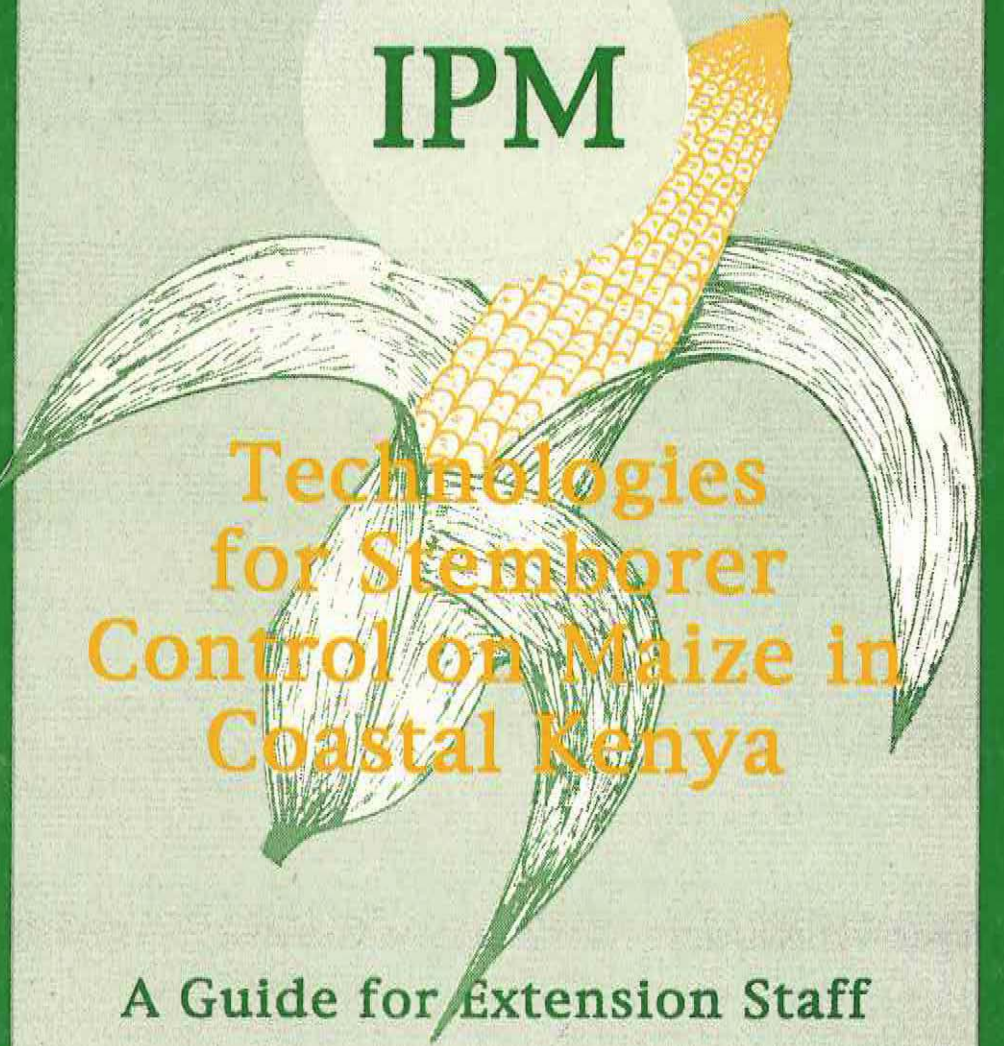
The International Centre of Insect Physiology and Ecology

IPM



Technologies for Stemborer Control on Maize in Coastal Kenya

A Guide for Extension Staff

Social Sciences Department

IPM

Technologies for Stemborer Control on Maize in Coastal Kenya

The International Centre of Insect Physiology and Ecology (ICIPE)
P.O. Box 30772, Nairobi, Kenya

