	FACTSHEETS OF PESTS OF PHYTOSANITARY SIGNIFICANCE TO KENYA	**28**

Prostephanus truncatus (Larger grain borer-LGB)

1. Identity

Preferred Scientific Name:

- *Prostephanus truncatus* (Horn 1878)

Preferred Common Names:

- Larger grain borer
- Greater grain borer
- Scania beetle
- Osama (Local: Kenya)

Other Scientific Names:

- *Dinoderus truncatus Horn*

Figure 1: Adult LGB beetle. Photo by Georg Goergen

Taxonomic Position:

Domain: Eukaryota Kingdom**:** Metazoa **Phylum:** Arthropoda **Subphylum:** Uniramia **Class**: Insecta, **Order:** Coleotera, **Family:** Bostrichidae

2. Hosts/species affected

P. truncatus is a pest of stored maize which attacks whole grains including the cob before and after harvest. It is also a pest of stored cassava, particularly cassava chips. The adults bore into a wide range of foodstuffs and other materials including wood, bamboo, plastic and soap

Other host plants include *Arachis hypogaea* (groundnut), *Dioscorea* (Yam), *Manihot esculenta* (cassava), *Phaseolus vulgaris* (Common bean), *Sorghum bicolor* (Sorghum), *Triticum aestivum* (wheat) and *Zea mays* (Maize).

3. Growth stages affected

P. truncatus attacks during the postharvest stage.

4. Biology and Ecology

Female LGB adult feed into maize grain making tunnels on which small egg laying chambers are established at right angles to the main tunnels. Eggs are laid in batches of 20 and covered with finely chewed maize dust. The larvae hatch after about 3 days at 27°C and live on the

maize dust produced by the adult's feeding activity. The entire life cycle from egg to adult is completed in about 25 days under favorable conditions (27-32°C and 70-80% relative humidity), a little longer under cooler or drier conditions. The LGB prefers high temperatures and relatively high humidity, but it is a hardy pest that can develop in grains with low moisture content. Adults disperse over short distances through flight.

Egg

They are white to yellow, with no surface features and have a broad ovoid (ellipsoidal) shape

Larvae

P. truncatus undergoes three larval instar stages and the average larval period is 16 days. The larvae is approximately 3-4 mm long, white to yellowish in colour, fleshy and sparsely covered with hairs. They are parallel-sided (they do not taper). The legs are short and the head capsule is small relative to the size of the body. Larvae hatch from the eggs after about three days at 27°C. They seem to thrive on the dust produced by boring adults.

Pupa

The last larval instar makes a pupal case from frass bound with secretions (from the larvae) within the grain or surrounding flour. It then molts into a pupa.

Adult

Development of the larva through to the adult stage on a maize diet and under the optimum conditions of 32°C and 80% humidity takes about 27 days (CABI, 2016). The adults are small beetles approximately 4 mm long, have a uniform dark brown to black color. These beetles are excellent fliers and are attracted to insect light traps. Adults frequently initiate their attack on stored maize cobs with intact sheaths by boring into the base of the maize cob cores, although they eventually gain access to the grain via the apex of the cob by crawling between the sheathing leaves (Hodges and Meik, 1984). Adults bore into the maize grains, making neat round holes and as they tunnel from grain to grain they generate large quantities of maize dust. Adult females lay eggs in chambers bored at right angles to the main tunnels. Egg-laying on stabilized grain, like that on the maize cob, is more productive than on loose-shelled grain as the ovi-position period is longer, equal in length to the life of the female, and the eggs are laid at a greater rate.

