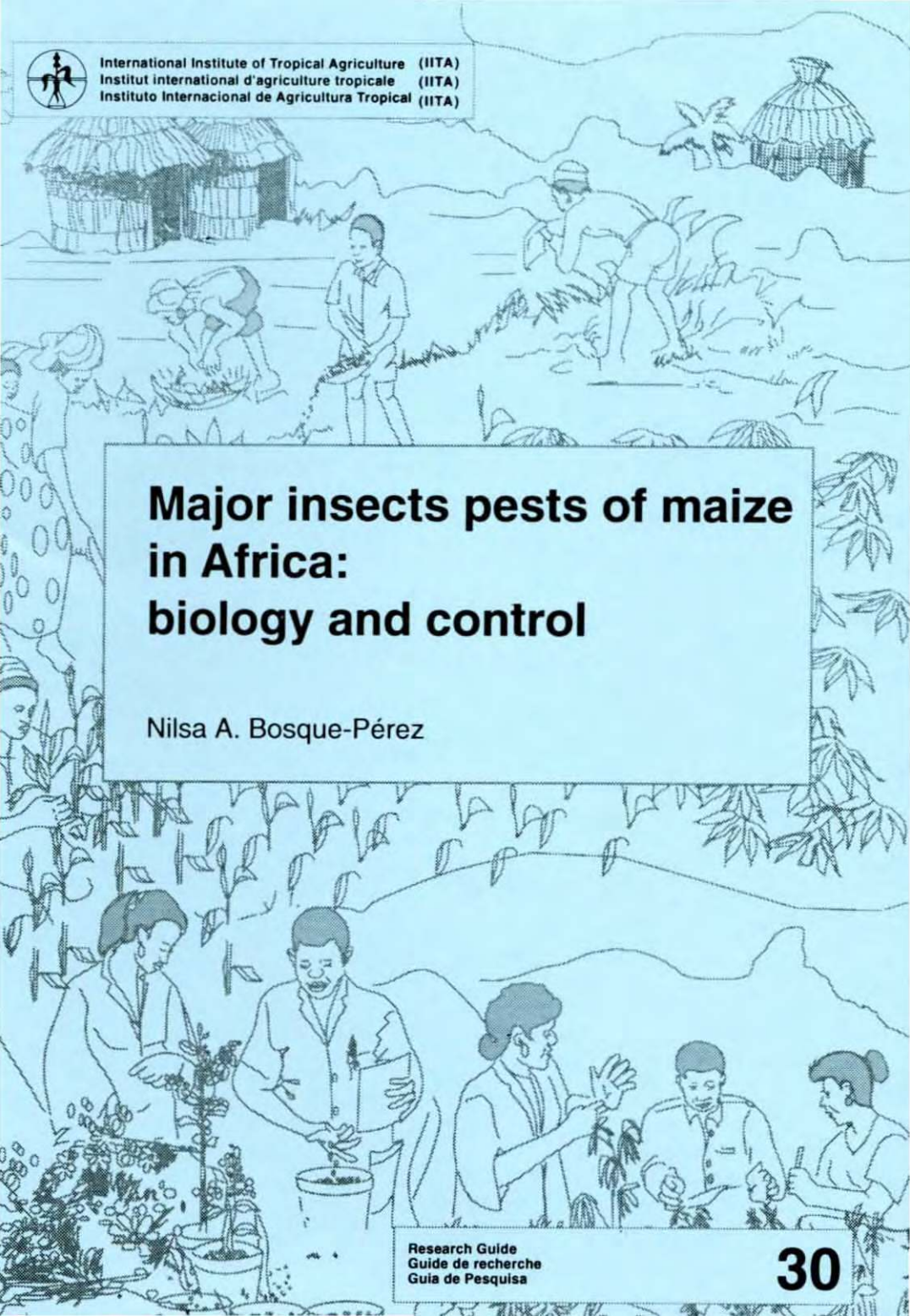

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Major insects pests of maize in Africa: biology and control

Nilsa A. Bosque-Pérez

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IITA Research Guide 30

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Nilsa A. Bosque-Pérez

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International Institute of Tropical Agriculture (IITA)
Training Program
PMB 5320
Ibadan
Nigeria

Telephone: (234-2) 2412626
Fax (INMARSAT): 874-1772276
Telex: 31417 or 31159 TROPIB NG
E-mail (Internet): IITA@CGNET.COM

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Editing	Ayotunde Oyetunde
Text processing	Kehinde Jaiyeoba
Layout	Nancy Ibikunle
Coordination	Rainer Zachmann

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Major insect pests of maize in Africa: biology and control

Objectives. This guide is intended to enable you to:

- describe the importance of insect pests of maize;
- discuss basic aspects of damage, biology, life cycles, and geographical distribution of stem borers, ear borers, soil insects, leaf feeders, and storage pests;
- control maize pests.

