

GASGA

GROUP FOR ASSISTANCE ON SYSTEMS
RELATING TO GRAIN AFTER HARVEST



Technical Centre for Agricultural
and Rural Cooperation ACP-EU

TECHNICAL LEAFLET No.1

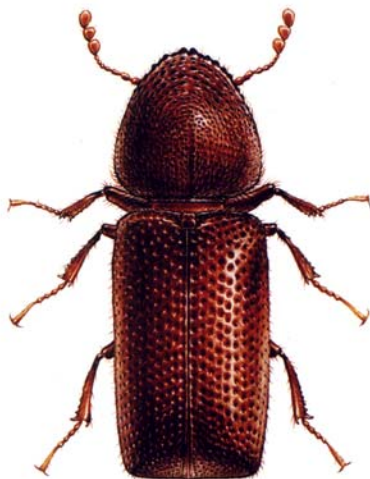
Larger Grain Borer

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Prostephanus truncatus



I
Lifesize

Figure 1 Adult beetle and larva (ICI copyright)

The Larger Grain Borer *Prostephanus truncatus* (Horn) (Coleoptera: Bostrichidae) has been known for many years as a pest of farm-stored maize in Central America, but since the late 1970s it has spread widely in Africa. In addition to maize, it is also a serious pest of dried cassava.

This information leaflet has been prepared to create awareness and to provide guidance to extension workers and other professionals concerned with the identification and control of this pest. Experience in those countries already suffering from Larger Grain Borer is that the application of appropriate control and containment measures can keep food losses within acceptable bounds. In order to achieve this success a strong commitment to applying these measures has been essential.

This leaflet was prepared by Rick Hodges at the Natural Resources Institute in consultation with other members of GASGA.

DAMAGE

Prostephanus truncatus is a primary pest of farm-stored maize. Whole grains, on the cob, may be attacked both before and after harvest. When infesting stored maize cobs, with husks intact, the adults frequently begin their attack by boring into the maize cob cores (Figure 2), although they eventually gain access to the grain at the apex of the cob by crawling between the cob and husk. Direct boring through the husk is also possible. The rate of development on loose shelled grain is usually slower than in grain on the cob. Damage is severe (Figure 3) – weight losses as high as 34% have been observed in some East African maize cribs after only 3-6 months' storage. Large quantities of grain dust are produced by the adults as they tunnel from grain to grain (Figure 3). Losses in dried cassava can also be exceptionally high (Figure 4), – average losses of 19% have been recorded after 6 months' storage and as much as 30% in some cases.

Adults bore into a wide range of foodstuffs and other materials, such as wood. In heavy infestations, wooden storage structures may become damaged and act as reservoirs of infestation from which the new harvest may be attacked.



Figure 2 Holes and dust produced by *P. truncatus* infestation in a traditional granary (note holes in the cob cores) (Photo – GTZ)

