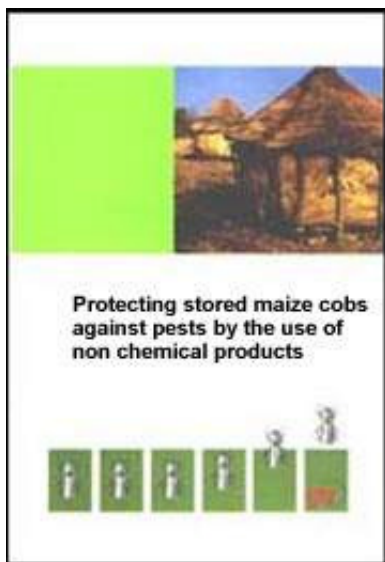







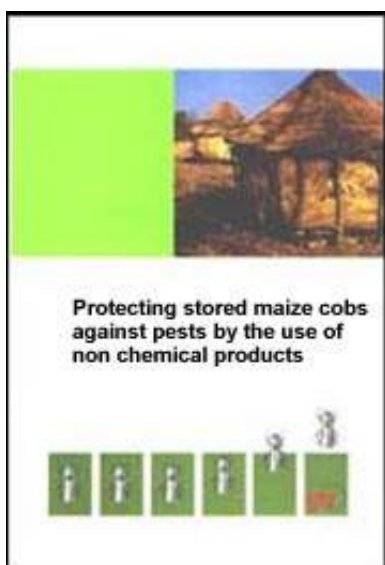









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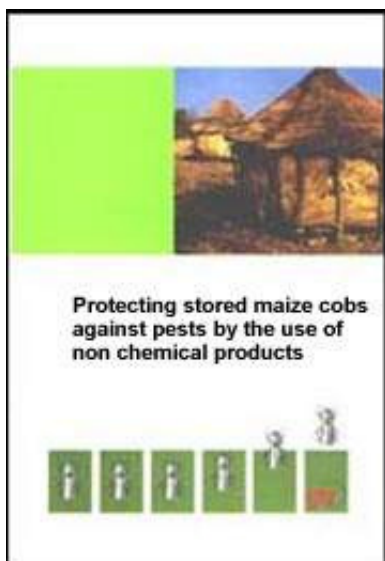
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A Strategy of Integrated Post-harvest Protection

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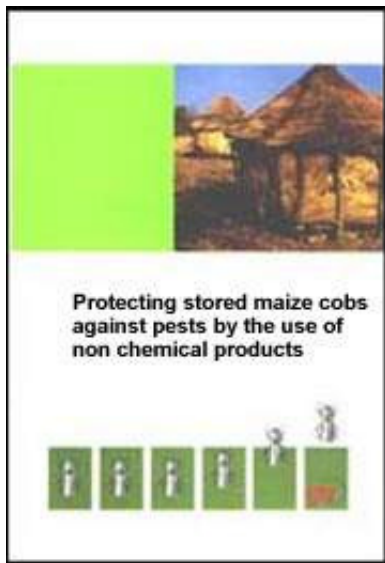
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Introduction

This leaflet is designed for agricultural extension workers who support farmers in problems relating to the storage of their produce. It presents measures to maintain the quality of maize cobs. The recommended measures are appropriate for storage without using any synthetic insecticides whatsoever, and without significant losses being caused by pests. This is especially attractive to small farmers with low financial resources, and to farmers in remote regions where synthetic insecticides are not available.

The particular advantages of this integrated package are:

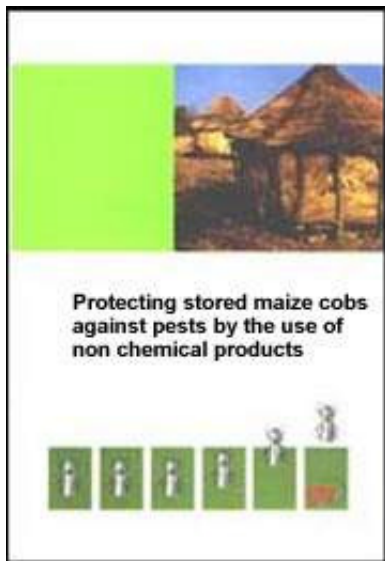
- **preservation of traditional forms and methods of storage**
- **simple application**