Study materials

- Specimens of maize pests in different developmental stages (eggs, nymphs or larvae, adults).
- Maize plants damaged by insects.
- Slides of different maize pests.
- Slides of maize plants affected by insects.

Practicals

- Study insect specimens.
- Visit fields to identify damage and pests.
- Demonstrate monitoring and control methods.
- Compare susceptibility of maize varieties.

Questions

1 How important is maize in East and West Africa?
2 What are the most important pests of maize worldwide?
3 Why are insects so successful?
4 What are the main methods of insect control?
5 What is integrated pest management?
6 Where did the most damaging pests of maize in Africa originate?
7 Which insect control methods are most appropriate for African farmers to employ?
8 Why are stem borers among the most important pests of maize in Africa?
9 Name three stem borer species and the stage of the maize crop they attack.
10 On what factors depend severity and nature of stem borer damage?
11 What is the range of yield losses caused by maize borers in Africa?
12 What species is often considered the most important pest of maize in sub-Saharan Africa?
13 Where is the maize stalk borer especially important?
14 What is often the most abundant borer species at the end of the maize growing season?
15 What is the potential for biological control of stem borers?
16 What has been suggested as the most promising means of stem borer control?
17 What are the three main species of ear borers?
18 How do soil insects affect maize?
19 Why are *Cicadulina* leafhoppers important as a pest of maize?
20 What are the most important storage pests?
21 Describe methods to control storage pests.

Major insect pests of maize in Africa: biology and control

Abstract. Insect pests severely limit the production of maize, one of the most important cereal crops worldwide. Losses reach millions of dollars annually. Control includes cultural, chemical, and biological methods in addition to plant resistance. Integrated pest management combines control methods in an environmentally sound manner. Effective control requires knowledge on damage, biology, distribution, and life cycles of insects.

1 Importance of insect pests of maize

Maize is one of the world's most important cereal crops. Its wide genetic diversity and multiple uses account for its cultivation in a large range of environments. Maize is the most important cereal crop in East Africa where it is a staple for a large proportion of the population.

In West Africa, maize is an important component of the farming systems and the diet of many peoples. In the latter region, maize is increasing in importance as it expands into the savanna zones.

Many factors limit maize production; insects and mites being among the most important. Lepidopterous pests are the most damaging insects of maize worldwide. This group includes stem and ear borers, armyworms, cutworms, and grainmoths. Next in importance are the beetles (weevils, grainborers, rootworms and whitegrubs), followed by the virus vectors (aphids and leafhoppers).

Although it is difficult to estimate the losses caused by insects that attack maize in Africa, the figure is certainly in the millions of dollars annually.

Insects are arthropods or "joint-limbed" animals. From the evolutionary point of view, they have been very successful and today occupy the most diverse ecologies on earth. Over a million species are known to exist and many remain undescribed.

The key to an insect's success lies in its great reproductive potential, small size, dispersal mechanisms, and ability to survive harsh environments. Very few insects are pests, the great majority are beneficial to humans.

For those insects that are pests, control measures must be devised to minimize the economic impact of their damage.

Pest control can be broadly classified into:

- cultural,
- chemical,
- biological,
- host plant resistance.

Cultural control includes agronomic practices such as crop rotation, planting and harvesting dates, crop refuse destruction, etc.

Chemical control includes the use of insecticides as well as other chemicals (i.e. attractants, repellents).

Biological control is the action of natural enemies (parasites, predators and microbial agents) including naturally occurring agents and agents which are introduced and managed by humans for pest control (also referred to as "classical biological control").

Host plant resistance to insects is the genetic property that enables a plant to avoid, minimize, tolerate or recover from injury caused by insects.

In most cases, the most effective and economical way of controlling pests is by combining various methods.

The term Integrated Pest Management is used to describe this concept, i.e., the management of pests by integrating control methods in an environmentally sound manner.

When considering control of insect pests of maize in Africa, it is important to keep in mind that maize is an introduced crop which evolved in the Americas.