September, 1997

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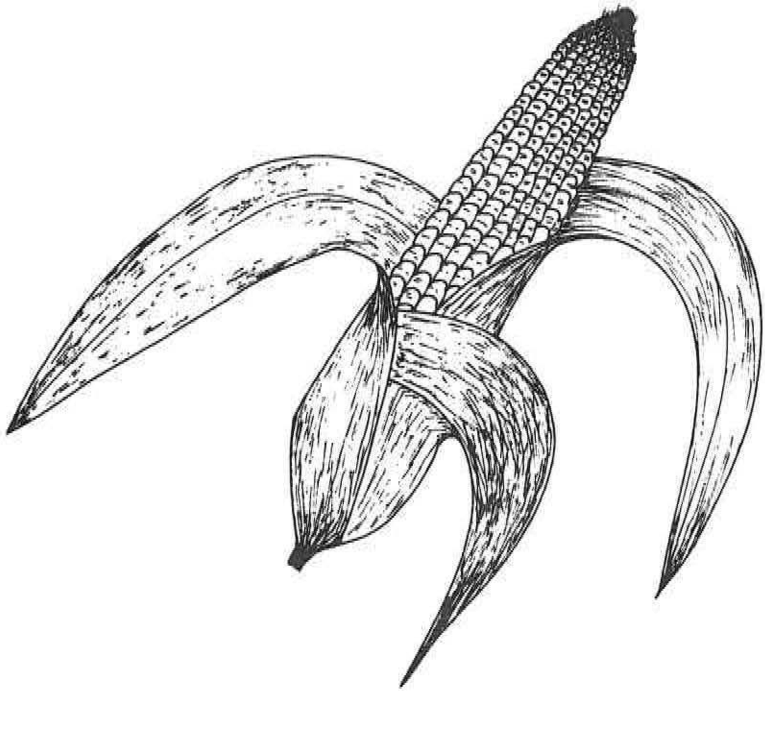

I. INTRODUCTION

The International Centre of Insect Physiology and Ecology (ICIPE) is a research institution engaged in research on insect pests and vectors of human and livestock diseases. The Centre's Interactive Socioeconomic Research for Biointensive Pest Management Technology Development (ISERIPM) project, which has been implemented in Kwale and Kilifi districts of Kenya, covers research work on maize, sorghum, cowpea and cassava, which are important food crops in Coast Province. Farmers and frontline extension staff of the Ministry of Agriculture, Livestock Development and Marketing (MOALDM) and staff of KARI have been actively involved in the ISERIPM project's research activities as collaborating partners.

The project has two main aims which are to: (1) test IPM technologies which have been developed in western Kenya with a view to ensuring their adaptability to local coastal conditions; and (2) develop methodologies of working with farmers, MOALDM's extension staff, and KARI researchers that can facilitate adoption of IPM technologies and enhance food production on a sustainable basis.

This brochure is a reference source for use primarily by extension staff who are responsible for the demonstration of the IPM technologies to farmers. Most of the information that is presented in this Guide has not only been discussed with farmers and extension staff, but has also been applied by farmers in the research areas during a number of seasons. Indeed, farmers have played an important role in all phases by evaluating the various components of the IPM technology and selecting the options they prefer. For example, out of the original ten maize cultivars and twenty sorghum cultivars tested, two maize and two sorghum cultivars have been selected with the participation of farmers. In the final phases of the project, the farmers were the key players since they managed all the activities of the trials according to the options they selected. The primary role of the researchers in these phases was to monitor the technology adoption proces and to observe and evaluate the modifications being made by farmers.

II. WHAT IS IPM?

Integrated Pest Management (IPM) has been defined in many ways. The Food and Agriculture Organisation (FAO) agreed on the following description: '*A pest population management system that utilises all suitable techniques in a compatible manner to reduce pest populations and maintain them at a level below those causing economic injury.*' This definition implies either the judicious use of insecticides or the use of none at all.

Why do we need IPM?

