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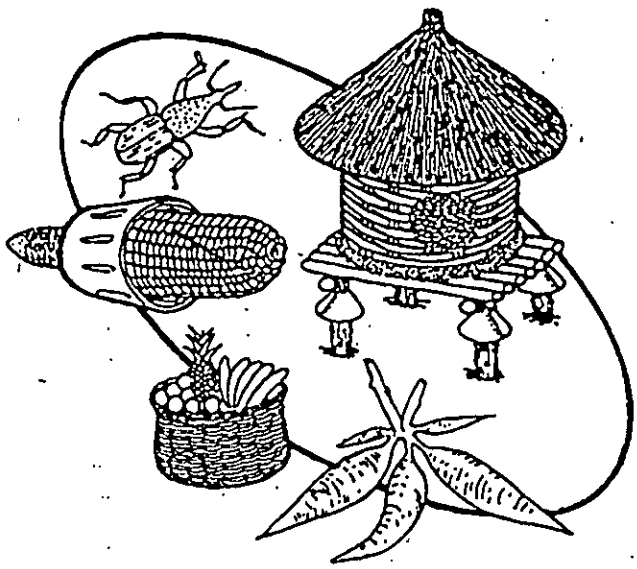

IMPROVED STORAGE INSECT PEST MANAGEMENT SYSTEMS

Manual for Extension Staff

(Manual No.8)

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Improved Storage Insect Pest Management Systems Based on the used of Botanicals, Analytical/Mechanical Methods and Judicious use of pesticides

Introduction

There are three main causes of Post-harvest losses in storage . These include insects , wet heating and rodents. Although all the three loss causal factors contribute significantly to energy loss within the food pipe line in Uganda, it is the insect pests which pose the greatest threat. There are two main groups of insects which are involved in causing the storage loss, and these are:

- Coleoptera :comprising beetles and weevils. The most notable members include bruchids curculionids, bostrichids, tenebrionids dermestids, cucujids and anobiids (Munro, 1996).

- Lepidoptera: insects "grain moths" include families Gelechiidae and Pyralidae

Stored product insect pest fall under two main categories and these include primary (see appendix).and secondary pests. Primary pests include those pests which attacked whole grains. Damage to grain may be by the larvae and /or adults. Secondary insect pests mainly infest partially damaged or processed products.

Losses caused by storage pests

Weight loss;

- Weight loss of 5-10 % of maize stored for just under a year due to insect infestation has been recorded from different ecological zones of Uganda. The main pest here is *Sitophilus oryzae.*

Quality loss

The food is tainted due to insect frass, cask skins, and secretions from the scent glands eg Red flour beetle adult secretes a compound with a sharp, acrid odour, unpleasant and possibly dangerous to human health.

Nutritional loss

- Loss in terms of nutritional value of the crop. Some insect larvae may preferentially attack the germ of the grain, thus removing a large percentage of the protein and vitamin content, whereas weevils feeding mainly on the endosperm will mostly remove carbohydrate content.

Loss in seed viability

- Some insects eg. Larger Grain Borer (*Rhyzopertha dominica*) may selectively attack the germ and cause grater loss in germination than others.

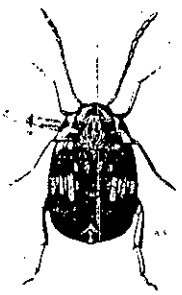
Plodia interpunctella (Indian meal moth)
Attack: Cereals, groundnuts
dried fruits



Those that attack legumes: (Bruchids)
Acanthoscelides obtectus (bean weevil)
Primary pest
Attack: Beans (*Phaseolus spp*)

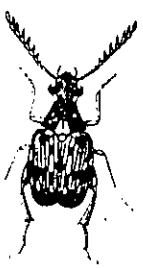


Zabrotes subfasciatus (southern Mexican beetle)
Primary pest
Attack: Beans (*Phaseolus spp*)
Sometimes cowpeas