The most damaging insect pests of maize in Africa, however, originated in this continent and evolved with the native grasses (i.e. stem borers and *Cicadulina* leafhoppers) and only "recently" adapted to feed on maize. Any attempts to control these pests must take into consideration the close association between their ecology and that of the native grasses.

It is also essential to remember that farmers in Africa are already doing many things to reduce pest damage (even inadvertently) and that a great majority of them cannot purchase insecticides.

We have included insecticides as possible means of control not because we endorse widespread use of insecticides (we certainly don't), but because in many instances, national program scientists, technicians and extension agents want to be familiar with potential agents of chemical control. Please refer to IITA's Research Guide 15 for advice on how to safely use insecticides.

2 Stem borers

Importance. Lepidopterous stem borers are among the most important insect pests of maize in Africa. Four borer species cause significant yield loss:

- the maize stalk borer, *Busseola fusca* Fuller (Lepidoptera: Noctuidae);
- the pink stalk borer, *Sesamia calamistis* Hampson (Lepidoptera: Noctuidae);
- the African sugar cane borer, *Eldana saccharina* Walker (Lepidoptera: Pyralidae);
- the spotted stalk borer, *Chilo partellus* Swinhoe (Lepidoptera: Pyralidae).

The first three are African, and are present in most countries of sub-Saharan Africa, while *C. partellus* is Asian and only recently introduced to eastern Africa.

Severity and nature of stem borer damage depend upon the borer species, the plant growth stage, the number of larvae feeding on the plant, and the plant's reaction to borer feeding. Almost all plant parts, leaves, stems, tassels and ears are attacked. Crop losses may result from death of the growing point (dead hearts), early leaf senescence, reduced translocation, lodging and direct damage to the ears. The incidence of stalk and ear rots is increased by larval feeding and the ears of lodged plants are often rotten. Yield losses caused by maize borers in Africa have been estimated to range from 10-100 %.

Maize stalk borer. *Busseola fusca*. *B. fusca* is often considered the most important pest of maize in sub-Saharan Africa. *B. fusca* is distributed from approximately 12 °N 30 °S but it does not occur in Madagascar or the Comoros. *B. fusca* was recognized as a major pest of cereals when originally described in 1901.

In West Africa, the maize stalk borer is abundant in the drier savanna zone, specially where sorghum is grown. Sorghum is believed to be the native host of *B. fusca* in West Africa. This insect is also abundant in the mid altitude regions across the continent.

The adult moths generally emerge in the evening and mate. Females lay their eggs between the leaf sheaths of the host plant; egg batches contain from 30-100 eggs. On average, a female lays 400 eggs. Six or seven days after, the eggs hatch. Infestations start at young plant stages. Larvae crawl over the plants, congregate in the funnel and feed on the rolled leaves. As the leaves grow away from the funnel, a characteristic pattern of holes or "window panes" can be seen.

Continuous feeding by the larvae might result in the destruction of the growing point, typically referred to as "dead hearts". After killing a plant, larvae usually migrate to new plants and enter by boring into the stem near the base. Tunneling of the stem and ears then occurs. Larval development will take between 26-33 days. When fully grown, larvae are 3-4 cm long and a pinkish-white color with small bluish-black spots along the sides of their bodies.

During the dry season, larvae (usually the third generation) enter diapause – a period of arrested development which usually occurs during adverse environmental conditions – and take up to six months to complete their development. With the initiation of the rains, the larvae pupate within the stems and adult moths emerge. Adults emerge 10-12 days after pupation.

Pink stalk borer. *Sesamia calamistis*. Tams and Bowden (1952) described fifteen species of *Sesamia*. *S. calamistis* and *S. botanephaga* are the two most important ones in Africa. According to Bordat et al. (1977) the former species is present in most countries of sub-Saharan Africa, Madagascar and the Comoros while the latter is present in West Africa, Sudan, Uganda and Kenya.

Adults of the pink stalk borer emerge in the late evening, and behave similarly to *B. fusca*. The moths are pale-brownish with darker margins on the forewings and white hindwings.

Eggs are laid between the leaf sheaths of the host plants. On average, each female lays around 300 eggs in a period of five days. Egg laying occurs from the time plants are two weeks old until flowering. The most serious damage, however, occurs at early plant stages.

Most larvae penetrate the stem shortly after egg hatch. Larval feeding might result in dead hearts and the tunneling and girdling activity of the larvae often results in stalk breakage.

