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Sampling and Preservation of Rice Insects

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WARDA Training Guide

1

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West Africa Rice
Development Association

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Contents

Preface

The *WARDA Training Guides* are special topic booklets which provide trainers with a set of material for practical instruction in the various aspects of rice science.

Each booklet in the series focuses on the development of special skills in a particular subject. Theoretical aspects have been minimized while many practical exercises are given to encourage and facilitate skills acquisition.

Besides trainers, field research assistants, agricultural extension agents, technicians and teachers in agricultural colleges will find these booklets useful in their training activities.

These booklets are published with the aid of a grant from the United Nations Development Programme (UNDP).

Titles in this series:

Guide 1	Sampling and Preservation of Rice Insects — *Elvis A. Heinrichs, Anthony Youdeowei* and *Joseph Kwarteng*
Guide 2	The Rice Plant and its Environment — *Monty P. Jones*
Guide 3	Survey and Development of Uplands for Rice Production — *A.B. Rashid-Noah*
Guide 4	Survey and Development of Lowlands for Rice Production — *A.B. Rashid-Noah*

About this Guide

Rice is one of the most important food crops in West Africa. In many areas, insect pests cause severe damage to the growing rice plant. If the developing rice grains are attacked, pest damage also reduces the grain quality. For these reasons it is necessary to control pests. To be able to do this effectively, the types of insects causing the damage and their natural enemies must be identified. This information can be obtained by sampling in the rice fields.

This training guide has been designed to provide essential information for a practical approach to sampling and preserving insects found in rice environments.

The guide can also be used to train field assistants in sampling rice insects. In this case, it should be read before a training session to provide background information. It will also serve as reference material for research assistants training in crop pest research.

1 Rice Pests

Sampling is the procedure for obtaining a sample of insects in a field.

Random sampling provides a representative portion of the insects in a given area.

Importance of sampling rice pests

Sampling of rice insects is important because it enables:

- the identification of various insect pests and their natural enemies in the rice field
- the determination of key insect pests and their natural enemies
- the study of the biology (time of occurrence of various life cycle stages) of rice insects
- the study of pest population distribution
- the assessment of pest density
- the establishment of the nature and extent of pest damage
- the determination of economic thresholds and economic injury levels
- the establishment of sound Integrated Pest Management (IPM) systems.

2 Sampling Methods

Several methods are used to sample different insect species that infest rice in the field. The most common methods include visual counting, sweep netting, use of an aspirator, and light trapping.

Visual counting

This method involves directly observing and counting the number of insects seen on the various parts (stem, leaves and panicles) of the rice plant (*see* Figure 1).

Figure 1 Making a visual count

Example

To estimate the population of rice bugs in a rice field by visual counting, proceed as follows:

Enter the field at one corner and move in a diagonal direction across the field. Carefully examine one panicle from each of 50 plants scattered across the field. Count the number of rice bugs on each panicle.

When 50 panicles have been observed, calculate the average number of rice bugs per panicle as follows:

$$\text{Bugs/panicle} = \frac{\text{Number of rice bugs counted}}{50}$$

Thus, if 80 rice bugs were recorded

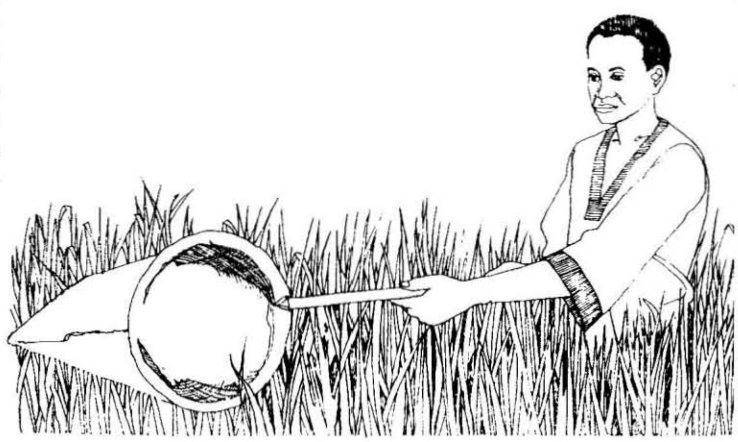
$$\text{Bugs/panicle} = \frac{80}{50} = 1.6$$

Note Since this is an average, fractions are allowed: 0.6 of an insect does not mean that you have a fraction of an insect.