Shortly after the introduction of chemical insecticides, environmentalists and biologists began to warn of unwanted side effects. Chemical pest control has resulted in more than 500 insect species becoming resistant to one or more pesticides. Other unwanted side effects include adverse consequences to human safety and pesticide residues in food. Synthetic chemical pesticides are inadequately selective and often destroy pest organisms as well as helpful insects. The number of species considered to be pests is actually quite small. There are many useful insects, including pollinators and those that produce honey and silk. In nature, many natural enemy species maintain plant-eating insects at non-damaging levels.

Opportunities in pest control with natural products from plants (e.g., neem) and microorganisms (e.g., delta endotoxins of *Bacillus thuringiensis*) are still very much a developing technology and will play an increasingly more important role in pest management in the future.

The notion of IPM is not altogether new. Traditional farmers in Africa have long used a number of methods to prevent or reduce pests. These include intercropping, relay cropping, manual removal of insects, planting during the appropriate dates, mulching, site selection, etc. The new element is the introduction of the concept of *economic injury levels* (EILs) to avoid unnecessary application of insecticides.

III. LIFE CYCLE OF THE SPOTTED STEMBORER, *Chilo partellus*

On-farm test plots of maize from the Kwale and Kilifi Adaptive Research Project showed that the average yield loss due to stemborers ranged between 17 and 23%. However, few farmers outside the study villages used available technologies to control stemborers. There is, therefore, need for the MOALDM to demonstrate the benefits of IPM to the farmers.

In order to control the stemborer effectively, it is important to understand its life cycle and to know what stage of it is destructive (see page 6).

There are two Chilo species at the Kenya coast, namely *Chilo partellus* and *C. orichalcociliellus,* but for the purpose of this manual we shall mainly refer to *Chilo partellus* (or simply Chilo).

1. The *adults* are pale brown moths bearing four wings. They migrate from the stems to look for their mates so as to produce subsequent generations. The adult Chilo is a free-living moth that does not feed on crop tissue. It only takes liquid (water) from plants and any other source, preferably one that is sugary. It lives for only about seven days and its main function is to mate and produce the next generation.

2. The adult moth lays *eggs* in masses of 50–100 on the lower surface of maize and sorghum leaves (and sometimes on the leaves of non-host plants in an intercropping situation). The eggs are arranged like the scales of a fish and are creamish-white in colour. They hatch within 5–11 days, depending on weather conditions (temperature and relative humidity) in the area.

3. Eggs hatch into *larvae*. The growth of the larvae is divided into stages called *instars*, which are the characteristic age-groups. The first instar larvae migrate from the lower surface of the leaves to the inner whorl of the plant to feed on the tender parts. The subsequent instars result from the insect shedding its skin (moulting) to give room for further growth. At the 3rd to 4th instar, the larvae migrate and burrow into the stem where they live and feed until they become pupae. It should be noted that the larva is the destructive stage of the stemborer, and is the best stage to target for control.

4. The *pupa* is a resting stage of the stemborer while living in the stem without feeding. It is brown in colour and looks very different from the larval stage. It stays in this stage for about seven days and then emerges into an adult.

IV. TECHNOLOGY OPTIONS FOR STEMBORER CONTROL ON MAIZE

Researchers, with the participation of farmers, have identified certain integrated pest management (IPM) technology options for stemborer control.* The options offered are for demonstration by extension staff in all eight divisions of Kwale and Kilifi districts. The IPM components are the following:

Tolerant Maize Cultivar, IC92M5. This is an ICIPE maize seed, variety cross hybrid, white in colour, early maturing, and tolerant in its reaction to stemborers.

Strip Cropping: Simultaneous planting of maize and cassava in strips: 4 rows of maize and 2 rows of cassava (see Fig. 1 on page 5).
The farmers can relay crop their fields with cowpea as their usual practice.

Application of Bt or Neem

The application of Bt or neem is justified by the level of pest infestation. Bt should be applied at specific stages of the plant. Maize and sorghum leaves should be checked for stemborer damage regularly between 3 weeks after plant emergence and 6 weeks. Refer to Plate 2 for symptoms of stemborer damage. Bt should be sprayed on the crops if it is found out that 30 out of 100 plants randomly observed show stemborer leaf damage. This is a monitoring task which can easily be performed by farmers. One to two applications may be required depending on the level of damage. (Refer to Box 1 and Box 2 on pages 8 and 9 for details of the methods of mixing and applying Bt and neem.)