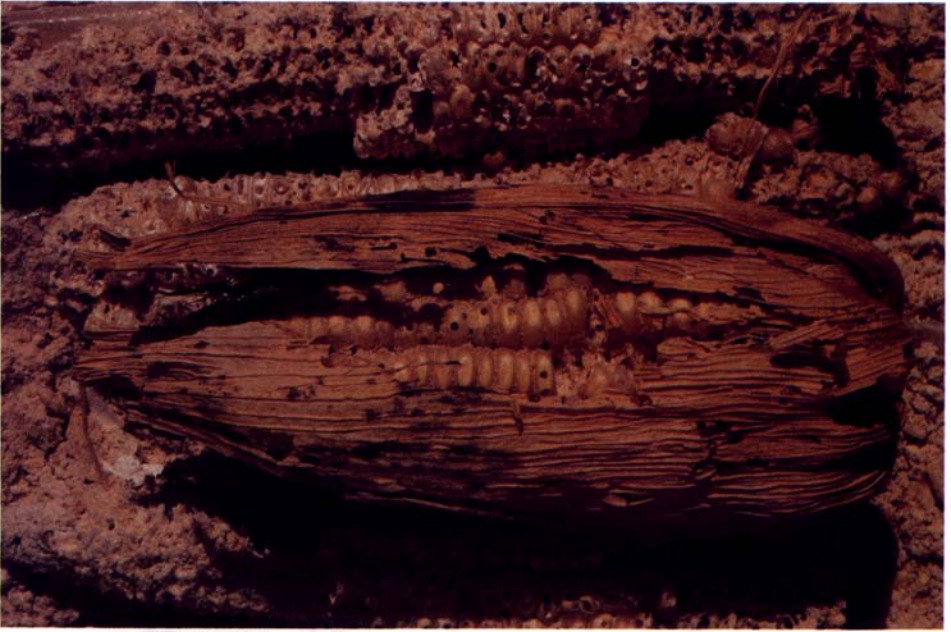


Figure 3 Damage to maize cobs by *P. truncatus* (NRI – copyright The University of Greenwich)



Figure 4 Damage to dried cassava (NRI – copyright The University of Greenwich)

RECOGNITION

The Larger Grain Borer belongs to a family of insects called the Bostrichidae, most of which are wood boring beetles. It is 3-4 mm long, cylindrical (as in Figures 5e and f) and dark brown in colour. The thorax bears rows of teeth on its upper front edge (Figure 5g) and the head is turned down underneath the thorax so that it cannot be seen from above (Figures 5e and g). The cylindrical shape and teeth on the thorax are also characteristic of other grain feeding insects in this family (Figures 5a,b,c and d). In *P. truncatus* the ends of the wing covers are flattened (Figure 5e) and this sloping region has two curved ridges at the tips (Figure 5f). The effect of the flattened ends to the wing cover and the ridges is to give *P. truncatus* a very square-cut end. This feature distinguishes *P. truncatus* from other bostrichids known to attack stored products, in particular *Rhyzopertha dominica* (Lesser Grain Borer) and *Dinoderus* spp. (Figure 5a).

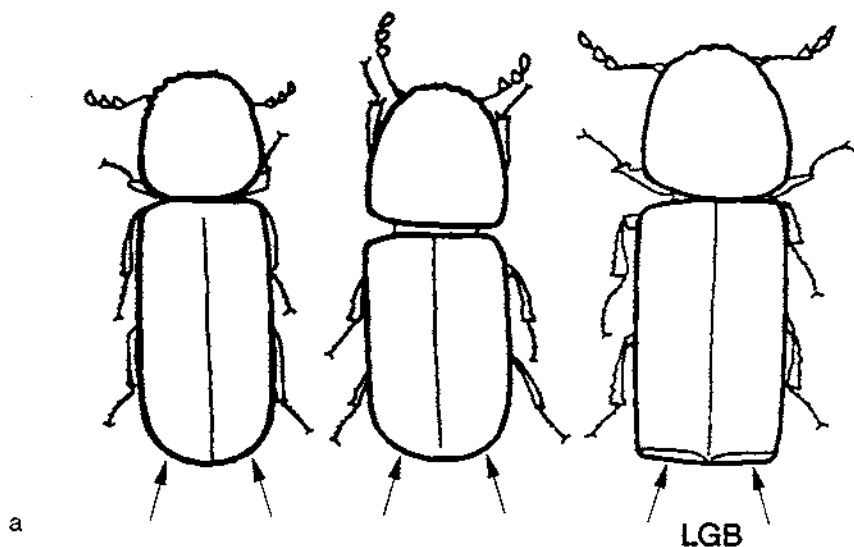


Figure 5 a Bostrichidae common in stored products (seen from above to compare the shape of the wing covers). From left to right *Rhyzopertha dominica*, *Dinoderus* spp. and *Prosthephanus truncatus*.