During the ear filling period, the majority of the larvae occur in the ears. Development of the larvae takes four to six weeks; mature larvae are pink with a brown head, buff and pink dorsal markings and about 3 cm long. Most larvae pupate within the stem or cobs.

Sesamia in contrast to *Busseola* breeds throughout the year and has no resting stage. However, it is less abundant during the dry season when it is limited to mature grasses (among others *Pennisetum purpureum, Setaria spp.* and *Rottboellia exaltata)* as a food source.

Sesamia spp. adults which emerge at the beginning of the cropping season are smaller and less fecund than those emerging later in the year. The combined effects of smaller numbers of less fecund adults result in lower incidence of *Sesamia spp.* in first season maize crops.

As the rains progress, new growth of the native grasses and first season maize provide a suitable host for insect growth. In West Africa, the population of this borer increases until it peaks around August-September. This occurs when second season maize crops are being grown, and as a result, *Sesamia spp.* can be a very serious problem; consequently many farmers do not plant second season maize.

African sugarcane borer. *Eldana saccharina.* The African stem borer presumably of West African origin, was first described from Sierra Leone, and has progressively spread towards East Africa. It probably occurs in all suitable areas of sub-Saharan Africa from approximately latitude 15 °N-30 °S.

The African sugarcane borer has been known as a pest of graminaceous crops in West Africa for more than a century. It has also been a very important pest in East Africa for many years. However, its incidence in the latter region has increased since the 1970's.

In West Africa, the importance of *Eldana* appears to be increasing in the savanna zones.

Eldana is often the most abundant borer species at the end of the maize growing season. Adults have pale brown forewings, with two small spots in the center and whitish hindwings. Females begin laying eggs

around flowering time of the maize plants. Eggs are yellow and oval and are laid on the plants or on debris or the soil. Up to 300 eggs are laid per female.

Eggs hatch in five or six days and larvae penetrate the stems or cobs. Larvae are grey or black and more active in habit than other stem borers. Larval development takes 21-35 days. Pupation occurs inside the stem and the pupa is covered by a cocoon made of silk and plant debris. Adults emerge in 7-14 days, mate, and start the cycle again.

A good external sign of *Eldana* attack is the adult exit-hole cut by the larvae prior to pupation, which often has a large amount of frass hanging from it. Although infestations by this stem borer occur relatively late in the development of the maize plants, damage as a result of their feeding can be severe with yield losses of up to 20 %.

Spotted stalk borer. *Chilo partellus*. The genus *Chilo* includes many species of borers which attack grasses and cereals and has worldwide distribution.

In Africa, two species are of major importance, *C. partellus* and *C. orichalcociliellus*. *C. partellus*, an introduced species, was first recorded in Uganda in 1953, and is a very serious pest of maize and sorghum in East Africa. Its behavior and life cycle are similar to those of *Busseola* but it does not undergo diapause. Infestations start when plants are young.

Adults are brown-yellowish, with beige colored front wings. The hind wings are pale straw in color in the male, and white in the female. Females of *C. partellus* often lay their eggs on the lower surface of the leaves

close to the mid vein. Up to 300 eggs are laid per female in overlapping rows of 50-100.

After seven days, the eggs hatch and larvae crawl to the top of the plant where they feed on the leaves. Later, they move to the base of the stem and penetrate above an internode. Fully grown larvae are 2.5 cm long and buff in color with four longitudinal broken bands. After feeding inside the stem, larvae pupate; the complete life cycle has a duration of six to seven weeks.

Stem borer control. Control of stem borers includes:

- chemical control,
- cultural control,
- biological control,
- resistant varieties.

Chemical control. It is important to realize that the majority of African farmers cannot afford insecticides. The insecticide Furadan (Carbofuran) is effective as a seed treatment or after planting (1 kg active ingredient/hectare).

If serious leaf damage is observed, Furadan granules can be applied to the soil or can be dropped into the plant's funnel when the plants have six or seven leaves. Furadan is a systemic insecticide which is effective even after the larvae penetrate into the stem.

Although effective for the control of *Eldana saccharina,* Furadan cannot be applied late in the season because of residues in the grain. Non-systemic insecticides like Sevin or Lindane control stem borers only if applied before the larvae begin boring into the stem.