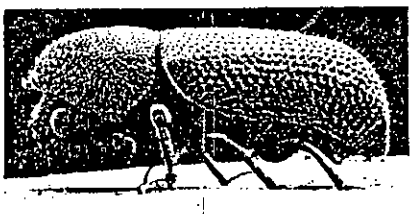


Callosobruchus spp (cowpeas weevil)

Primary pest
Attack: Cowpeas



Prostephanus truncatus (Larger Grain Borer)
Attack: Larvae & adult consume grain, reducing it to dust (maize)
Bore holes in wooden structures & containers
Infest roots e.g cassava



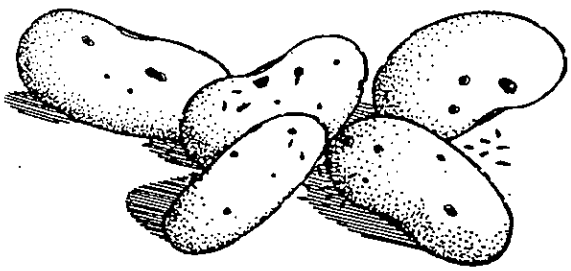
Examples of damage caused by insect pests



Maize cob damaged by Larger Grain Borer (Prostephanus truncatus)



Maize grain infested with weevils (*Sitophilus sp*)



Beans infested with bean weevils

Control strategy and methods: General

Timely harvest

Infestation of crop by insects usually starts in the field. Therefore crops should be harvested as soon as it is ready for harvest to avoid build up of pests in the field, and should be thoroughly dried before storage and during storage of there signs of re-infestation.

Storage hygiene

Storage structures should be thoroughly swept repaired and if possible, disinfested using appropriate storage pests control chemicals. 2% Actellic is available in drug shops and can be used for this purpose. This is done to avoid carrying over of pests in store from one season to the next. Jute sisal and nylon sacks used to store grain must be washed and boiled in hot water and dried to kill off insect pests, their eggs larvae or pupae.



Thoroughly clean and dry previously used container



Boil used sacks in hot water, and dry in hot sun.



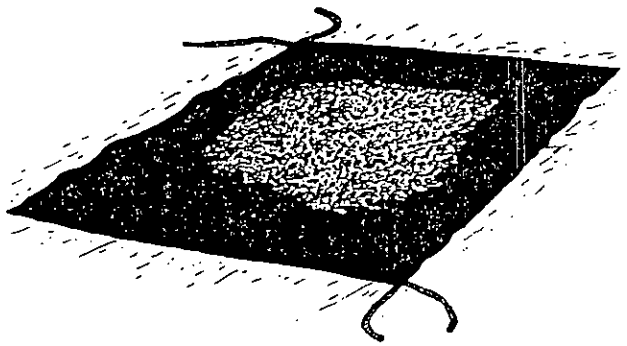
Repair storage structures, blocking cracks and holes



Sweep the storage area and burn swept rubbish.

Sundrying

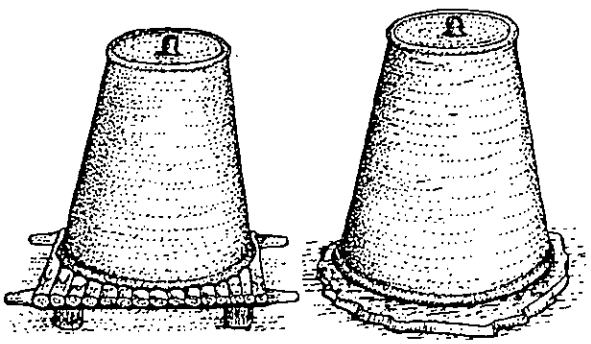
Many storage pests (particularly *Sitophilus spp*) are susceptible to high temperatures (say up to 40°C). Sun drying in shallow layers during a hot day for prolonged periods has the advantage of destroying emerged adult insects, and possibly some or all of the larvae in the drying grain. Secondly adult insects fly away when exposed in the sun, and their eggs are also liable to attacks by predatory ants.