- b *R. dominica* (seen from the side)
- c *Dinoderus minutus* (seen from the side)
- d *D. minutus* (thorax – arrows indicate shallow depressions)
- e *P. truncatus* (seen from the side)
- f *P. truncatus* (showing ends of wing covers – arrows indicate ridges)
- g *P. truncatus* (thorax)

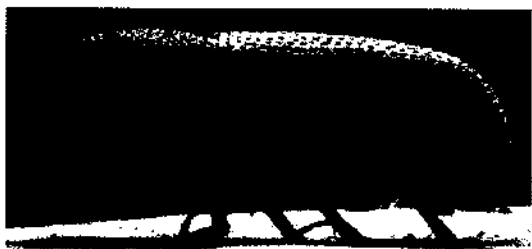
(Figure 5a-g, NRI – copyright The University of Greenwich)



b



c



e



f



d



g

DISTRIBUTION

The Larger Grain Borer has long been known in Meso-America and northern South America. However, in 1981 it was identified as a new pest causing severe losses to farm-stored maize in the hot dry Tabora region of Tanzania. It subsequently spread widely within Tanzania and into Southern Kenya, Burundi and recently Malawi. In West Africa, a serious outbreak of the pest was found in 1984 in Togo, and more recently it has been identified from Ghana, Benin, Guinea Conakry, Burkina Faso and Niger. The current distribution of the pest as well as unconfirmed records are shown in Figure 6. It is believed that *P. truncatus* has the potential to spread to all the major maize-producing regions in Africa

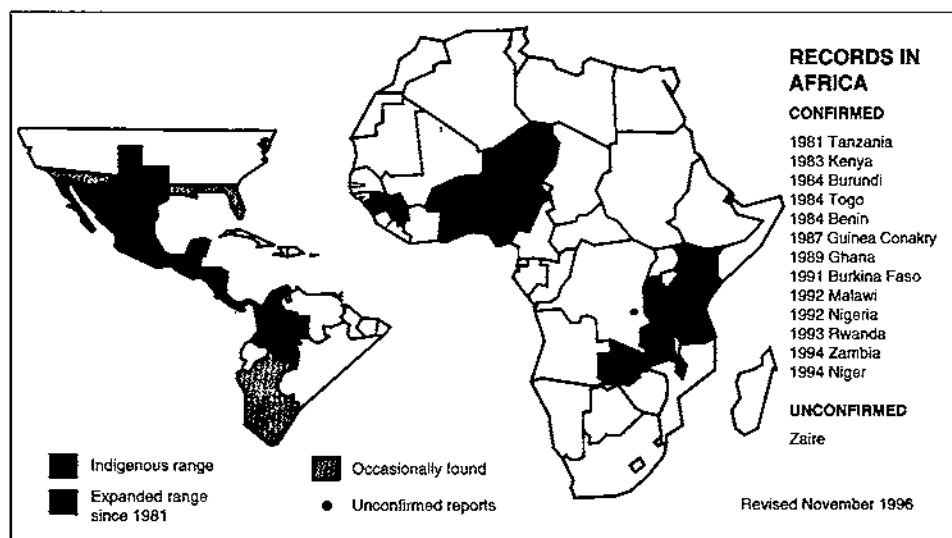


Figure 6 World distribution of *P. truncatus*

LIFE HISTORY

P. truncatus is not restricted to stores but occurs widely in the natural environment. Although no preferred breeding sites have yet been discovered, laboratory tests show that it is able to breed successfully on dried wood from a range of trees, as well as the dried stems of cassava and maize plants. However, information to date suggests that all these food sources are inferior to maize grain and cassava roots, on which much greater populations can develop.

Adult *P. truncatus* are good fliers and infestation may start in the mature maize crop in the field, whilst maize and cassava are drying, or once these have been dried and placed in store. Adults bore into the cassava, or maize husks, cobs or grain, making neat round holes. As they tunnel the adults generate large quantities of dust. Eggs are laid in chambers bored at right angles to the main tunnels; the larva (Figure 1) hatches after 3-7 days. It eventually develops into a pupa which then gives rise to the adult. As the immature stages develop entirely within the food source, they are not normally seen.

P. truncatus is tolerant of dry conditions so that development is possible in grain at equilibrium with a relative humidity as low as 40% (10% moisture content for maize). The insect develops best at fairly high temperatures (about 30°C) and relatively high humidities (about 70% r.h. = 13% grain moisture content). Under these conditions the life cycle, from egg to adult, can take place in as little as 25 days but in somewhat longer periods under cooler or drier conditions.

