

Integrated stored product protection for farmholders

A Synoptic Compilation of Measures to Control the Larger Grain Borer (LOB) and Associated Storage Pests in Maize and Dried Cassava

Elaborated by

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Project integrated control of the Larger grain borer in farmers' post-harvest systems"

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Preface

From the economic point of view and in terms of protection of the natural resources, it is much more reasonable to protect harvested produce against loss than to invest in further increases of the agricultural production. According to investigations made by GTZ 5 to 30 % of the African maize and cassava harvest is destroyed after six to eight months of storage by stored product pests. The losses depend on the storage system and the presence of the Larger Grain Borer (LGB), which is particularly devastating. According to FAO statistics the overall production of maize in Africa is 36 million t per year. Taking into account that three quarters of the total harvest are stored at farm level, the minimum losses amount to 1.35 million t every year. Much of these losses can be prevented using integrated post-harvest protection measures.

Integrated post-harvest protection on the farm level means the selection of appropriate measures according to the specific situation on every single farm. Integrated post-harvest loss prevention combines profitability with the protection of the natural resources. There are various possibilities to reduce or completely avoid the use of chemical stored product protectants. It is the task of the farmers and the extensionists to analyse the needs carefully before choosing the measures that suit them best. Criteria like simplicity, availability, cost, labour expense must always be taken into account. In this context, the extension brochure is intended to contribute to post-harvest loss reduction and to the improvement of food security.

However, there is a high demand for ready-made Integrated post-harvest packages which can be transmitted to the farmers in a Top-down approach. Such approaches will invariably fail, because they do not take into account the socio-cultural and economic conditions which vary from case to case. The present leaflet cannot cover all these conditions. Instead, it gives an overview of commonly practiced methods and measures to control the LOB and other stored product pests including the prevention of mould development. Methods which do not include the use of synthetic insecticides are particularly recommended in this leaflet.

Improved post-harvest protection allows the farmers to profit from the annual fluctuations of the market prizes by selling quality products at the time when the prizes are high. By this the farmers can considerably increase their incomes, because the price fluctuations are often much more important than the monetary value of post-harvest losses.

The contents of the leaflet are presented in a matrix which provides a quick access to the relevant information. The single elements included must be combined by the users of the leaflet in order to form integrated stored product protection schemes that meet the above mentioned requirements.

The leaflet is primarily directed to extension workers and subject matter specialists who are the main transmitters of agricultural innovations. The methods and measures listed below may concern different target groups. Therefore, the target groups are indicated in the matrix using the following abbreviations:

DM Decision makers

FA Farmers

SM Store managers

AP Applicators of insecticides to protect stored products (commercial and private)

WO Women in rural households

The numbers indicated in the column "Info" refer to the publications listed under "Further information" at the end of this leaflet.