Sun drying crop on black plastic sheet

Airtight storage

This is a cheap insect eradication method . Insects like any other organisms need oxygen to respire. In an airtight structure all the oxygen is use up as respiration goes on and carbondioxide is formed which results in the death of the insects. Remember, the produce must be well dried before storing.



Mud-straw bin with tight cover

The use of insecticides

Traditional methods of storage pest control have a limited degree of effectiveness. As a result farmers have to turn to using chemical control methods despite the fact that they are expensive and need knowledge of proper application.

There are many different poisons that kill insects but only a few of these are useful in grain storage. The insecticides available for use for storage purposes are of two major types : Contact chemicals and fumigants.

Contact insecticides:-

Contact chemicals kill the insect if it comes into contact with the poison. They have low mammaliation toxicity. Contact chemicals are available in several forms-dust or powder, or as wettable powders, or emulsifiable concentrates for sprayed application. The use of contact insecticides by small holder farmers will be either in a admixture or as surface treatment and they are easier and safer to handle. The specific compounds most usually recommended are malathion and more recently pirimiphos methyl (the ICI product, *Actellic,* also available in aerosol form) the latter performing well against species resistant to malathion.

Malathion breaks down quickly in hot and humid environment and so is of limited importance in such environment.

Fumigants

Fumigants are gases, and provide no residual effects. They are taken into the body of the insect through its respiratory system, resulting in death. Their advantages over contact poisons include ability to penetrate the grain mass and into crevices where insects may be concealing, and to kill all stages of insect life.

Warning:

Fumigants are toxic to human beings, and therefore need to be handled with the greatest of care by trained personnel, wearing protective clothing. They should not generally be used by the unsupervised farmer.

For successful fumigation the grain must be held in a container as near airtight as possible e.g metal silo or in plastic bags. For grain stored in bags, the usual method is to cover it with a fumigation sheet whose edges are sealed to the ground or the walls. The most promising compound for supervised use is *Aluminium phosphide.* This is available in tablet form, that liberate the toxic gas phosphine on contact with residual humidity in the stored grain.

Successful fumigation is only achieved in an airtight environment i.e the fumigation should be without holes such that there is no gas leakage.

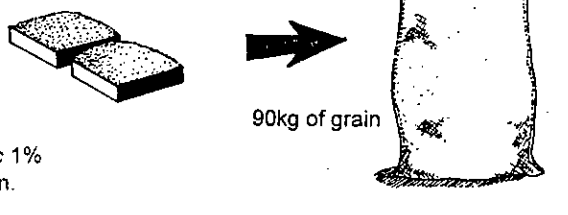
Additionally, fumigation duration should not be less than 72 hours. Longer hours are recommended. Dosage rates should e 2-3g/M^3 depending on the severity of infestation and pest species.

Recommended insecticides and application rates for cereal and legume grain

Actellic (Primiphos-methyl) 1%	50gm per 90kg grain
Actellic (Pirimiphos-methyl) 0.5%	100gm per 90 kg grain
Etrimfos (Entrimifos) 2%	50gm per 90 kg grain
Malathion (Malathion) 2%	50gm per 90 kg grain
Bromophos 2%	50 gm per 90 kg grain
Gardona (Tebrachlorinphos) 3.25%	50 gm per 90 kg grain
Methacrifos 2%	50 gm per 90 kg grain

How to measure the insecticides for use in a village situation.

The dust admixture are usually packed in specific quantities for treatment of a definite volume or amount of grain as shown above. Manufactures may also provide a measure or "spoon" for measuring a definite amount from the insecticide of any or these measuring aids a farmer should be able to improvise and use whatever is available. For instance the usual sized "Empty match Box" filled with Actellic 1% or Malathion dust contains approximately 25gm of the chemical. Two such filled "Empty match-boxes" top" bottle tops can thus treat one bag of maize grain.