Sweep netting

Walk through the crop holding the sweep net stretched out straight in front of you, with the opening always facing the plants to be sampled (*see* Figure 2). Make a forward stroke across the plant harboring the insect, followed immediately by a quick back stroke. Count each stroke of the net as one sweep.

Figure 2 Sweeping to sample rice insects



After about 50 sweeps, fold the net to prevent insects from escaping and then transfer the insects to a killing jar or plastic bag.

The efficiency of the method depends on the stage of the crop, the speed of sweeping, the angle of the net and the type of insect being sampled. Sampling is best done in the early morning or late afternoon when insects are usually most active.

Note

The number of sweeps to be taken depends on the size of the plot being sampled. A $100m^2$ (10m x 10m) plot requires 25 sweeps. A larger plot will require proportionally more sweeps. Thus, a $200m^2$ plot will require 50 sweeps.

Example

To estimate the population of stalk-eyed fly, a *Diopsis* species, in a $100m^2$ plot using the sweep net, proceed as follows:

Enter the field at one corner and move in a diagonal direction across the field. Make 25 sweeps; transfer the insects to a killing jar or plastic bag. Count the number of *Diopsis* collected. Calculate the number of *Diopsis* per sweep as follows:

$$\text{Number of } \textit{Diopsis} = \frac{\text{Number of } \textit{Diopsis} \text{ collected}}{25}$$

Thus, if 200 *Diopsis* are collected in 25 sweeps,

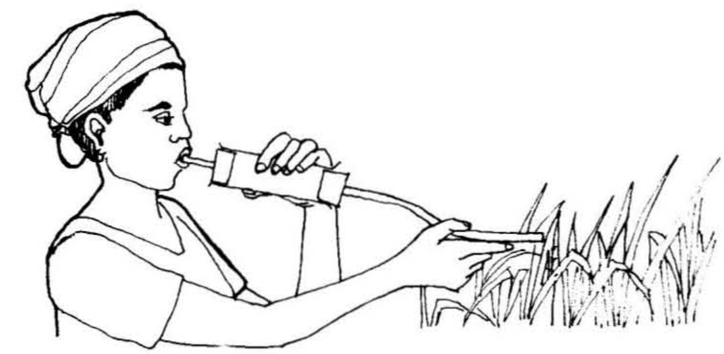
$$\text{Number of } \textit{Diopsis} \text{ per sweep} = \frac{200}{25} = 8$$

As well as flies, the sweep net is useful for sampling insects such as adult stem borers, beetles, leafhoppers and grasshoppers.

Use of the aspirator

An aspirator (*see* Figure 3) is used to sample small insects that move on the rice plant. Power suction with vacuum equipment can be used to sample rice hills for beetles and leafhoppers, and their predators.

Figure 3
An aspirator in use



The aspirator can be used to establish the composition and population levels of insect species on plants. The aspirator functions as a sucking device to suck insects off the plant into the aspirator tube. When using the aspirator, approach the plants slowly, place the inlet tube over the insect and suck on the tube. When collecting is completed, transfer the insects to a glass vial containing an appropriate preservative.