Farmers may, of course, wish to purchase and use chemical fertilisers such as DAP and CAN to increase their output. Those who cannot afford to buy chemical fertiliser have the option to fertilise their land by the use of composts as will be explained later.

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* Although the focus here is on maize, the same principles apply for the control of stemborers on sorghum.

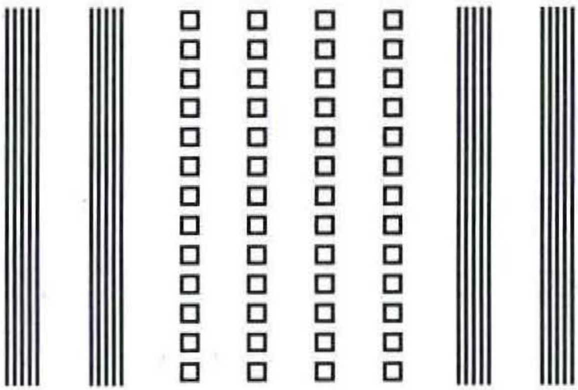


Fig. 1. Strip cropping of maize and cassava

Rows 75 cm apart

☐ Maize plant, within maize row spacing 40 cm, 2 plants/hill

||||| Cassava plant, within cassava row spacing 50 cm

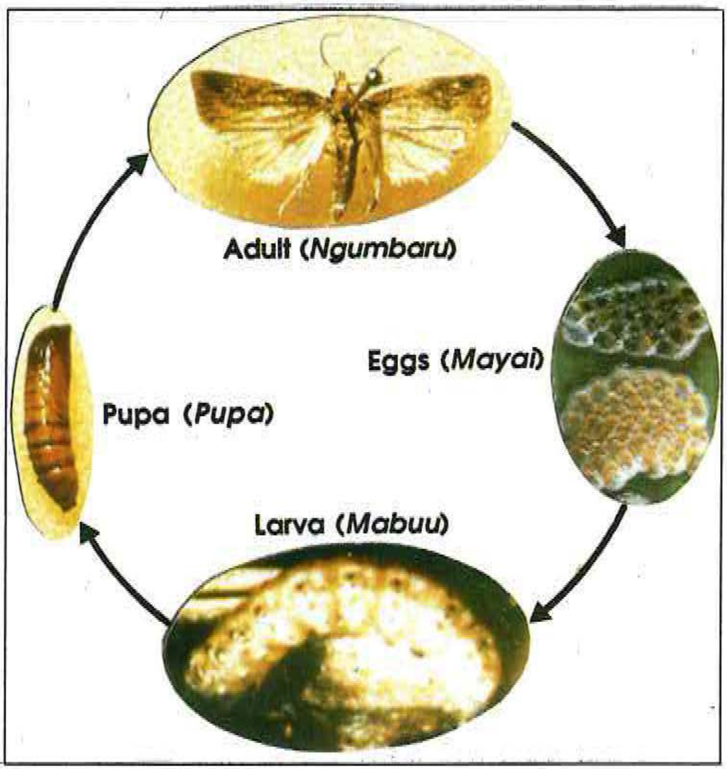


Plate 1. Life cycle of stemborer

Dead heart damage symptom of emerging shoot

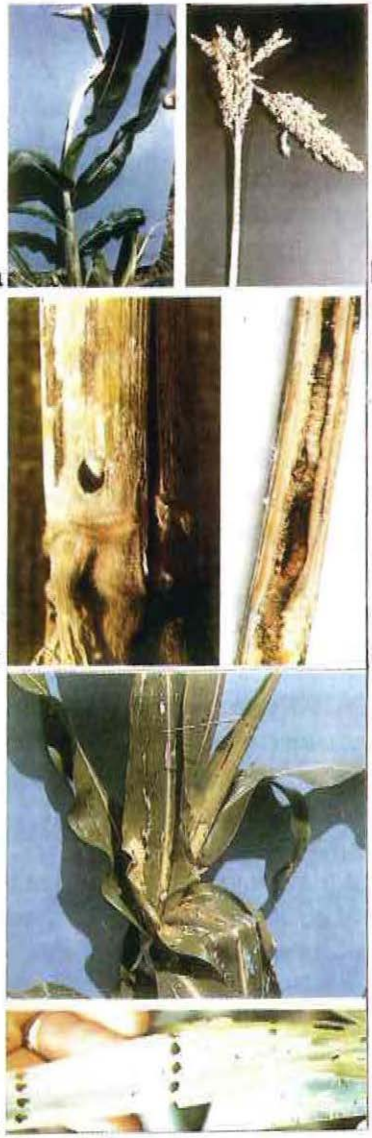
Sorghum head breaking

Stem showing exit hole of larva

Stem tunnelling

Leaf damage

Leaf damage



a b c d e

Plate 2. Symptoms of stemborer damage

Box 1

HOW TO PREPARE AND APPLY Bt

1. ***How to Mix Bt for Application***
   Dissolve sugar in water at the ratio of 0.5 g to 99.5 ml of water. Add 2 ml of Bt to every 98 ml sugar solution and mix well. For ease of measurement, pre-marked cups should be given to the farmer to measure the quantity of sugar and Bt to be added to a given quantity of water in gallons. Bt liquid should be made available to the farmers.

2. ***When to Spray Bt***
   Bt should be sprayed on the crops when 30 out of 100 plants show stemborer damage. One or two applications may be required depending on the level of damage:

   FIRST APPLICATION if needed, should be at around 3 weeks after plant emergence.

   SECOND APPLICATION should be 2 weeks after the first one. Any further borer damage after the second application may not significantly reduce the yield and may therefore not be necessary.

3. ***How to Apply Bt***