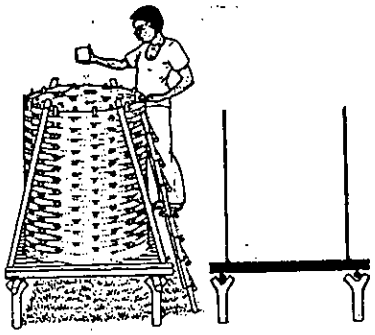
Two match-boxes each containing 25gm. of *Actellic* 1% to be mixed with 90kg. grain.

Measurement of insecticides for use in a village situation

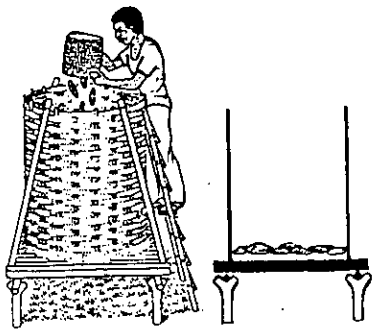
Procedure of dusting grain with insecticides.

i) **Layer -by-layer dusting of maize cob.**

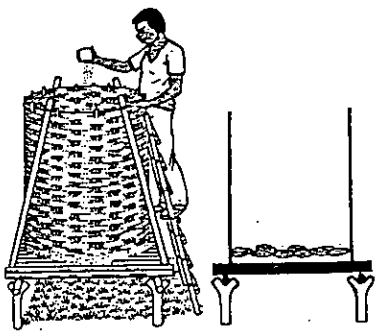
Sandwich method. The well dried and cleaned maize cobs should be treated layer by layer as they are put into the store granary . The following illustrated procedure is recommended.



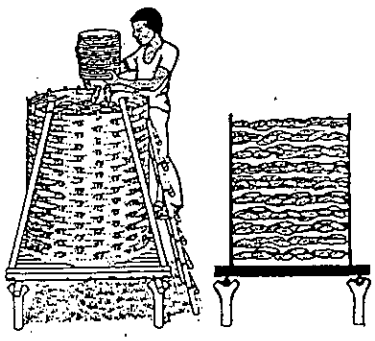
Sprinkle the inside wall and floor with a fine layer of insecticidal powder



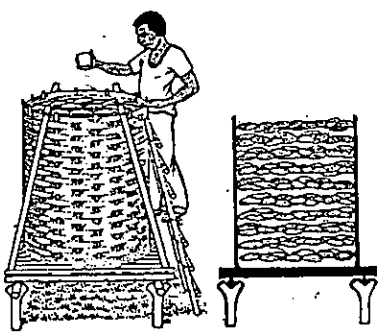
Completely cover the floor of the store with a layer of cob.



Sprinkle the inside wall and floor with a fine layer of insecticide powder



Put in more layers of cobs and sprinkle each layer with insecticidal powder.



When you have put in all the cobs, cover the top layer with a thick coating of insecticidal powder.

When you have put in all the cob cover the top layer with a coating of insecticidal powder.

ii) Dusting of produce in grain form



Empty the bag of grain on the floor in a heap insecticidal



Sprinkle correct amount of powder over the heap



Shoved the heap to another part of the floor using a shovel spade



Then shoved it back again



When you have finished there should not be any patches of insecticidal powder seen