- **very low costs**
- **ready availability of the required preparations (no dependence on dealers)**
- **good protective effect against insects**
- **no hazard to consumers**
- **good environmental compatibility**

The environmental compatibility of stored-food protection measures has been continuously improved in recent years, not least due to the fact that in many African countries, programmes of biological control of the Larger grain borer (*Prostephanus truncates*) have been launched, in which the predatory beetle *Teretriosa nigrescens* (*T.n*) is used to keep populations of the Larger grain borer under control. The beneficial species pursues its prey into its habitats both in the field, and into maize stores. The integrated stored-food protection package described in this leaflet is conducive to maximising the impact of the beneficial species, whilst providing adequate protection against the major stored-food pests such as species of *Sitophilus*, the Larger grain borer or the Angumois grain moth (*Sitotroga cerealella*).

For farmers producing large quantities of maize for cash or merchants storing maize on an intermediate basis over long periods, the protective measures described below will be of only minor relevance. For these target groups, storage and stored-food protection measures would be recommended which include shelling, treatment with synthetic insecticides and storage in sacks. Nevertheless, farmers producing for sale can also improve their maize storage, especially the storage of maize for their own use by studying and applying individual elements of the described strategy.

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The major stored-food pests

Most damage in stores is caused by insects a few millimetres in size such as *Sitophilus* species, the Larger grain borer, grain moths and several others. The illustration below shows enlargements of the most common pest species, as well as the beneficial species *Teretriosoma nigrescens*. These stored-food pests can cause reductions in quality, as well as considerable weight losses,

the animals incapable of movement. The combination factors prevents propagation and development, and destroys adult pests.

Alternative dusting preparations

Similar effects are also elicited by other dusts. These include first and foremost ash, but also laterite dust clay dust or very fine sand. The quantities commonly applied vary considerably, and can reach up to 50 percent by volume. Depending on the type of dust however, it is also possible to achieve an acceptable protective effect with considerably smaller quantities. The appropriate dose can be determined locally by performing small experiments.

Surveillance of the store

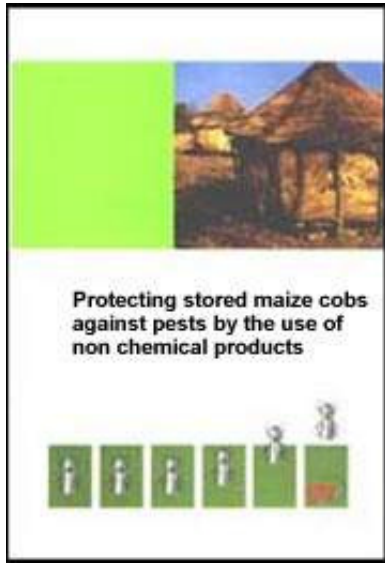
When the products have been stored, work is still not complete. The store must be checked at weekly intervals in order to detect any damage or infestation in good time. In this connection, special attention should be paid to the following factors:

- 1. condition of the store (stability, protection against rain)**
- 2. cleanliness of the store's surroundings .**
- 3. mould**
- 4. pest infestation**

Minor damage to the store, e.g. holes in the roof should be repaired immediately. Remove any tall grass, bushes or refuse close to the store as these offer protection to rodents. If mould develops, dry the products immediately. At the first sign of pest infestation, market or process the maize if possibly immediately.



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Economic aspects

Without appropriate stored-food protection measures, farmers are often left with no alternative but to sell their produce soon after harvest, even though it may not be possible to secure attractive prices on the market. Integrated stored-food protection enables farmers to extend the storage period without having to take the risk of increased losses. As a result, farmers with surpluses have greater choice in selecting the appropriate date of sale, which means they can wait for periods where maize prices have reached a high level. Conversely, for farmers with a small crop, there is a reduced risk of having to purchase expensive additional food at the end of the storage season. The presented package thus helps secure income in rural areas. This is most effective where there is a lack of capital for investment

The integrated stored-food protection package described here has the particular advantage of using materials which are available everywhere, and of being based

essentially on traditional practices. As a result, the costs are unusually low, and a high level of acceptance among farmers can be anticipated.

