Sampling Malayan Black Bugs (Heteroptera: Pentatomidae) in Rice

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ABSTRACT Sampling Malayan black bugs, Scotinophara coarctata (F.), in rice was conducted on the island of Palawan, the Philippines, using fluorescent-street-light traps, Petromax gas-lantern traps, and visual counts in the field. Peak catches in light traps occurred around the time of the full moon, especially during mid-August 1984, mid-April to mid-May, and June 1985. However, we found no relationship between densities of S. coarctata in light traps and in the field. Population sampling revealed that data from S. coarctata fit a negative binomial distribution, with a clumping coefficient of $k = 0.50$. A sequential sampling plan was developed and compared with intensive sampling using visual counts of bugs on individual hills of rice. Using sequential sampling, 44-56% fewer samples were needed to arrive at the same decision obtained by intensive sampling. Over 90% agreement between intensive sampling and sequential sampling was found.

KEY WORDS Scotinophara coarctata, negative binomial, sequential sampling, light trap

ALTHOUGH THE Malayan black bug (MBB), Scotinophara coarctata (F.), has been reported as a pest of rice for many years in various parts of Asia, it was only recently found in the Philippines in damaging numbers (Barrion et al. 1982). In that country, the MBB is confined to the island of Palawan, where serious outbreaks have affected rice yields greatly.

The most extensive work on S. coarctata biology was reported by Corbet & Yusope (1924). However, to date, there is little information about sampling populations of MBB, except for reports of catches in light traps (Miyamoto et al. 1983). A reliable and cost-effective method of sampling S. coarctata is necessary to determine if damage thresholds (Heinrichs et al. 1986) are reached. Then insecticide applications can be properly timed.

The objectives of our study were to monitor the seasonal activity of adult S. coarctata with light traps and relate this to population densities, and to develop sampling techniques in the field.

Materials and Methods

Light-trap and Field Sampling. This study was conducted on Palawan Island, the Philippines. Traps attached to fluorescent street lights, and traps using gas-powered lamps (Petromax) in the field were used to determine MBB activity. Both types of traps had a plastic cone positioned underneath the light. Net bags were attached to the tip of the cone and adult MBB that fell into the cone were trapped in the bags. Fluorescent street lights were ca. 10 m high, and the Petromax lamps were ca. 1 m from the ground.

Two fluorescent street lights were located at Palawan National Agricultural College (PNAC), Aborlan; the Petromax lamps were installed in ricefields at Tigman, Malinao, and Pilot School, all of which are near the towns of Narra and Aborlan. MBB counts were recorded from the traps daily. A comparison between catches at fluorescent street lights and Petromax lamps was made. In addition, samples were taken every 2 wk by counting numbers of MBB on 48 randomly selected rice hills from fields where the Petromax traps were installed.

In a separate study to develop a sampling method in the field, visual counts of MBB adults and nymphs per hill made in situ in the ricefields were compared with absolute counts. This experiment was conducted in Narra, Palawan, in a plot of ca. 0.5 ha. After counting numbers of MBB adults and nymphs in 40 hills from the plot, entire hills were removed, placed in plastic bags, and transported to the laboratory, where numbers of adults and nymphs were counted and recorded. Each hill represented the sampling unit. Sampling was carried out for a total of 12 wk. The two techniques were compared statistically using Student's $t$ test and regression analysis.

Development of Sequential Sampling Plan. To develop a sequential sampling plan, information about the insect’s distribution, the damage threshold, and levels of risk of making a wrong decision must be available. The distribution pattern of S. coarctata was determined based on the data gathered from the experiments dealing with the comparison between visual counts and absolute counts. During the 12 sampling occasions, 40 hills were inspected weekly for a total of 480 samples. Data sets were fitted to frequency distributions using a
The FORTRAN program developed by Gates & Ethridge (1972) was used to facilitate computation. The economic threshold of three bugs per hill was reported for MBB (Heinrichs et al. 1986). We used the following parameters for calculations of the sampling plan: $m_1 = 2$, $m_2 = 4$ (class limits); $\alpha = 0.20$, $\beta = 0.20$ (risk levels); and common $k = 0.50$ (clumping parameter of the negative binomial distribution).