Advantages

- Cheap method in terms of cost

Disadvantages

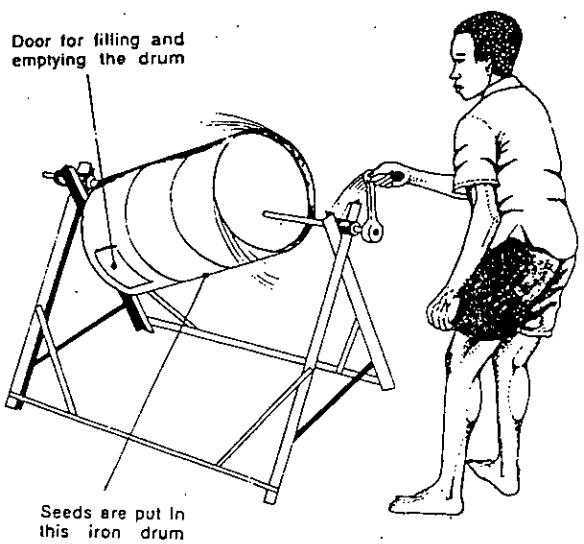
- Pollution of the environment
- The operator is affected directly by the dust
- Difficult to ensure uniform seed dressing
- Physical loss of insecticide
- Require skill/experience to reap benefit.

When the process of dusting is completed bag the treated grain and put it straight into a clean dry store or pour the grain directly into a clean dry storage structure and effect appropriate storage management from time to time during storage.

iii) **Insecticidal treatment of grain in a rotary drum.**

A 200-litre metal oil drum can be modified for use in the application of insecticides on grains. The modification will include:-

- An opening cut on one of the walls of the drum for loading and unloading grain.
- The opening is provided with a hinged, tightly lockable door
- A round metallic shaft, eccentrically welded to the drum, suspends the drum.
- A crank attached to the shaft is manually actuated to rotate the drum.



A simple rotary drum for the insecticidal treatment of the grain.

During operation a measured quantity of grain together with an appropriate dosage of insecticidal powder, are uniformly mixed through the wobbling rotation of drum. Cross bars may be welded inside the drum to facilitate the exercise.

The treatment drum can handle about 100kg. of bean seed per turn and is operated by making about 8 to 10 tons to ensure uniform treatment of seed. Chemical application rates remain as recommended by the chemical manufactures.

Its advantages include:

- less work involved in getting the seed treated
- no danger of inhaling chemical
- uniform treatment of seed
- prevents chemical losses due to being blown a way or attachment to surfaces.

Disadvantage of using rotary drum

- It requires high capital investment

More information on insecticides

Not one single pesticide is safe. This is a rule that should always be kept in mind when using insecticides or other pesticides. Insecticides are poisons for killing insect and they can be very dangerous to humans as well as to animals and fish. Some insecticides are less hazardous than others, but when not used in the correct way any insecticides may become very dangerous. Always use insecticides as directed and take the necessary precaution.

Direction for effective use of insecticides

Before you buy insecticides find out the costs. The costs of buying and applying it may be higher than the potential benefits. This applies particularly to small farm storage.

To use insecticides effectively in storage you should:

- Only use them with clean, dry grain in good storage condition
- Find out which insecticide to use under specific circumstances or against specific pests. Not all the insecticides available are suitable. For instance:- some insecticides can be used on grain for seed, but cannot be used on cereals for food because the residue is toxic to humans. Others can be used for treating both types of grain.

- Some insecticides cannot be used in combination with certain materials, e.g malathion should not be used or put in metal containers.
- Some insects have developed resistance against several insecticides.
- Know that quantity and timing of application are often critical for successful use.

To use insecticides safely you must:

1. Never buy or use an insecticide when there is no label which tells you which insecticide is in the package . The concentration of the insecticide as well as user instruction should be given on the container as well.

2. Make sure the mixture is correct for its purpose. Using a wrong insecticide can poison the grain.

3. Follow the instructions for use very strictly. If there are no directions, do not use the poison.

4. Do not use more than the recommended dosage

5. Know how to apply insecticide properly

6. Wear protective clothing to avoid coming into contact with the insecticide. Avoid inhaling dusting powder, gases or fine droplets by wearing a mask. Avoid contact with the skin by wearing gloves, a shirt with long sleeves, trousers and shoes.