Drying

Maize can only be stored well if it has been properly dried. When drying maize in the sun or over a fire turn it to ensure even drying end to prevent overheating. Dry it until a moisture content of below 13% is achieved, which is suitable for long-term storage. If the maize is not dried sufficiently, it can easily become mouldy. Drying at temperatures above 60°C causes the kernels to crack, and leads to an increased risk of infestation by secondary pests. Seed can already lose its viability at a temperature of 43°C.

Sorting

The next step is careful selection of intact maize cobs for long-term storage. All cobs displaying insect infestation, mould, mechanical damage or any other inferior qualities, must be removed and processed as soon as possible. This will prevent contamination of the healthy cobs, and maintain overall quality of the produce

Dividing the harvest

The harvest is now divided into two parts. The first is for short-term daily requirements, whilst the other is for long-term storage.

Studies have shown that, during the first three to four months after storage, as a rule no high losses are caused by insects, and hence no special protective measures are necessary during this period. Maize intended for consumption during

this period therefore need not be treated. The farmer should store this maize separately.

Only those cobs intended for longer-term storage need to be treated. This should be performed in a separate store or in a suitable storage area. In this way the farmer can save working time and money. This aspect is also of significance to market-oriented farmers

Storage hygiene measures and rat control

The most important point in both short-term and long-term storage is the application of proven hygiene measures, which include thorough cleaning of the store and its surroundings. Remove all material remaining from the last harvest. If possible, treat the empty store with an insecticide to expel or destroy any concealed pests. Repair any damage to the roof before further storage. With clay stores, seal any cracks.

Stores standing on posts can be protected against intrusion by rodents with simple barriers,

Treatment With lime dust

A proven and inexpensive dusting preparation for maize cobs stored in their husks is quicklime which is distributed evenly in a fine coat over the stored products. This lime dust has a dehydrating effect on insects, blocks their respiratory orifices and renders

If the store is inadequately protected, problems with rodents (rats and mice) are

also to be anticipated, these can be easily be prevented (see section on storage hygiene measures and rat control).



***Prostephanus truncatus* (Larger grain borer)**



***Teretriosoma nigrescens* (beneficial species)**



***Sitophilus zeamais* (maize weevil)**



***Sitotroga cerealella* (Angmois grain moth)**

The integrated stored-food protection package

It has proved to be the case that individual measures of stored-food protection often do not lead to the desired result, as storage constitutes merely one element of the complex post-harvest system. Each stage of this system influences the subsequent stages in the simplest case (subsistence farming), the post-harvest system "maize" is characterised by the following stages:

sowing - harvest - transport - drying - sorting - measures of traditional stored-

food protection - storage - shelling - processing or consumption

The package of integrated measures to protect maize cobs against stored-food pests presented in this leaflet, sets in at several of the above-mentioned stages of the system, and comprises the following components:

Selection of varieties

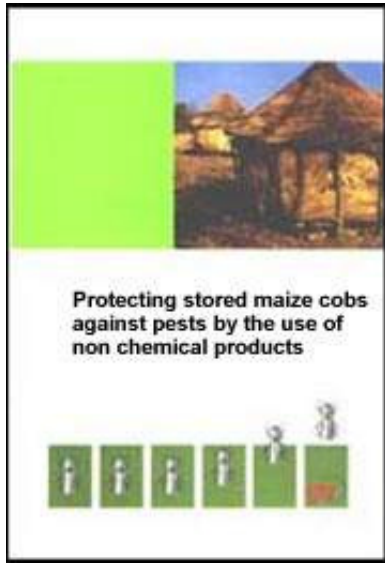
The storage properties of different varieties should already be taken into account when planning cultivation. Local varieties with long husks tightly enclosing the cob are more suitable for traditional storage than high-yielding varieties with short husks. Stored product pests infesting maize in the store have very great difficulty penetrating the protecting enclosing leaves. The only exception to this is the Larger grain borer, which finds them no obstacle.

Harvest date

It is important to harmonise the farming calendar such that the required labour is available on the best date for harvest. If the harvest is brought forward, there is a risk that the maize will be too moist, and later become mouldy in the store. On the other hand, the longer the maize remains on the stem, the greater the risk that stored-food pests might already infest the crop in the field, and continue to feed on the maize in the



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Source: Richard J. Hodges Proceeding of the 6th International Working Conference on Stored-product Protection Canberra, 1994; up-date Albert Bell, October 1996

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Published by

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in Farmers' Stores"**

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