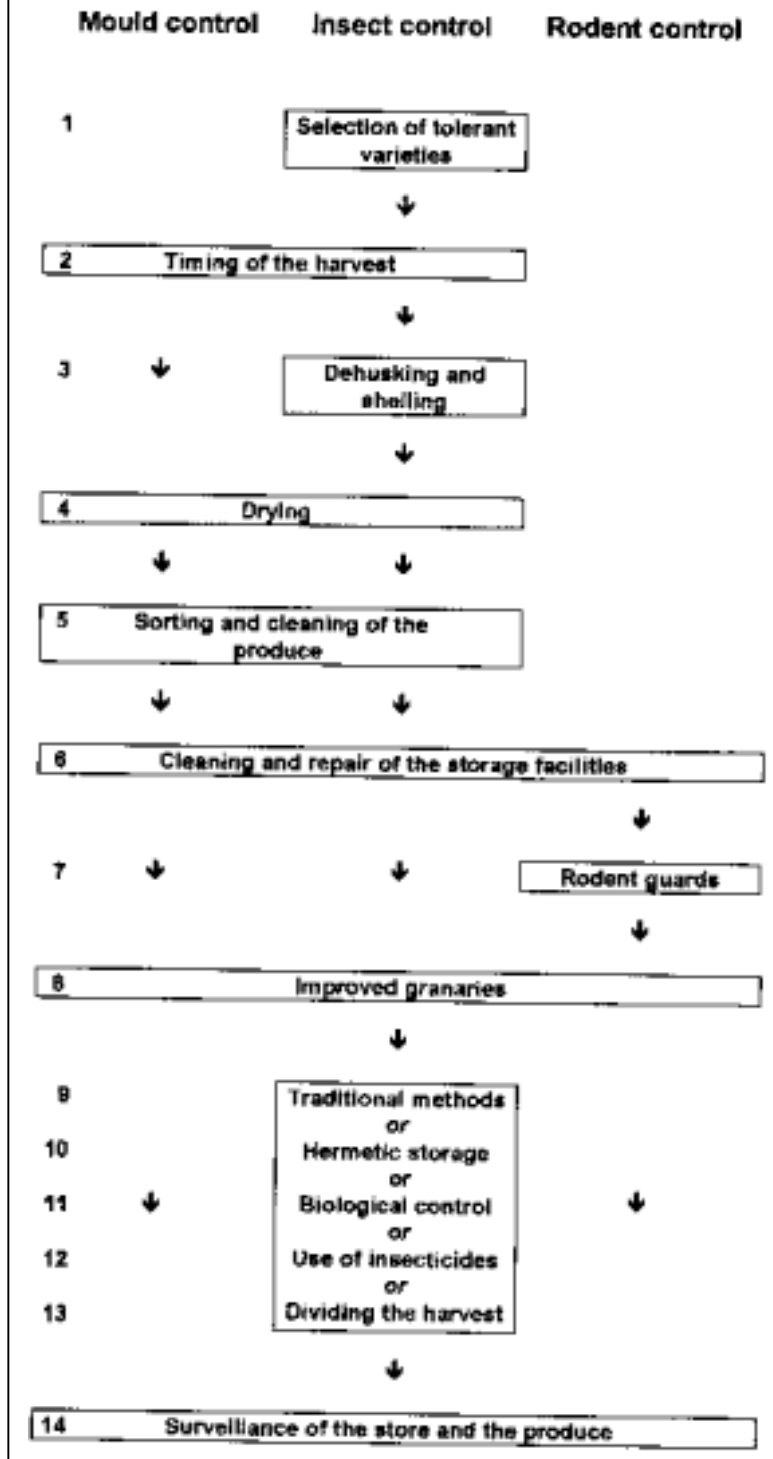
No.	Methods and measures	a) Potential for application	b) Instructions and recommendations for the application	c) Effects on the target organisms	d) Observations and combination with other measures	Info					Environmental considerations	
						DM	FA	AM	AP	MS		
1	Selection of tolerant varieties	Make choice on the seed with focus on traditional storage systems. An information system on tolerant varieties is available on internet.	Choose varieties with UGR which are completely covered by the husk. Traditional varieties generally fulfil this requirement, but new varieties may be preferred by the farmer because of their high yield. Select only varietal types for storage (see measure 2).	varieties which cover the whole cob prevent most stored product insects from attacking the maize cob.	Fully covered cobs show generally less damage by the UGR than others. However, they are not sufficiently resistant if the method is not accompanied by additional measures (1, 2, 4, 5, 7, 8, 9, 11, 12 and 14).							This measure does not have any negative impact on the environment or human health.
2	Timing of the harvest	Harvest and combine to be stored under all kinds of conditions.	Do not harvest before the time of physiological maturity, but avoid an early harvest. Make a ready for harvest when the grains are hard and without a visible sign of silage. The maximum maturity is more difficult to determine. Maturity is always a function of the variety.	Harvest harvested at the right time has maximum stability and resists better against insect and mould attack. Cereals grown late yields at harvest.	Maize when a harvest/maturity maximum will not occur, while late harvest often leads to field attack by certain stored product insects including the UGR which will be brought to the storage together with the harvested product. This measure is one of the prerequisites for a good storage and grain together with all other methods.							This measure does not have any negative impact on the environment or human health.
3	Drying and shelling	Maize should be naturally dried (see methods 12 and 13) and store the maize in bags.	Maize should be dried immediately after harvest. Store it in hermetically sealed containers (see method 10) in air a maximum needed stored product protection (see methods 12 and 13) and store the maize in bags.	Avoid premature shelling. Premature shelling will need to be done by hand which can provide dangerous injuries. Spouting will not occur if sufficiently dried right grains.	Avoid shelling of maize. The most important temperature for insects is 20°C. Shells for consumption can be exposed to temperatures of up to 80°C, higher temperatures lead to less germination, cooking of grains and loss of nutrients. Good drying is a further prerequisite for all other storage practices.							If specifically stored product protectants are used according to the manufacturer's instructions under 12.
4	Collect drives	Maize and cobs should be collected under all kinds of conditions.	Efficient methods like drying in the sun or in solar dryers can be used to dry the safe moisture content for storage in sealed containers (3% moisture (step 12)). On the drying process in regular intervals.	Avoid premature shelling. Premature shelling will need to be done by hand which can provide dangerous injuries. Spouting will not occur if sufficiently dried right grains.	Avoid overheating of maize. The most important temperature for insects is 20°C. Shells for consumption can be exposed to temperatures of up to 80°C, higher temperatures lead to less germination, cooking of grains and loss of nutrients. Good drying is a further prerequisite for all other storage practices.							Don't drying and drying under solar for insects is 20°C. Shells for consumption can be exposed to temperatures of up to 80°C, higher temperatures lead to less germination, cooking of grains and loss of nutrients. Good drying is a further prerequisite for all other storage practices.
5	Sorting and cleaning of the produce	Maize and cobs should be collected under all kinds of conditions.	Select only maize cobs and grains of top quality without any visible damage for storage. Separate any impurities including insects from loose grain by screening.	Sorting and cleaning eliminates a large part of the stored product insects (especially from the field).	When sorting with care for all kinds of damage (weed infestation, mould and mechanical damage). Use damaged produce as soon as possible. Sorting and cleaning goes with all other methods.							This measure does not have any negative impact on the environment or human health.