Cultural control. Cultural control includes removal of damaged cobs and stems from the field to reduce the number of pupae and larvae and thus the infestation of the next crop. Destruction of the first crop residues however, has little impact on infestation of the second crop by *Sesamia* spp. because the moths migrate into maize after emerging from their alternate grass hosts. Early plantings suffer less damage from stem borers.

Biological control. Some potential for biological control of stem borers exists. Several parasites and predators help suppress borer densities. Ants are effective predators of the various borer species. *Chilo partellus* is a likely candidate for biological control because it is an introduced species. IITA's Biological Control Program is conducting research on natural enemies of *S. calamistis* and *E. saccharina* in collaboration with the Maize Research Program.

Resistant varieties. Resistant varieties have been suggested as the most promising means of stem borer control. For the last several years, IITA has been devoting efforts to develop moderate sources of resistance to *S. calamistis* and more recently to *E. saccharina*. This has proven to be a long-term relatively expensive objective. Moderate levels of resistance could be combined with other methods of control to reduce the economic impact of stem borers.

3 Ear borers

The three main species of lepidopterous ear borers in Africa are:

- *Mussidia nigrivenella* Ragonot (Pyralidae),
- *Heliothis armigera* (Hubner) (Noctuidae),
- *Cryptophlebia leucotreta* (Meyrick) (Olethreutidae).

Cryptophlebia, although widely distributed, seldom reaches incidence levels of economic importance.

Mussidia nigrivenella. *Mussidia nigrivenella* larvae feed on the distal portion of the ear and bore through the grain making tunnels and consuming the embryos. Only close inspection reveals the degree of damage.

Mussidia is thus an important pest of the maturing maize cob. Infestations start in the field, female moths lay their eggs on the silks, where young larvae feed for a few days before reaching the grain. Damage to the grain continues during storage, even when cobs have been dried, and grains are often reduced to a powdery residue.

No clear method of control exists, but a good husk cover and a long husk extension certainly reduce infestation.

Heliothis armigera. The bollworm, *Heliothis armigera,* is an occasional pest of maize in some parts of Africa. It feeds on maize ears as well as leaves. Larvae spend their lives in the plant. The pupal stage occurs in the soil.

A large number of parasites and predators (including birds) attack *Heliothis*. Cannibalism and diseases

caused by viruses and bacteria also reduce populations. Crop rotation is useful. The insecticides Endosulfan and Carbaryl also provide control.

4 Soil Insects

The establishment of maize seedlings is commonly affected by a variety of soil insects including rootworms, white grubs, ground beetles, cutworms and termites.

Maize rootworms. *Buphonella* spp. (Coleoptera). The larvae of *Buphonella* beetles bore into the underground portion of the maize stem when plants are at the two-leaf stage. As a result, plants are either killed (dead hearts) or tiller and remained stunted. The insect appears to have only one generation per year in maize and for the remainder of the year develops on native grasses.

Maize rootworms might be controlled with seed dressing by insecticides. Marshal 25 ST is probably one of the most effective insecticides available. Weed control is important as it reduces larval populations.

White grubs. *Heteronychus* spp. (Coleoptera: Scarabaeidae). Several species of scarab beetles occur in Africa. They eat a wide range of materials, and all developmental stages occur in the soil. White grubs are especially abundant in soil with high content of organic matter. The larvae live for several months and eat decomposing plant material while adults live up to a year and gnaw roots.

Adults emerge at the beginning of the rains and eggs are laid on the soil. Attacks to maize fields by adult beetles might be very severe, and seedlings wilt and fall over. The adult is 15-20 mm long and shiny black or brown in color. The larva is a curved, soft, yellowish white grub with brown legs and head.

Ground beetles. *Gonocephalum* spp. (Coleoptera: Tenebrionidae). Larvae sometimes attack underground parts of plants. Adults eat and cut the parts in contact

with the soil. Attack might be more serious if a dry spell occurs during the rainy season. Adults are black, 8-10 mm long, elongated and flattened. Seed dressing or application of insecticide to the soil at planting assists in control. Marshal 25 ST appears to be effective.

Cutworms. *Agrotis* spp. (Lepidoptera: Noctuidae). Female moths lay their eggs at the base of crop plants or weeds, and upon hatching, young larvae will feed on leaves. Older larval stages occur underground and feed at night at the base of plant, often cutting the neck of the plant at ground level. Weed control before planting is essential to avoid cutworm attacks.

Termites. (Isoptera). Several species of termites in the genera *Macrotermes, Microtermes and Odontotermes* attack maize. Termites are distributed throughout the tropics but are more problematic in dry regions.