Light trapping

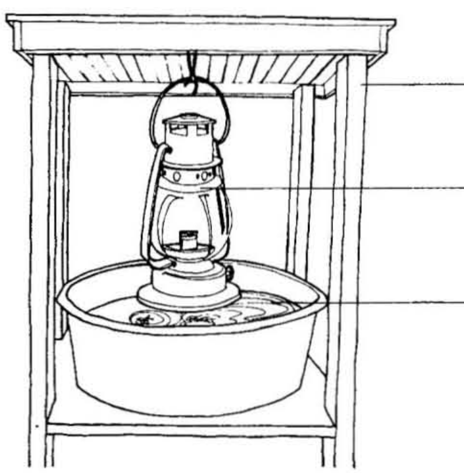
Light traps can be used to sample adult populations of rice pests such as armyworm moths, caseworm moths and rice bugs.

Although adults of some species (e.g. stem borers) do not cause plant damage, they lay eggs on the plants.

These hatch into larvae that feed on the plants and damage them. Thus light-trap catches provide an indication of plant damage to be expected in the field. If light-trap catches are high, fields must be closely monitored.

The method consists of placing a light trap in the field at night. Insects attracted by the light are trapped in a bowl containing an appropriate solution such as water with 1% detergent. The light can be powered by battery or other sources of electricity, but a small hurricane lamp works well. A cover should be provided to protect the trap from the weather (*see* Figure 4).

Figure 4
A light trap made with a kerosene lantern



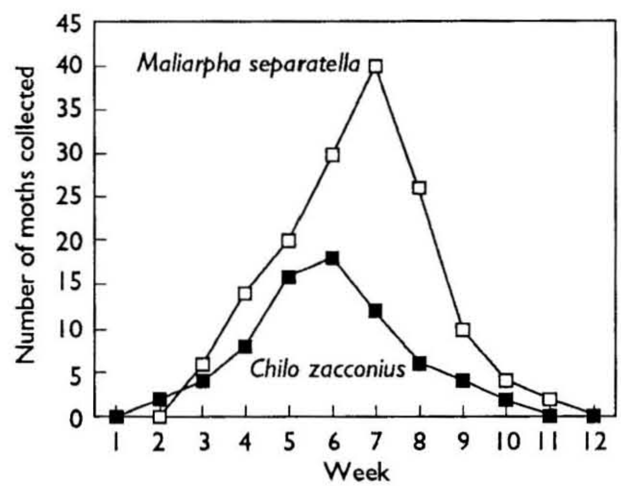
The following example shows how light-trap data can be utilized and presented. In this example, light-trap collections were made daily and the number of insects of each species was totaled for the 7 days of each week. The number of moths of *Chilo zacconius* and *Maliarpha separatella* collected weekly over a 12-week period is given in Table 1.

Table 1 Number of moths of *Chilo zacconius* and *Maliarpha separatella* collected weekly (7 days/ week) in a light trap

Week	*Chilo zacconius*	*Maliarpha separatella*
1	0	0
2	2	0
3	4	6
4	8	14
5	16	20
6	18	30
7	12	40
8	6	26
9	4	10
10	2	4
11	0	2
12	0	0

These data were then presented in graphic form as in Figure 5. The graph indicates that *M. separatella* was the most abundant species, the *C. zaccconius* moth population peaked at week 6 and the *M. separatella* population peaked at week 7.

Figure 5 Weekly catches of two moth species in a light trap (data from Table 1)



From the graph we can predict that oviposition on rice plants in the field will begin in week 2 for *C. zacconius* and week 3 for *M. separatella.* Ovipositon will peak at week 6 for *C. zacconius* and week 7 for *M. separatella.* Deadhearts, where the central shoot has been killed by stem borer larvae, will begin occurring about 3 weeks after oviposition.

3 Assessing Pest Damage to Rice in the Field

Damage caused by rice pests can be evaluated and used as an indirect method for establishing pest numbers.

The number of stem borer larvae can be estimated by assessing the plant damage they have caused. Stem borer larvae feeding on rice plants kill the central shoot at the tillering stage resulting in 'deadheart', and the panicle at the reproductive stage resulting in a white earhead with chaffy grains called 'whitehead'.