6	Cleaning and repair of storage facilities	Storage facilities should be cleaned under all kinds of conditions.	Remove any remnants of produce from containers before storing the new harvest. Clean containers and rooms thoroughly with a steam. Repair cracks and holes in walls. Clean the surroundings from dirt, rubbish and old pests. Burn the rubbish.	Cleaning and repair of storage facilities eliminate pests and destroy their hiding places. Cleaning of the surroundings from dirt, rubbish and old pests.	Maize often has infestations of old stocks in small cracks and holes and can enter the new harvest if no storage hygiene is practised. The rubbish must be burnt to make sure that any pests hidden in between are destroyed. Repair cracks and unsealed open areas. Such hygiene measures should always accompany all other methods.							This measure does not have any negative impact on the environment or human health.
7	Moisture control	Traditional granaries based on wooden poles.	Hang sufficiently water-tight sheets tightly around each pole of the granary in order to obtain a minimum length of 30cm. These sheets must be nailed to the poles at a height of 1 m above the ground.	These sheets do not prevent rodents from climbing up the poles and entering the granary.	The rodent measurements must be observed carefully, as they often can jump very high and numerous granaries that are built too low. Rodent granaries can be compared to the measures 1, 2, 3, 4, 5, 6, 8, 9, 11, 12, 13 and 14.							This measure does not have any negative impact on the environment or human health.
8	Improved granaries	Traditional granaries of the 'Jahangir' type.	Produce the maize and cobs in a lot and an end of the line and to rodent granaries in the supporting structure of the storage.	It is an improved to hang the produce to better protect from all kinds of damage and handling a 'Jahangir'.	Take care that the Jhangiri model is constructed so that it will last long. Inspect regularly in order to detect and repair any damage in time. Combine with the sheets 1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 12, 13 and 14.							This measure does not have any negative impact on the environment or human health.
9	Traditional grain protectants	Maize of traditional granaries for cobs and cobs are known.	a) Add natural products (see measures 10, 11, 12, 13, 14) to the maize and cobs. b) Use natural products (see measures 10, 11, 12, 13, 14) to the maize and cobs. c) Use natural products (see measures 10, 11, 12, 13, 14) to the maize and cobs.	Many traditional methods of stored product protection date from centuries ago and are not very effective.	Most traditional methods are not as effective as a treatment with synthetic products, but they contribute to a certain degree to the control of storage pests. They are easily available and cheap and can be used in combination with the sheets 1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 12 and 14.							Historical substances are generally environmentally safe. However, some of the grain protectants can be toxic to human beings.
10	Hermetic storage	Storage of wet (and) maize in air-tight and airtight containers.	Fill maize grains in well covered drums or similar containers and close them tightly. Keep these containers in a dry place, preferably indoors.	Final insects in the container die soon because of lack of oxygen and moisture withdrawal.	This method is particularly recommended in dry areas. If the maize is not hermetically sealed, it will be damaged by insects and rodents. Use together with 2, 3, 4, 5, 13 and 14.							This measure does not have any negative impact on the environment or human health.
11	Biological control with <i>Faenoneproctus</i> (<i>F.a.</i>)	Control of the cobs with <i>Faenoneproctus</i> (<i>F.a.</i>)	The predatory beetle <i>F.a.</i> , a biological control agent, has been introduced from Central America, it is released in the field by qualified protection specialists. It is released in the UGR. It suppresses and destroys on its own and reduces activity the UGR on which it feeds exclusively. The release campaigns involve surveying of the UGR populations, information and training of the farmers, regular releases in areas with high UGR populations and follow-up studies in order to evaluate the impact of <i>F.a.</i> on the population dynamics to the biological control of the UGR started in 1996.	The UGR and the adults of <i>F.a.</i> only on the UGR and adults of <i>F.a.</i> constitute a competitive population. This biological insect activity finds grain reserves, released by the UGR. The UGR feeds itself on its prey in the infestation, when the UGR often is present in the hidden parts of the maize cobs and husks.	The biological control of the UGR has been the subject of a national protection survey. The farmers have the UGR, but no additional control agents. The release of <i>F.a.</i> and adults appears to have been studied before the introduction of <i>F.a.</i> to allow in order to ensure the success. After the first releases in 1996, the active distribution of <i>F.a.</i> has effect on the UGR populations and a significant egg reduction of stored maize has been reported and confirmed. Biological control works together with methods 1, 2, 3, 4, 5, 6, 7, 8, 9, 12 and 14.							The biological control of the UGR contributes to reduce the amount of insecticide used in stored product protection and has thus positive effects on the environment and human health. Tests conducted have shown that does not damage the stored product and does not reduce germination, seedling, honey bees or the maize insect pest fauna.
