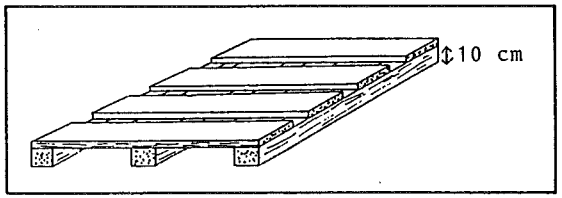
5.2.4 Storage Techniques

5.2.4.1 Stacking Bags

- Pallets

Always stack bags on pallets! Place the pallets in a way that enables a free current of air under the stack!

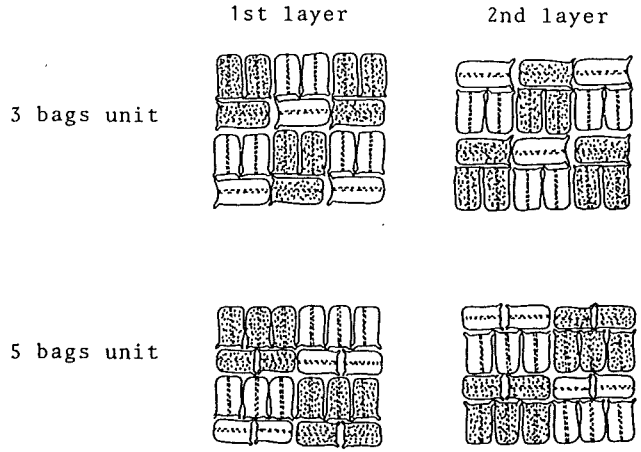
The pallets should be 10 cm high in order to facilitate aeration from below. As an additional advantage rodent infestation can easily be determined. The following illustration shows a model with three base beams and cross beams of a thickness of at least 2.5 cm.



The overall surface area of the supporting bars should not be less than approx. 40 % of the entire surface area of the pallet in order to prevent the bottom bags being damaged as a result of too much pressure.

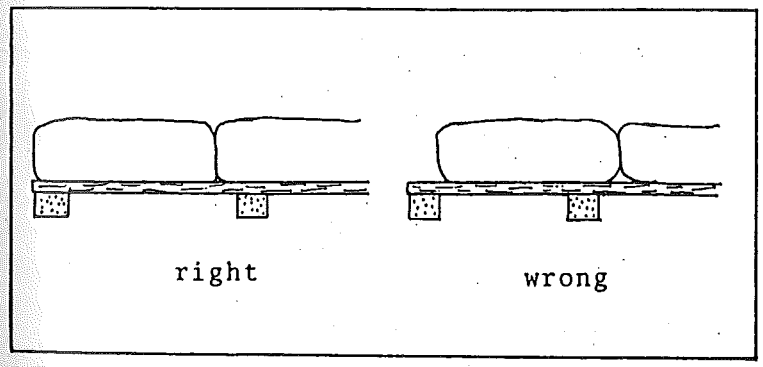
- Stacking the bags

The objective when stacking bags is to build up safe stacks which will not collapse. In practice, three or five bags units, depending on their size, have proved most effective whereby overlapping the bags in the different layers is essential.

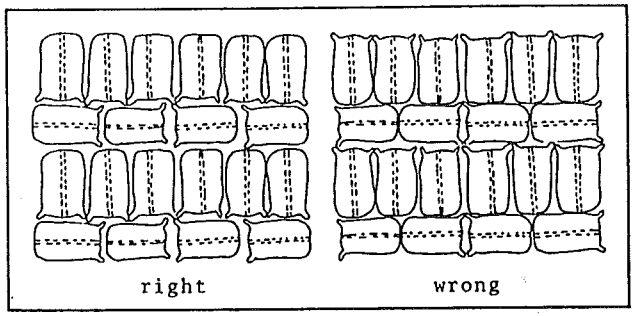


Attention must be paid to the following:

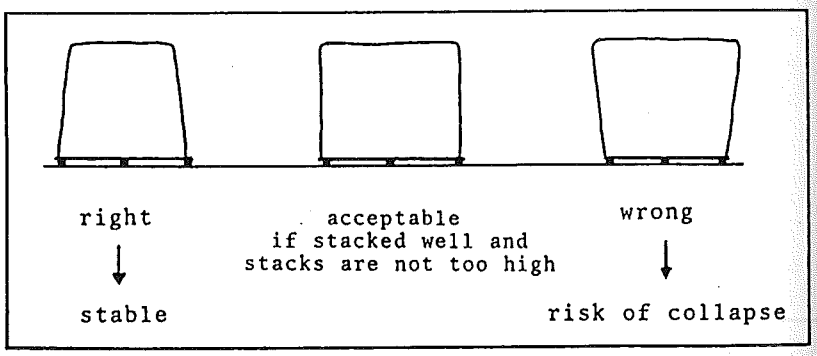
- Start exactly at the edge of the pallet:



- Eears of bags (side where the bag is sewn) should be pointing inwards the stack in order to prevent grain spilling.



- Stack the bottom layers with larger intervals than the top ones in order to enable the stack to slightly taper. On higher stacks, occasionally leave out some bags in the upper layers to retain the conical form.



- On every layer, work inwards from all four sides. If this results in gaps occurring in the middle of the upper layers, the stability of the stack will not be affected.

- **Size of stacks**

For the purpose of stability, jute bags should not be stacked any higher than 4 m and plastic bags no higher than 3 m! Plastic bags are more slippery and the stacks thus less stable.