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The sequential sampling plan for S. coarctata was compared with intensive sampling, where a fixed number of 20 samples was taken randomly, and the treatment decision was based on the economic threshold of three bugs per hill. Using the sequential plan, the scout began consulting the sequential table after the fifth sample and stopped as soon as a decision (treat or do not treat) was reached. In cases where the running totals were within the "continue-sampling zone" on sample 20, the decision to treat was recommended. Counts were made using visual inspection and only third-instar to adult MBB were counted.

The numbers of sampling occasions in each location were as follows: 20 in Pilot School, 12 in Malinao, and 19 in Tigman, for a total of 51 sampling occasions.

**Results and Discussion**

**Light-trap and Field Sampling.** Weekly totals of S. coarctata in fluorescent-street-light traps during August 1984–July 1985 at two trap sites at Aborlan, Palawan, are shown in Fig. 1. Peak activities were recorded in mid-August 1984, from mid-April to mid-May, and in June 1985. Smaller peaks were evident in September and early November 1984, and from late February to early March 1985. In general, peaks of MBB movement...
Fig. 2. Comparison of catches using street-light traps and Petromax light traps.

found from street-light traps coincided with the peaks in catches in Petromax light traps (Fig. 2). Highest numbers of bugs were collected by both types of light traps during the full moon. This phenomenon has been observed by other researchers (Malaysian Agricultural Research and Development Institute 1982).

To determine if a relationship existed between catches in light traps and population density of *S. coarctata* in the ricefields, catches in Petromax traps were compared with counts in the field (Fig. 3). It was not possible to relate the density or activity of MBB in Petromax light traps to population density in fields in any of the three locations. One possible explanation for this is that rice is not the only known host of *S. coarctata* (Miyamoto et al. 1983). Other hosts available in the area included *Zea mays* L., *Hymenachne pseudoenterrupta* (Willd.) Steud., *Scirpus grossus* L.f., *Scleria suumatrensis* Retz., *Colocasia esculenta* (L.) Schott, *Vigna unguiculata* (L.) Walp., and *Musa sapientum* L.

Thus, we would not recommend these light traps as indicators of the seasonal occurrence or density MBB in the field. It may be that a better relationship between catches in traps and population density in the field could have been detected had there been denser bug populations. In our study, population densities always averaged below six per hill. However, this was above the economic threshold (Heinrichs et al. 1986).

There was a strong correlation (*r* = 0.95–0.97) between the absolute counts of bugs (bagged plants) and relative sampling methods (visual counts per hill) (Fig. 4). Estimates of the mean numbers of MBB using the two methods were not significantly different (*P* > 0.05; Student's *t* test). Thus, reliable and accurate population estimates of nymphs and adults were obtained using visual counts in the field.

**Development of Sequential Sampling Plan.**

Data sets obtained from field sampling most often fitted the negative binomial distribution. This was expected because female MBB lay their eggs in clusters at the base of the plants. The common *k* (Southwood 1978) was 0.5. Levels of risks of calling a low infestation high (*a*) or a high infestation low (*b*) were set at 0.20. In other words, there was an 80% probability of making the correct decision. Decision lines (*d*₁ and *d*₂) and a MBB sequential sampling plan are shown in Fig. 5. For field use, a table that can be derived from the decision lines is more practical and easier to use. This sampling plan greatly reduced the time required to reach a treatment decision. Other studies have shown that there was an 80% savings in time using sequential sampling for planthopper
showed agreement; 23 were "treat" decisions and 25 were "do not treat" decisions. When means in the intensive sampling ($n = 20$) were near the threshold level (i.e., 2.5–3.2 MBB per hill), the sequential table, in most cases, recommended "continue sampling" after sample 20 was taken. On such occasions, the sampler was advised to "treat."

The sequential sampling plan was tested at a range of MBB densities. At low and high population levels, fewer samples were required to reach a decision. In most cases, as few as five hills were sampled to arrive at a decision.

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