CONTROL IN STORAGE

Control on farm

Good storage practice

As with all storage pest infestations, store hygiene is very important. Stores should be thoroughly cleaned between harvests and particular attention paid to burning or burying maize and cassava residues and maize cob cores. Residual infestation in used sacks can be killed by immersing the sacks in boiling water. There may also be residual infestation in the wooden structure of stores which in practice cannot be eliminated unless the affected timbers can be removed or the whole store fumigated under gas-tight sheet.

Before the newly harvested maize or cassava is placed in store, insect infested cobs or roots should be separated out and put aside for immediate consumption. They must not be placed in store.

Protection of maize

In locations where *P. truncatus* is likely to cause significant damage to stored maize, farmers are recommended to shell their uninfested cobs and admix a suitable insecticidal dust with the grain. It is important to ensure that grain has been properly dried before treatment and storage. Shelling facilitates the efficient admixture of the insecticide and may also reduce the extent of damage since the pest develops less well on shelled grain than on cob maize.

Once shelled, the grain should be stored in a suitable container. This might be a sack, but the most effective containers are those that can be sealed, such as old oil drums or mudded cribs or baskets. Sealed containers minimize reinfestation by insects and prevent rodent damage. If unsealed containers are used then it is advisable to keep them in a rat-proofed store, that is, one with rodent guards.

If insecticide treatment is required then admixture with a 'cocktail' of an organophosphorous insecticide and a synthetic pyrethroid is the most effective treatment. This is because *P. truncatus* is very susceptible to pyrethroids which are relatively ineffective against *Sitophilus* or *Tribolium* spp., whilst the converse is true with the organophosphorous compounds. Suitable cocktails are marketed in both East and West Africa, such as 'Super Actellic' and 'Sofagrain'. It is important to follow the manufacturers' recommendations for application.

Protection of cassava

Dried cassava may be protected with the same insecticidal dusts used on maize. However, the procedure may be expensive in relation to the value of the crop. In order to minimize losses, roots should be left in the ground for as long as possible to reduce the storage period. After lifting and as soon as it has been sun dried the cassava should be transferred to sealed containers.

Control in warehouses

P. truncatus has proved to be of little importance in warehouse storage. However, as warehouses often serve as transit stores, staff must always be alert to the possible danger of spread from infested stocks. If stocks are found to be infested by the pest then they should be fumigated under gas-tight sheets immediately. Such a fumigation should only be undertaken by fully trained staff using phosphine or methyl bromide.

Biological control

A specific predator of *P. truncatus*, a beetle called *Teretriosoma nigrescens* Lewis (Histeridae), has been discovered in Central America. The immature stages of *P. truncatus* are eaten by both the adult and larva of the predator (Figure 7). To complete development the larva of *T. nigrescens* consumes up to 60 prey items. In the absence of live food, adult *T. nigrescens* are able to survive, but not breed, for up to a year by scavenging on grain debris and dead insects. Under controlled conditions the predator has been shown to suppress population growth of *P. truncatus*.



Figure 7 Adults and larva of *T. nigrescens* (NRI – copyright The University of Greenwich)

In the hope of providing some measure of control of *P. truncatus*, *T. nigrescens* was introduced into Togo in January 1991 and into Kenya in May 1992. The spread and establishment of the predator is currently the subject of considerable research effort.

For further information request a copy of: 'The use of *Teretriosoma nigrescens* for biological control of the Larger Grain Borer (*Prostephanus truncatus*)' from GTZ (see *Further Advice* for address).

MONITORING

The detection of the beetle and monitoring its populations are important tasks for plant protection authorities and researchers. Except when population densities are very high, it is not possible to detect the pest by visual inspection. However, the beetle can be discovered, even at low population density, by the use of traps baited with the chemical attractant (pheromone) produced by male *P. truncatus*. The pheromone is synthesized in the laboratory and loaded into plastic capsules which then release the pheromone slowly through their walls. A pheromone capsule is placed in a suitable trap.

Flight traps (Figure 8) are generally considered to be the best for monitoring or detecting *P. truncatus*. They are positioned outside stores and suspended about 1-2 m from the ground. Male and female beetles fly into the traps mostly at dusk and dawn. In monitoring programmes, traps should be placed in a wide variety of locations including those away from stores or maize-producing areas since substantial catches of *P. truncatus* have been obtained in uninhabited, uncultivated areas.