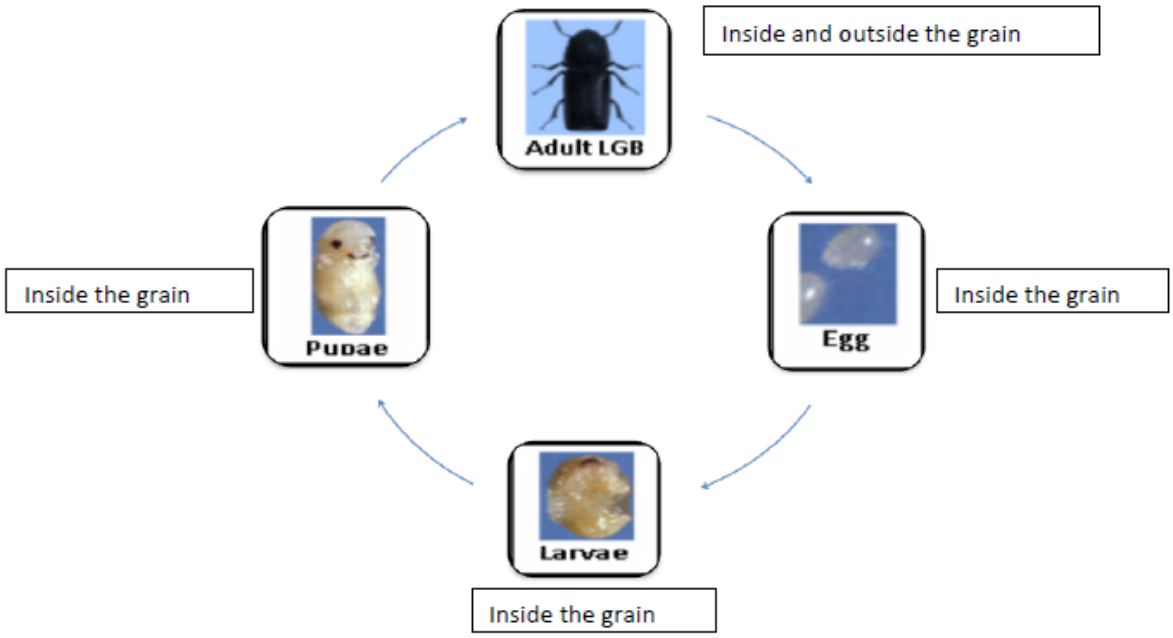

Figure 2. The life cycle of Larger Grain Borer (Photo courtesy of www.drss.gov.zw)

5. Symptoms

Adult LGB produce neat round holes as they tunnel through stored maize grain or other starchy products, such as dried cassava chips, creating large quantities of dust. Damaged grains can be identified as they are usually covered by a layer of this dust. Larvae and pupae may be found in the tunnels made by the adults.

Figure 3. Maize cob damaged by LGB. Photo

Figure 4. Damaged maize grain damaged by LGB. Photo courtesy of

courtesy of J.Maundu, icipe.

(http://www.naturalcropprotection.margraf-verlag.de/borer.htm)

In maize the adult beetles bore into maize cobs, husks and grains leaving tunnels and empty grain shells. The adults prefer grain that is still attached to the cob rather than loose-shelled grain. Damage is often greater on unshelled maize. The pest also bores into the wood used to construct the stores in which the grains are kept.

6. Means of movement and dispersal

Dispersal of *P. truncates* occurs through movement of infested produce. Adults are also capable of flight from one place to another.

Figure 5. *Prostephanus truncatus* infested maize cob. Image from: Pests and Diseases Image Library, http://old.padil.gov.au/pbt/index.php

7. Impact

LGB can cause significant losses in stored grain, ranging from 19-30% after 6 months of storage. It causes a weight loss of the grain, as well as reduced quality and nutritional value, leading to economic losses for farmers and traders. Furthermore, there are strict quarantine measures against the pest and detection can result in rejection of traded goods.

Figure 6. LGB damage on maize grain (too much flour produced). Source: www.drss.gov.zw/index.php/2013-02.../19-plant-protection-research-institute

Infestations in maize may start on the mature crop in the field, i.e. when moisture content is at or below 18%. Weight losses of up to 40% have been recorded in Nicaragua from maize cobs stored on the farm for 6 months (Giles and Leon, 1975). In Tanzania, up to 34% losses have been observed after 3 months storage in the farm with an average loss of 8.7% (Hodges et al., 1983).Losses caused by *P. truncatus* in dried cassava roots can be very high. The dried roots are readily reduced to dust by boring adults and a loss of 70% has been recorded after only 4 months of farm storage (Hodges et al., 1985). Depending on storage time, yield losses of up to 45 and 100% have been recorded for maize and cassava chips, respectively, in West Africa; while 62% yield losses have been reported in Mozambique.

In the early days after the arrival of *P. truncatus* in East Africa, countries with the pest found their maize exports banned. For example in 1987-88, it is estimated that Tanzania lost US$634,000 in export earnings (Boxall, 2002).