The percentage of deadhearts or whiteheads can be estimated by counting the number of deadhearts at the tillering stage, or whiteheads at the flowering stage, in a given 100-hill, random sample (or $4m^2$ sample area).

Example

A 100-hill sample had a total of 600 tillers. Of the 600 tillers examined, 150 had deadhearts. At harvesting, the same 100 hills were sampled and the sample had 350 panicles of which 32 were whiteheads. To calculate the percentage of deadhearts and whiteheads use the following formulae:

$$\% \text{ deadhearts} = \frac{\text{Number of deadhearts x 100}}{\text{Number of tillers}}$$

Since the number of deadhearts recorded was 150, then

$$\% \text{ deadhearts} = \frac{150 \times 100}{600} = 25\%$$

$$\% \text{ whiteheads} = \frac{\text{Number of whiteheads} \times 100}{\text{Number of panicles}}$$

Since the number of whiteheads counted on 350 panicles was 32, then

$$\% \text{ whiteheads} = \frac{32 \times 100}{350} = 9.1\%$$

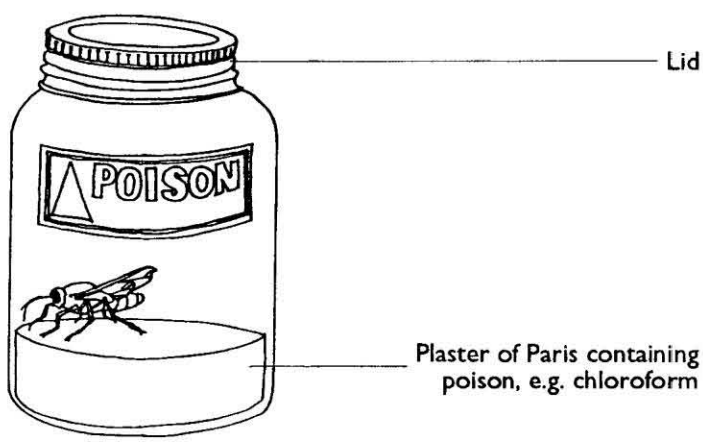
This sampling method can be used satisfactorily to estimate infestation by *Diopsis*, *Chilo*, *Sesamia* and *Scirpophaga* species.

4 Preservation of Rice Insects

After insects have been collected from the field, they should be killed, stored in an 80% ethanol solution and later mounted on insect pins.

Insects can be killed in a killing bottle (*see* Figure 6) or in a small polyethylene bag with an appropriate insecticide spray. If insects are not placed in the ethanol solution, they should be mounted within 24 hours of being killed, otherwise their joints will become stiff. All mounted insects should be labeled before they are stored in boxes or museum cabinets.

Figure 6
A killing bottle

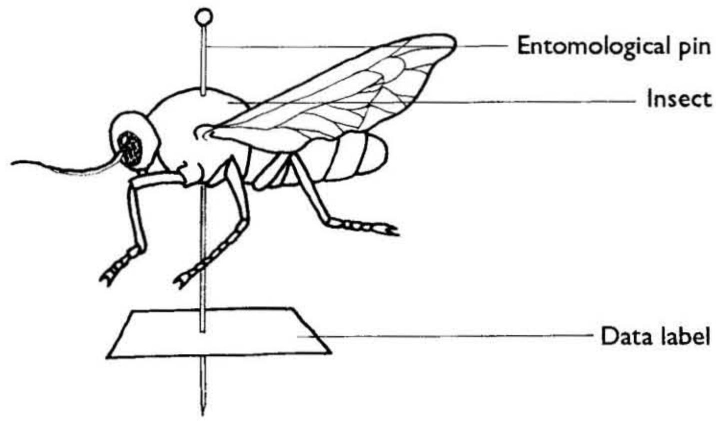


Descriptions of some of the methods used to preserve various insect specimens follow.

Direct pinning

Insects are mounted by inserting stainless steel entomological pins through the body, as shown in Figure 7.