   Direct the nozzle of the sprayer to the whorl of the maize plant and spray a puff inside. The plants should be sprayed individually. After spraying, the equipment should be washed with soap, then dried and stored.

Box 2

SUSTAINABLE STEMBORER MANAGEMENT WITH NEEM

Lepidopteran stemborers are highly injurious to maize, sorghum, and millet in sub-Saharan Africa. An inexpensive, relatively safe, and environmentally friendly pest control technology is needed to reduce the losses caused by stemborers. Repeated trials at the experimental station and in farmers' fields conducted under ICIPE's Neem Awareness Project have shown that stemborers can effectively be controlled and yields correspondingly increased by applying neem, *Azadirachta indica* (*Mwarubaini* in Kiswahili) seed powder (NSP) or deoiled neem cake powder (NCP). Neem, an evergreen mahogany, is widespread in coastal Kenya. Large quantities of neem fruits and seeds can be collected locally.

Methodology

1. Depulp the fruits and shade-dry the seeds for 3 to 4 days; rake the seeds 2 or 3 times daily.

2. Pulverise the dried seeds using a locally available mortar and pestle. Deoiled, powdered neem cake (NCP) can also be used, but cake production requires a mechanical or electrical oil expeller. The advantage of using an expeller is that in addition to neem cake one gets the highly valuable neem oil which has excellent medicinal and pest control properties.

3. Mix NSP with sawdust or ash in equal parts (1:1).

4. Take a pinch (2 g) of NSP mixture or NCP (1 g) between thumb and index finger and apply into the whorl of each plant when the crop is knee-high (3 weeks old). Damage is controlled as young stemborer larvae in the whorl can no longer feed or grow, as neem has strong antifeedant and growth inhibitory effects.

5. Compare the insect damage in neem-treated and untreated plots; neem-treated plants are taller and more vigorous, and they produce bigger cobs.

6. Neem is safe to bees, wasps, spiders, fish, birds, warm-blooded animals, and other non-target organisms, including humans.