12	Application of synthetic stored product protectants	Maize for storage in hermetically sealed containers (see methods 10, 11, 12, 13, 14) in air-tight and airtight containers and highly resistant to the protection of stored.	i) Seal the maize and cobs in a recommended insecticide according to the manufacturer's instructions. In airtight hermetic storage. Do not use any other product for stored maize protection. Hold the official recommended dose of the insecticide due to the maize and use it thoroughly. Observe the safety instructions carefully. Do not experiment with higher or lower dosages or products. Use the instructions for treatments of maize for consumption. ii) Treat the inside walls of the granaries and storage containers, or the bags with a thin layer of the stored product insecticide.	Synthetic products provide a good protection against insect pests in stored maize due to their strong and long-lasting insecticidal effect.	Further insecticides can be recommended when their application is of economic advantage for the farmer. This is only the case for storage longer than 6 months. Buy only the amount of insecticide required for one season from an authorised dealer and use it soon because of the limited shelf life of these products. Keep all bags in full packages and keep products. The success of the treatment depends on the right storage and level distribution of the product. The effect is best in sealed maize. Treatment of maize on the cob has better results. The combination of insecticide treatment with the measures 2, 3, 4, 5, 6, 7, 8, 9, 11, 12 and 14 is recommended. For cobs only in satisfactory application techniques have been developed so far.							If synthetic stored product protectants are applied to hermetically sealed maize, there are considerable risks to the health of the farmers and the consumers, which can be reduced with the measures 10, 11, 12, 13 and 14.
13	Drying the harvest	Maize for storage in hermetically sealed containers and highly resistant to the protection of stored.	This method is based on drying the harvest in a hot air oven and another use for longer storage. The hot air oven is treated with a synthetic insecticide, because the stored product insects do not cause significant damage during this period. On the second part is selected and treated following the instructions given above (12) to protect the stored maize.	During the hot air oven treatment, the insecticide provides maximum protection of stored maize with a synthetic insecticide. The same principles as described in 12, 13.	During the second insecticide application for farmers who want to sell the surplus of their maize harvest at a later time, when the prices are high. They can find only the use of the insecticide which they want to sell and achieve a considerable reduction of the cost of treatment, as the surplus for home consumption is stored under traditional conditions. Combining with 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 and 14 are possible. Method 12 is a separate part of drying the harvest.							During the hot air oven treatment, the insecticide provides maximum protection of stored maize with a synthetic insecticide. The same principles as described in 12, 13.
14	Surveillance of the stored product	All storage structures and stored products.	Inspect the storage maize granaries or containers including the surroundings and the stored product regularly at least once a week. Watch out especially for signs of damage to the structure. Use a method that might prevent the produce to moisture or pests. Look out for traces of the presence of rodents. For long periods and for the development of mould.	Surveillance does not have any direct impact on pest organisms. However, timely detection of any damage to the storage structure and of the presence of pest organisms includes the impact of pest prevention.	Whenever a damage to the storage structure is detected, repair it immediately in order to avoid further damage to the maize and the product. The presence of rodents can be detected through the use of traps, grain moisture, applied grain, etc. Measures often be watched directly, especially if such in case of infestation later insecticide is applied to prevent further losses (see drying, drying, stock settings). Surveillance goes together with all other measures.							This measure does not have any negative impact on the environment or human health.