Figure 7 Direct pinning



To pin, place the insect on a pinning block and insert the pin. Mount the specimen about 1.5cm under the pinhead.

Pin different groups of insects as follows:

1 Large bees, wasps and flies — pin through the thorax at the base of the right wing.

2 Stink bugs — pin through the triangular scutellum, a little to the right of the midline.

3 Beetles — pin through the right wing just behind the thorax.

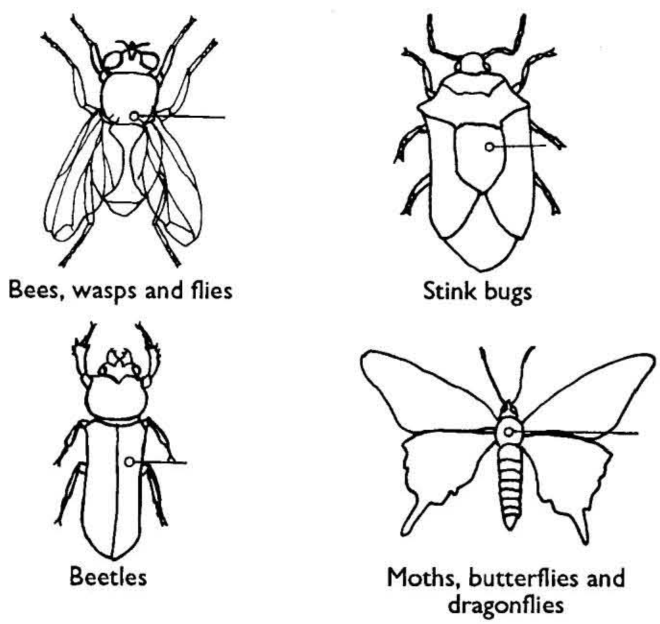
4 Grasshoppers — pin through the back of the thorax to the right of the midline.

5 Moths, butterflies and dragonflies — pin through the center of the thorax at the thickest point, or at the base of the front wing.

6 Small beetles, bugs, leafhoppers and wasps — mount on card points (*see* Figure 9 *overleaf*).

The points for pinning various insects are illustrated in Figure 8.

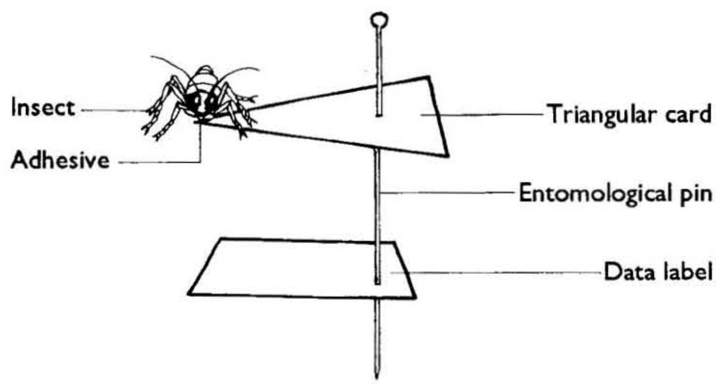
Figure 8 Points for pinning various types of insects



Carding

This method is used for insects that are too small to mount on pins. Gum arabic, or other suitable adhesive, is used to stick the insect near one end of a piece of card. An entomological pin is passed through the other end of the card and through a data label, as shown in Figure 9. This method is known as pointing or triangular carding.