Roots as well as the lower part of the stem might be destroyed resulting in lodging. Vascular tissues might be damaged and wilting would occur especially under water stress conditions. Drought-stressed or senescent plants are often attacked, but young vigorous plants may be infested also. In extreme cases, the ears are invaded by termites. Numerous natural enemies help control termites.

Chemical control is difficult, but insecticides such as Lindane and Furadan are effective. If insecticides are available and can be purchased, they can be used for mound poisoning, for a general application to the soil (in this case uniform dispersion and shallow incorporation are required), for local application, or as a seed dressing. It is important to remember, however, that termites have beneficial effects for the soil.

5 Leaf feeders

Insects with chewing mouth parts such as lepidopterous larvae, grasshoppers or locusts feed on the leaves of maize plants. If attacks are severe, plants might be killed or yield might be reduced. Insects with sucking mouth parts might transmit viruses (i.e. leafhoppers, aphids) or inject toxins (i.e. spittle bugs).

Armyworm. *Spodoptera exempta.* (Lepidoptera: Noctuidae). Armyworms only occasionally attack maize. This pest is more important in East Africa, but in 1988, serious outbreaks occurred throughout West Africa. Under certain conditions, larvae are gregarious, and move fast through vegetation usually in large numbers. Eggs are laid on the undersurface of leaves. Larval stages last 10-20 days. Pupation occurs in the soil. Outbreaks are associated with the rainy season. In East Africa, infestations occur earlier in the south, progressing northwards with time.

Natural enemies such as birds, parasites and pathogens normally keep the populations under control. If severe outbreaks occur, insecticides (Furadan, malathion, trichlorphon) will provide control.

Locusts and grasshoppers. (Various species) (Orthoptera: Acrididae). During outbreaks, migratory locusts can cause serious damage to maize. Locusts breed in localized areas and spread in swarms.

Thus, control using insecticides has to be coordinated by affected countries and inter-governmental agencies like FAO. Work is underway to develop microbial insecticides (various fungal species) for the control of locusts and grasshoppers. Several organizations are collaborating in these efforts including the International Institute of Biological Control (IIBC) and IITA.

Aphids. (Maize aphid, *Rhopalosiphum maidis* and wheat aphid, *Schizaphis graminum)* (Homoptera: Aphididae) Aphids are often present in large and dense colonies on leaves and tassels.

If many aphids are present, leaves will be distorted and will show signs of chlorosis. The tassel, if heavily damaged might become sterile. This could be a problem for seed production.

Vigorous plants are tolerant of aphid attack and natural enemies usually provide sufficient control. If heavy infestations occur, Pirimor, an insecticide specific for aphids, or a systemic insecticide as dimethoate may be used.

Leafhoppers. *(Cicadulina* spp.) (Homoptera: Cicadellidae). *Cicadulina* spp. are important as vectors of maize streak virus (MSV) and maize mottle/chlorotic stunt virus. *C. mbila* and *C. storeyi* are known to be the most important vectors of both viruses.

Adult leafhoppers are small, (2-3 mm long), and have transparent wings with a longitudinal stripe. Their body is yellowish with dark markings on the dorsum. Adults are commonly found resting on the upper surface of young maize leaves.

The best control method is the use of streak resistant varieties. See IITA Research Guide 38 on *Cicadulina* leafhoppers and maize streak virus for details.

Spittle bugs. *(Poophilus* sp., *Locris* spp.) (Homoptera). Spittle bugs feed on leaves and within leaf whorls resulting in chlorotic spots and blotches on the leaves. Nymphs remain inside a foamy spittle mass (thus the

name), while adults are active. Spittle bugs feed on various native grasses and can achieve high densities in late planted crops.

In most cases, infested plants recover from damage and natural enemies are active in controlling these pests so that no intervention is needed.

6 Storage pests

Weevils. *Sitophilus zeamais* and *S. oryzae*. (Coleoptera: Curculionidae). *Sitophilus* weevils are the most important pests of stored-maize. They are found in all warm and tropical parts of the world and are responsible for heavy losses every year.

Adults are long-lived (up to a year), and females lay eggs throughout most of their adult life. Each female can lay up to 150 eggs. Eggs are laid individually in small holes chewed into the kernel by the female. Eggs hatch in 6 days, larvae feed inside the grain for approximately 25 days.