R.C. Saxena, Co-ordinator, Neem Project, ICIPE

V. ADDITIONAL METHODS OF PEST CONTROL

Early Planting

Farmers should be encouraged to prepare land and plant early at the beginning of the long rains. However, the decision on the safe dates for early planting should be left to the judgement of the farmers.

Plant Residue Management

Remains of plants after harvest may harbour insect pests that come back to attack newly-planted crops. Such remains should be disposed of constructively. They can be used for feeding cattle or for making compost manure. By making compost out of plant residue, one not only can reduce pest attack but also increase soil fertility. Extension staff should explain how to prepare and use compost.

VI. ENSURING THE SUSTAINABILITY OF IPM TECHNOLOGY

Some years back, farmers were seldom included in discussions of problems of farming. Today it is widely believed that farmers should play the key role in farm improvement activities. It is the farmers who must identify the problems and needs of farm development, seek new knowledge and resources, and make decisions relating to such development. Thus, if a farmer is motivated and keen to improve farming techniques, there is no doubt that development will take place. With determination and hard work, the farmer can produce not only enough food for the family but also a surplus for sale.

Need for Farmers' Organisations

It is often said that 'unity is strength'. It is believed that the sustainable use of IPM technologies can be enhanced if farmers make a cooperative effort by forming farm organisations. Such organisations can facilitate the acquisition of essential inputs, seed multiplication and storage of seeds, sharing of equipment, marketing of produce, etc. The following organisations have, therefore, already been created in the study villages:

District	Village	Organisation
Kwale	Mamba	Mawazo
	Makambani	Mwakoyo B Group
	Mwalewa	Mwangaza wa ICIPE Group
	Tsuini	ICIPE Hatua Group
Kilifi	Silala	Tushauriane Youth Group
	Pingilikani	Pingilikani ICIPE Self-Help Group
	Lutsangani	Bahati ICIPE Self-Help Group
	Tandia	Hika-Hika Group

New organisations should be created or existing ones strengthened in other parts of the two districts to ensure the sustainable utilisation of IPM technologies. It is hoped that in this effort, extension staff can use the existing organisations as models.

Supply of Essential Inputs

Maize Cultivar IC92M5

The ISERIPM Consultative Committee consisting of ICIPE, MOALDM and KARI staff has been informed that the ICIPE maize cultivar IC92M5 has undergone the usual national seed variety performance trials and is expected to be certified in the near future. In the meantime, if it becomes necessary, farmers can multiply their own seeds as they have already successfully done in 1997 in all eight of the project villages.

Bt

It is known that Bt is already available in the market. However, production of Bt is also being planned under the auspices of the ICIPE TechnoPark. A Nairobi industrial firm is expected to produce and market this input under this scheme. In the meantime, ICIPE can assist in making this input available if requested by the extension service.

Neem

Neem extracts are also expected to be produced under ICIPE's TechnoPark arrangement. However, since the neem tree grows widely, especially in Kilifi District, farmers have access to adequate supplies of the seeds which they can themselves process and apply, as already demonstrated in the farmer-managed technology trials.

Cassava Cuttings

Cassava cuttings are usually available for planting in Kwale and Kilifi districts. Farmers may, however, need assistance in obtaining cuttings during drought periods. It is believed that arrangements can be made with KARI Mtwapa Station for the supply of planting materials, since it already has fairly extensive on-station cassava trials.

In conclusion, therefore, it is believed that with the support and assistance of the extension staff and the efforts of the farmers themselves, the sustainable utilisation of the new IPM technologies can be ensured.

Other Reading Materials

Sithanantham S., Kamau G. M., Wekesa E. and Mwangi K. (1996). *Improved Insect Pest Management for Maize, Sorghum and Cowpea Production in Coastal Kenya.* A Technology Handbook for Extensionists. ICIPE Science Press, Nairobi.

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icipe Tropical Insect Science for Development

ICIPE Science Press
PO Box 72913
Nairobi, Kenya

ISBN:92 9064 110 X