Figure 9
Triangular carding



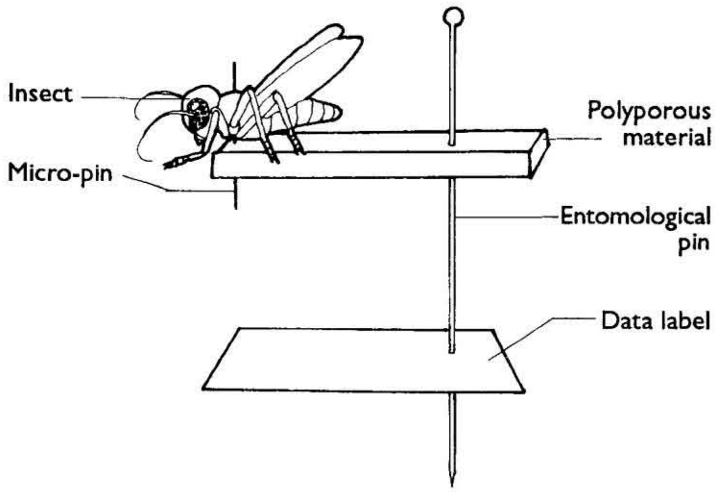
In some cases a rectangular piece of card is more suitable. The specimen is glued to the surface of the card at the underside of its abdomen. Its legs are spread out and fixed to the card using a brush and glue.

Carding is suitable for small coleoptera (beetles) and hymenopterans (bees and wasps). It is not suitable for permanent collections as the underside of the specimen is obscured.

Micro-pinning or staging

This method is used for minute insects such as small homopterans (e.g. leafhoppers), hymenopterans and dipterans (flies). A tiny entomological pin is pushed through one end of a strip of polyporous material leaving the point of the pin ready to receive the specimen. A larger pin is pushed through the other end of the polyporous strip to secure the data label (*see* Figure 10).

Figure 10
Micro-pinning or staging



Setting

To set an insect, spread the wings and legs in a horizontal position on a setting board. The insect (a moth, for instance) is placed so that the thorax and abdomen rest in a groove on the board, and an entomological pin is passed through the thorax. The wings are then spread out on the board with setting needles, so that the inner margins of the fore wings are in a straight line, at right angles to the body of the insect. The hind wings are spread out in the same manner. Both sets of wings are held down with setting tape. The antennae are arranged symmetrically.

Once set, the specimen is left in a drying cabinet for a few days or, in the absence of a drying cabinet, it should be left to dry in the laboratory for a few weeks. When drying in the open, specimens should be protected from ants and cockroaches or damage by rodents.

Labeling

On mounting, insects should be provided with a data label giving the time, place and method of capture. This information should be recorded soon after capture, while accurate details are available. The specimen should be identified on the label to order and family level and, if possible, to species level. The classification can later be confirmed by a taxonomist or other qualified specialist. It is useful to add the collector's name to the label.

A small rectangular card will serve as a data label. Labels should always be secured with the specimen, on the same pin, or in the same tube if the specimen has been pickled. The information can be written in lead pencil or indelible ink.

Pickled specimens

A specimen can be preserved by pickling in a tube with a liquid preservative. Pickling is used to preserve larvae of holometabolous insects, such as caterpillars, and adult beetles and bugs, prior to pinning.

The most suitable liquid preservative for pickling is 80% ethanol (alcohol) with glycerine added to prevent stiffening. Once the specimen has been placed in a tube, it should be well stoppered preferably with a rubber stopper or screw-top lid. The label should be dropped into the tube with the specimen.

Pickling is suitable for keeping duplicates of the large numbers of insects normally obtained from light traps.

Temporary storage

Another method of keeping insects, such as stem borer moths, is to enclose them neatly between two layers of cotton wool (with the relevant data written on a piece of card) and wrap them in newspaper shaped to form an envelope (*see* Figure 11). Drops of carbon tetrachloride or flakes of naphthalene should be added to the cotton wool to protect the specimens from attack by insects.