Pupation occurs inside the grain, and the adult chews its way out of the kernel leaving a characteristic emergence hole. Total development periods range from 35-110 days depending on humidity, temperature conditions and host. Adult weevils are reddish-brown to black with four reddish-orange circular markings on the wings. Separation of the two species requires examination of the genitalia.

Infestation normally starts in the field. Early harvesting will reduce infestation, a tight long husk cover will also reduce it. Storage should be free of weevils. Storing maize on the cob with husks on reduces weevil infestation. Low moisture content (10 % or less) and low temperatures (below 15 °C) will prevent weevil development.

Prior to storage, maize can be treated with Actellic 25 EC (20 % solution) by spraying the insecticide with a spraygun. There is wide genetic diversity in maize in relation to susceptibility to weevil attack, and it is possible to develop varieties with some degree of resistance to weevils.

Larger grain borer (LGB). *Prostephanus truncatus.* (Coleoptera: Bostrychidae). The LGB is a serious pest of maize of recent introduction to Africa. It was first found in Tanzania from where it spread to other East African countries. More recently, it was accidentally introduced to Togo from where it moved into Benin and Ghana.

According to experts, *P. truncatus* has the potential to spread to all major maize-producing regions of Africa. Adults feed on maize grains on the cob both before and after harvest. Larvae also feed on grain. Damage is severe and losses of maize stored in cribs are as high as 34 % after 3-6 months storage. Grain dust is produced by the adults as they feed. Adults also feed on wooden structures and dry cassava.

The optimum strategy for the control of the LGB varies according to location/situation and has not yet been fully established. Hygiene of the storage place/containers is essential.

Although the current recommendation is to shell the maize and treat with an admixture of pyrethroid insecticides, we recognize this is not practical under many situations (that is, unavailability of insecticides or cash to purchase them, farmers reluctance to shell the grain due to labor constraints or in order to reduce weevil damage).

The following insecticides are recommended (g/100 kg maize):

- Permethrin 0.5 % dust - 55 g
- Deltamethrin 0.2 % dust - 50 g
- Fenvalerate 1.0 % dust - 50 g

Since the LGB is an introduced pest, there is potential for biological control. A predatory beetle, *Teretriosoma* sp. has been identified as a natural enemy of LGB and work is underway in Africa for its possible release.

See IITA Research Guide 32 on storage pests for details and other pests of maize.

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8 Suggestions for trainers

If you use this Research Guide in training ...

Generally:

- Distribute handouts (including this Research Guide) to trainees one or several days before your presentation, or distribute them at the end of the presentation.

- Do not distribute handouts at the beginning of a presentation, otherwise trainees will read instead of listen to you.

- Ask trainees not to take notes, but to pay full attention to the training activity. Assure them that your handouts (and this Research Guide) contain all relevant information.

- Keep your training activities practical. Reduce theory to the minimum that is necessary to understand the practical exercises.

- Use the questions on page 4 (or a selection of questions) for examinations (quizzes, periodical tests, etc.). Allow consultation of handouts and books during examinations.

- Promote interaction of trainees. Allow questions, but do not deviate from the subject.

- Respect the time allotted.

Specifically:

- Discuss with trainees about experiences and problems with insect pests of maize: biology and control (10 minutes).

- Present and discuss the content of this Research Guide, considering the study materials listed on page 3 (1 ½ hours).

  Have real samples, infected maize cobs and grains available for each trainee.

  You may photocopy the illustrations of the Research Guide on transparencies for projection with an overhead projector.

- Conduct the practicals suggested on page 3 in groups (3-4 trainees per group; 2 hours). Make sure that each trainee has the opportunity to practice. Have resource persons available for each group and practical.

  Visit farmers' fields and stores, evaluate damage, discuss with farmers, (men and women), and demonstrate prevention and control measures (½ day). After the visit, discuss with trainees about their experiences (1 hour).

International Institute of Tropical Agriculture (IITA)
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The International Institute of Tropical Agriculture (IITA) is an international agricultural research center in the Consultative Group on International Agricultural Research (CGIAR), which is an association of about 50 countries, international and regional organizations, and private foundations. IITA seeks to increase agricultural production in a sustainable way, in order to improve the nutritional status and well-being of people in tropical sub-Saharan Africa. To achieve this goal, IITA conducts research and training, provides information, collects and exchanges germplasm, and encourages transfer of technology, in partnership with African national agricultural research and development programs.

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