8. Movement in trade

Plant parts liable to carry the pest in trade include: Bulbs, Tubers, Corms, Rhizomes, Roots, True seeds (including. grain) and wood.

9. Detection and inspection

Early detection of the pest is difficult unless the populations are high because they develop inside the cob or grain and are therefore not visible. Flight traps baited with pheromones are used to monitor for large infestations of adult beetles. Farmers can look for tunnels and irregular shaped holes in stored grain and large quantities of dust. Damage is rarely noticed until exit holes appear and adults are seen roaming on the grain mass. Because the LGB larvae develop inside the grain it is difficult to detect the pest by visual inspection unless its numbers are very high.

10. Phytosanitary significance

P. truncatus remains a quarantine threat to maize-growing regions in the whole World.

11.0 Management

Cultural Control

- Maintaining a clean storage facility. The storage facility should be cleaned thoroughly between harvests. Any old stock should be removed and burned before bringing newly harvested grain.
- Sacks used to harvest or store grain can be immersed in boiling water to kill any remaining infestations.
- The removal of infested residues and the selection of only sound material for storage
- Maize varieties with a good husk cover should be used that provide protection and are less likely to be attacked

- If using a wooden storage facility, the wood should be inspected for tunnels and infested boards removed. Farmers should be encouraged to construct storage structures using brick or non-wood materials such as metallic containers, old oil drums, mud or cement-plastered basket cribs. Roofs should be constructed with iron sheets instead of grass-thatch to prevent the pest from harbouring and breeding in the roof. If using grass-thatch, the roof should be thick and cone shaped.
- Cobs should be shelled and dried to moisture content of below 12% before storing.
- Maize stock should be sold within three months after harvest when infestation of the LGB is lower.
- Crop residues should be destroyed after harvest and cob cores burned after shelling.
- Maize should be harvested shortly after maturity, before the LGB has an opportunity to enter the grain.
- Mixing the stored grain with a dust, such as ash or clay, causes the beetles to desiccate and can help reduce populations

Freezing and Heating

Where the infrastructure exists, freezing for several days and heating for 24 hours have proved to be effective control methods for stored product pests.

Controlled atmosphere

Where suitable infrastructure exists, low oxygen and carbon dioxide-enriched atmospheres can be used to control stored product pests.

Physical control

The removal of LGB adult insects from the grain by sieving can reduce populations but it is very labor intensive.

Biological Control

The beetle *Teretrius nigrescens*is is a specific predator of the larger grain borer in Central America. The predator has since been introduced into Kenya. The adult and the immature stages of this predatory beetle feed on eggs and larvae of the larger grain borer. The predatory beetle was also released into other African countries such as Benin, Ghana, Guinea-Conakry, Malawi, Tanzania, Togo and Zambia. Studies have shown that it is well established and spread in most countries. The predator has contributed to the reduction in density of the pest (http://www.infonet-biovision.org/PlantHealth/Pests/Larger-grain-borer-LGB).

Chemical Control

Various products are registered in Kenya for control of the Larger Grain Borer: Thiamethoxam 3.6g/Kg + Pirimiphos Methyl 16g/kg), Deltamethrin 2g/kg, Malathion 2.0% w/w + Permethrin 0.3% w/w, Spinosad 1.25g/Kg, Fenitrothion 15g/Kg + Fenvalerate 3g/Kg or Bifenthrin 1g/Kg (0.1%) (See comprehensive list on www.pcpb.or.ke). Chemical control has also been based on the use of fumigants such as phosphine and methyl-bromide which have been applied since the pest invaded Africa. The use of inert dusts, particularly diatomaceous earths, has widely been tested and applied against *P. truncatus* in Africa.

Integrated Pest Management (IPM)

The combined use of several control methods for *P. truncatus* in granaries of small scale farmers in Africa has been widely investigated. Tyler and Hodges (2002) recommended implementation of phytosanitary measures, particularly quarantine inspection of large-scale traded maize, cassava and other *P. truncatus* host commodity products. Some of the promising approaches towards effective IPM for *P. truncatus* comprises of the application of Spinosad combined with diatomaceous earth (Chintzoglou *et al*., 2008;
Vayias *et al*., 2009), the application of wood ash, combined with conidia of the fungus *B. bassiana*, (Smith *et al*. 2006), as well as the use of hermetic bags (Groote *et al*., 2013).

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