7. Destroy empty insecticides containers. It is dangerous to re-use them.

8. Never use an expired pesticide

9. Wash your hands and clothes after using insecticides

10 Do not eat, drink or smoke while using insecticides

11. Keep poison containers as well as application equipment away from children and animals.

12. Do not throw way waste chemicals or pour them into a river or anywhere else.

What to do incase of poisoning

Incase of poisoning the following is recommended

- Quickly assess the situation and if necessary send for a doctor or take patient to a doctor
- Remove patient from the area of poisoning. Undress and wash the patient
- Place the patient flat on his stomach and face to one side.
- Carry out artificial respiration if patient is not breathing but be careful not to get poisoned in the process.
- If insecticides has been swallowed, instigate the patient to vomit. Do not use salt, milk, tea or coffee since these may react with the chemicals and aggravate the situation.

Never use an insecticide until you are sure you know exactly how it should be used

CONTROL METHODS OF SPECIFIC CROP

Sifting and winnowing:

The grain is put in a sieve with a mesh size smaller than that of the grain and shaken. The insects which pass through the sieve are collected and burnt. Additionally helps in eliminating eggs that have been loosely laid. A disadvantage of sieving is that attacked grains are not separated from healthy grains. Therefore, insects that may be developing within the grain may go on to complete its life cycle .

Winnowing produces the same results as sifting.

Local Plants and herbs

A number of local plants and herbs have been found to be effective in the control of storage pests.

The vegetative parts of the plants are sundried and ground into powder. This is then mixed with the stored produce usually at the dosage rate of 1.5-2% w/w.

Examples of these are:

Tephrosia controls pigeonpea and cowpea pests
Tagetes and tobacco are effective against pigeon pea pests
Latana is used in beans as a protectant.

Storage of dry legumes in pod is another way to control pest of cowpeas and pigeon peas . Pods prevent insects from gaining easy entry inside.

Vegetable oils exert particularly good control of bruchid beetles on pulses, by inhibiting development of the eggs, which are laid on the surface. Adult beetle are however, not affected. After treatment the produce can be stored in sacks.

One advantage is that the oils are easy to apply and only small amounts are required (for instance 2-4 m/kg threshed beans). Mix the oil and product thoroughly in a suitable container, preferably in portions.

There are some disadvantages to the use of oil:

I) Oil can have an adverse effect on the germination power of the oil treated seeds. Therefore vegetables oils should only be used to protect cereals which are intended for food.

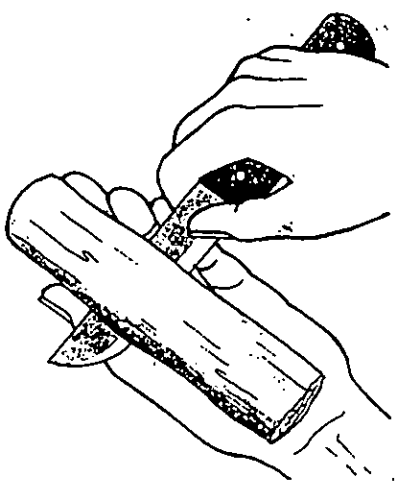
ii) Locally made oil may go rancid which will then make the taste of the product unpleasant.

Some examples of the use of oil

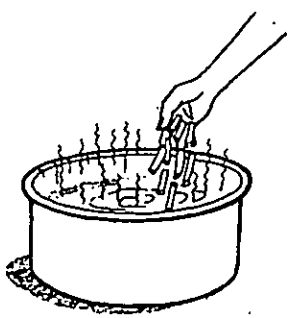
Storage product	Type of oil		Amount of oil Effect
Cowpea	Groundnuts oil	5m/kg	Protects the cowpeas against the cowpea weevil infestation for about 6 months
Mung beans	beans Cotton seed oil	6m/kg	Minimal infestation of the beans occurs after 3 months. After 6 months only 3.5% of the seed are usually damaged.
Beans	Neem oil	2-3m/kg	Well mixed this amount of neem oil protects the beans for about 6 months. Neem oil has an insecticidal effect as well as a repellant.