Further information

Special extension leaflets and brochures on some of the measures listed in this matrix have been published by this and other post-harvest projects of GTZ. They are listed below under the numbers appearing in the column "Info" of the matrix. These publications can be ordered free of charge from the addresses given in the preface of this leaflet. The languages in which they are available are indicated in brackets.

- 1 Traditional Means and Methods of Stored Product Protection (english/french)
- 2 Plant-derived Products as Protectants against the Larger Grain Borer (*Prostephanus truncates*) and other Stored-food Pests (english/french)
- 3 Protecting stored maize cobs against pests by the use of non chemical products english/french)
- 4 The Pest from Afar (english/french/german)
- 5 News from the Larger Grain Borer (english/french)
- 6 Recommendations on the Use of *Teretriosoma nigrescens* for the Biological Control of *Prostephanus truncates* (english/french)
- 7 The Use of *Teretriosoma nigrescens* for the Integrated Control of the Larger Grain Borer (*Prostephanus truncates*) (english/french)
- 8 Getting it Right: Integrated approach for Short and Long Term Post harvest Protection english/french)
- 9 Recommendations for the Choice of Insecticides to Protect Stored Products in the Tropics (english/french)
- 10 Hifadhi bora ya mahindi ngazi ya kaya (kisuahili)
- 11 Manual on the Prevention of Post-harvest Grain Losses (english/french/arabic/portuguese)

Flow chart of integrated stored product protection measures



Flow chart of integrated stored product protection measures