rearing medium affects the progeny production, their performance and handling efficacy. The objective of this research was to develop a suitable rearing media for *T. castaneum*. The research tested wheat flour, crushed broiler feed, crushed dog feed and corn flour alone and in different combinations. Twenty adults of *T. castaneum* were introduced to each medium separately, and removed after 2 weeks. The progeny adults emerged in each rearing medium was determined. The progeny produced differed with the food medium. In general, the rearing media having a combination of ingredients produced more