An additional advantage of these pheromone traps is that they also attract the predator *T. nigrescens*. The traps may thus be used to monitor both species.

For more information on how to monitor *P. truncatus* request a copy of 'How to use pheromone traps to monitor the Larger Grain Borer (*Prostephanus truncatus*)' from NRI (see *Further Advice* for address).

The traps and pheromone capsules are available commercially (see *Further Advice* for address). Care should be taken to follow the manufacturer's instructions for use.



Figure 8 Flight trap used to monitor *P. truncatus* (NRI – copyright The University of Greenwich)

SENSIBLE PRECAUTIONS

To delay the spread of *P. truncatus* and reduce the associated food losses it is essential to take the following precautions.

For production areas not yet infested

To reduce the risk of spread to your country:

- require stocks of maize and cassava coming from areas known to have *P. truncatus* infestation to have a valid fumigation certificate;
- ensure that quarantine officers are trained to recognize the pest and know what action should be taken against it; and
- ensure that there are rigorous inspection procedures at point of entry.

Be ready to deal with the pest:

- by undertaking regular surveys in areas where the risk of introduction is high. Pheromone-baited traps should be used for this task; and
- by ensuring that extension workers and plant protection agents are made aware of the problem and are ready to advise farmers on methods to reduce losses.

For the grain trade and food aid donors

It is crucial that the grain trade and food aid donors become aware of the dangers of shipping cargoes infested by *P. truncatus* into those countries as yet uninfested by this pest. They must take the following precautions:

- ensure that their shipments are fumigated according to current phytosanitary regulations or, where such regulations do not exist, they must insist that a suitable fumigation is undertaken; and
- if stocks are to be transported across a third country infested with *P. truncatus*, then every precaution must be taken to prevent infestation in transit. Stocks in open railway wagons or on lorries should be completely covered with a transport sheet (tarpaulin) and on reaching the final destination must be fumigated.

FURTHER ADVICE

It is most important that all concerned with agriculture are made aware of this dangerous pest. Anyone discovering *P. truncatus*, in a previously unaffected area, should contact their local Ministry of Agriculture, Extension or Plant Protection Service immediately. **Live specimens should not be sent to an uninfested area for identification purposes. It is important to submit only dead specimens for confirmation of identification.**

Further information and advice about this pest can be requested from the members of GASGA listed below. For those wishing to make video presentations, a VHS video (PAL) entitled 'From Dust to Maize: overcoming the Larger Grain Borer in Africa' can be ordered from NRI.

Natural Resources Institute (NRI)
The University of Greenwich
Food Security Department
Central Avenue
Chatham Maritime
Kent ME4 4TB, UK

CIRAD-CEEMAT
Domaine de la Valette
Avenue du Val de Montferrand
34090 Montpellier.
FRANCE

Food and Agriculture Organization
of the United Nations (FAO)
Plant Production and Protection
Division
Via delle Terme di Caracalla
00100 Rome
ITALY

Deutsche Gesellschaft für Technische
Zusammenarbeit (GTZ) GmbH
Post-Harvest Project
Pickhuben 4
2000 Hamburg 11
GERMANY

Supplier of pheromone traps

Agrisense BCS Ltd
Treforest Industrial Estate
Pontypridd
Mid Glamorgan
CF37 5SU
UK

Tel. UK: (1433) 841155

Fax UK: (1433) 841152

TECHNICAL CENTRE FOR AGRICULTURAL AND RURAL COOPERATION (ACP-EU)

The Technical Centre for Agricultural and Rural Cooperation (CTA) was established in 1983 under the Lomé Convention between the African, Caribbean and Pacific (ACP) States and the European Union Member States.

CTA's tasks are to develop and provide services that improve access to information for agricultural and rural development, and to strengthen the capacity of ACP countries to produce, acquire, exchange and utilize information in these areas. CTA's programmes are organized around three principal themes: strengthening facilities at ACP information centres; promoting contact and exchange of experience among CTA's partners; and providing information on demand.

CTA, Postbus 380, 6700 AJ Wageningen, The Netherlands.