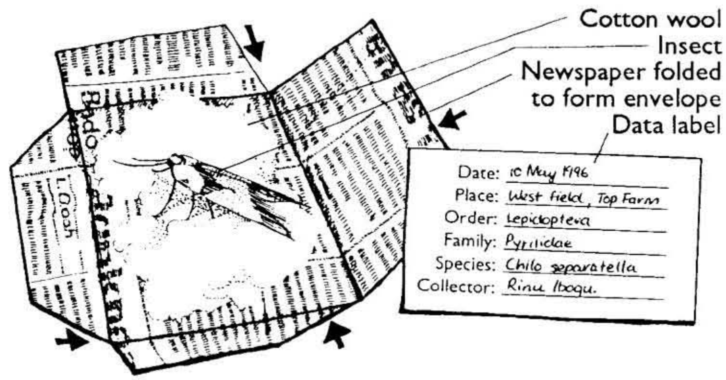


Figure 11 Making paper envelopes for temporary storage of specimens

Paper envelopes can also be made to store delicate insects such as small moths. These envelopes can be stored in a wooden box or drawer with some crystals of naphthalene placed at each corner.

Permanent storage

Pinned specimens should be stored in drawers which are placed in a cabinet. Naphthalene crystals should be kept in a small container in a corner of each drawer to protect the specimens from damage by insects or other animals. Fresh crystals should be added at regular intervals of about two weeks.

5 Procedure for Sending Insect Specimens for Identification

Identification of insects requires the assistance of a taxonomist. Taxonomists are specialists able to identify insects up to the species level. Insect specimens should be classified at least to the order level and preferably to the family level, and then properly labeled and packed before being sent to the taxonomist.

Contact should be made with the taxonomist to obtain approval before sending the insects for identification.

6 Suggested Exercises

1 Assemble and identify the tools and equipment needed to sample for insects in a rice field.

2 a) Walk through a rice field and sample for insects by making quick forward and backward sweeps with a sweep net.

b) Empty the insects you have collected into a killing bottle. Alternatively, use a polyethylene bag and kill them with an aerosol insecticide.

3 Prepare the insects for preservation by the following methods:

a) Direct pinning — make sure that insects are pinned in the right places

b) Rectangular carding
Triangular carding

c) Micro-pinning or staging

d) Setting.

Recommended Reading

Illustrated Guide to Integrated Pest Management in Rice in Tropical Asia by W.H. Reissig, E.A. Heinrichs, J.A. Litsinger, K. Moody, L. Fiedler, T.W. Mew and A.T. Barrion.
International Rice Research Institute (IRRI), Los Baños, Laguna, Philippines. (1988), (411pp).

A Laboratory Manual of Entomology by Anthony Youdeowei.
Oxford University Press, Nigeria. (1977), (208pp).

Biology and Management of Rice Insects by E.A. Heinrichs.
Wiley Eastern, (New Delhi) and International Rice Research Institute (IRRI), Los Baños, Laguna, Philippines. (1994), (779pp).

About WARDA

The West Africa Rice Development Association (WARDA) is an intergovernmental research association with a mandate to conduct rice research, training and communications activities for the benefit of the West African sub-region. Originally formed in 1971 by 11 countries with the assistance of the United Nations Development Programme (UNDP), the Food and Agriculture Organization of the United Nations (FAO), and the Economic Commission for Africa (ECA), it now consists of the following countries: Benin, Burkina Faso, Cameroon, Chad, Côte d'Ivoire, The Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, and Togo. WARDA is now a member of the network of 16 international agricultural research centers supported by funds from donors of the Consultative Group on International Agricultural Research (CGIAR).

WARDA's goal is to provide and strengthen West Africa's capability in the science, technology and socio-economics of rice production. Through these efforts, it is envisaged that the livelihood of the small-holder farming family can be sustained and improved, opportunities for rural employment increased, and prospects for food security enhanced.

The Headquarters of the Association are located at M'bé near Bouaké, Côte d'Ivoire. WARDA also maintains regional research sites near Saint Louis, Senegal, and at IITA, Ibadan, Nigeria.

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Keywords: rice Oryza spp., sampling methods, assessing damage to rice in the field, preservation and curation of insect specimens, pinning, carding, preservation of soft-bodied specimens, procedure of shipping specimens for identification, permanent storage