Dried cassava chips

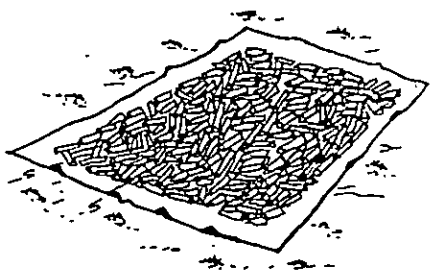
Blanching : A freshly sliced cassava root is dipped in boiling water for about 10 minutes and dried in the sun. When stored the cassava will keep for a long time without getting seriously infested by storage pests.



Slicing fresh cassava



Dipping slices in hot water

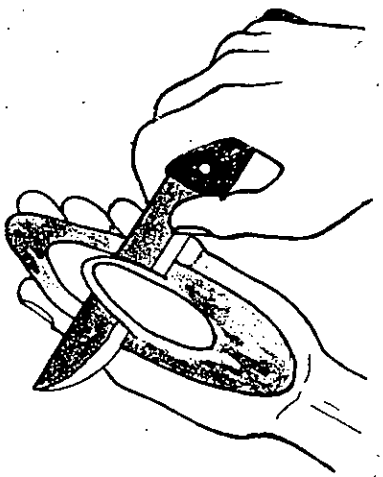


Drying blanched slices in the sun

Salting:

Dried sweet, potato

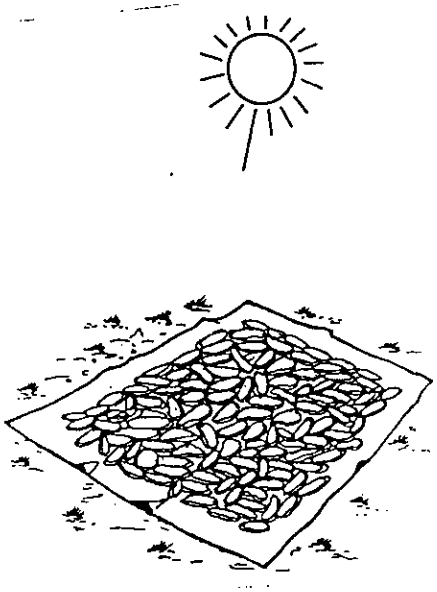
Slices of fresh sweet potato roots are salted with a finely ground common salt (about 2kg per 100kg) and dried well in the sun. It has been found that this dried salted sweet potato keeps longer in storage without any serious signs of infestation than un-salted slices.



Slicing fresh potato



Salting potato slices



Drying salted sweet potato slices in the sun

Appendix

Major pests of cereal grains

Scientific Name	Common Name	Pest status
Sitophilus oryzae	Rice weevil	Primary
Sitophilus zeamais	Maize weevil	Primary
Prostephanus truncatus	Larger grain borer	Primary
Rhyzopertha dominica	Lesser grain borer	Primary
Dinoderus minutus	Dinoderus	Primary
Sitotroga cerealella	Angoumois grain moth	Primary
Ephestia cautella	Almond moth	Secondary
Ephestia elutella	Tobacco moth	Secondary
Plodia interpunctella	Indian-meal moth	Secondary
Tribolium casteneum	Red flour beetle	Secondary
Tribolium confusum	Confused flour beetle	Secondary
Oryzaephilus surinamensis	Saw-toothed grain beetle	Secondary
Cryptolestes ferrugineus	Flat grain beetle	Secondary
Araecerus fasciculatus	Coffee bean weevil	Primary
Lasioderma serricorne	Cigarette beetle	Primary

2. Major pests of grain legumes

Acanthoscelides obtectus	Bean weevil	Primary
Zabrotes subfasciatus	Southern Mexican beetle	Primary
Callosobruchus maculatus	Cowpea weevil	Primary
Callosobruchus chinensis	Adzuki bean weevil	Primary
Callosobruchus rhodesianus	Pulse beetle	Primary