When determining the size of stacks, take into account the store's capacity, the ratio of its length to its breadth and its height, the position of the doors and the size of the fumigation sheets available! Set the dimensions of the stacks to facilitate sealing with a single fumigation sheet!

If the stacks are too large, they can no longer be effectively controlled, and if they are too small, space is wasted. Do not exceed stack sizes of approximately 250 t!

Leave a space between the top of the stacks and the roof of a least 1.5 metres in order to be able to carry out control measures.

Standardized stack sizes should be prescribed for all stores. This has the following advantages:

- It enables optimum use of space.

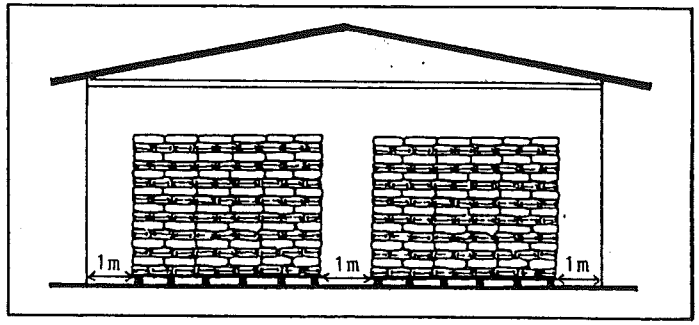
- It permits standardised instructions for treatments and fumigation as well as for taking samples.

- It simplifies controls.

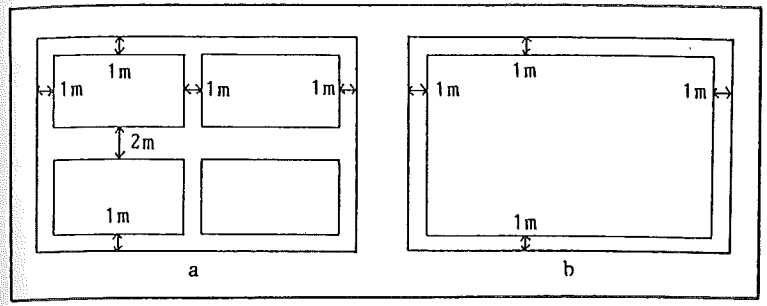
- It enables the purchase of perfectly-sized fumigation sheets.

- Positioning of stacks

All stacks of bags must be freely accessible at all times in order to carry out controls, surface treatment and fumigation. Leave a minimum space of 1 m between stacks and between the stacks and the walls!



Mark the positions of the stacks by painting a line on the warehouse floor (a)! If the sizes of the stacks are not fixed, paint a line at a distance of 1 m from the walls all around the floor (b)!



Provide a site plan before storage!

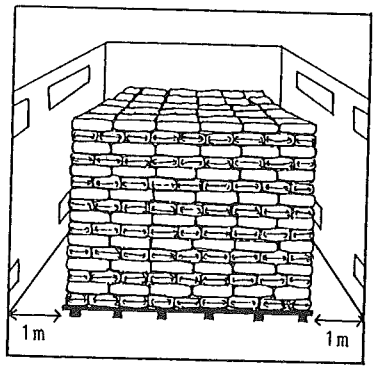
- Marking the stacks

Book-keeping and routine work is made considerably easier if the individual stacks are marked with numbers or letters for easy identification. These markings may be made on the walls, the floor or the roof pillars, as long as they are always clearly visible. They should also be entered on the stack card.

- Stack cards

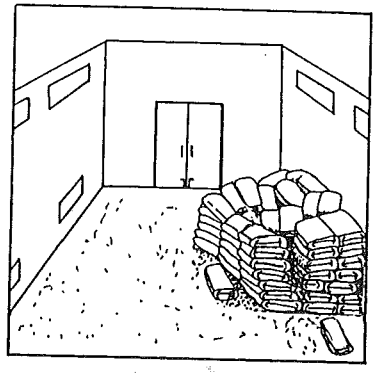
Attach a stack card (sometimes referred to as a "bin card") in a clearly visible position to every stack of bags, containing the most important information. All controls and treatments should also be entered on the card. You will find a sample of a stack card in the section on book-keeping (5.2.4.4).

Summary of Bag Stacking:



RIGHT

- A space of 1 m is left between stack and wall.
- The stacks are on pallets.
- The pallets are set up allowing an optimum air flow beneath the stacks.
- The bags are stacked in units of three.



WRONG

- The bags are touching the wall.
- The bags are on the floor.
- No aeration of the stacks is possible.
- The bags are stacked irregularly.

Consequences:

- The stack is free of rodents.
- The stack is well aerated.
- The stack is stable.
- The stack can be controlled, treated and fumigated at any time.

- The stack is a nesting place for rodents.
- No aeration takes place.
- The stack may collapse.
- The stack cannot be controlled, treated or fumigated.

5.2.4.2 Controlled Ventilation

Controlled ventilation has a positive effect on the moisture content of the stored produce and the temperature in the store.

Humid air can **remoisten** whereas dry air **further dries** the stored produce until the relevant equilibrium moisture content has been reached (see Section 2.2.4). This means that the ventilation openings should be kept closed if the relative humidity is high and opened if the relative humidity is low.

Further drying of the stored produce is only possible, however, if this method is consistently practised over a certain period of time, as the exchange of moisture in stacked produce takes place relatively slowly.

The equilibrium moisture content of the stored produce does not only depend on the relative humidity of the atmosphere, but also on the temperature, which influences the ability of the air to absorb water. The change in the equilibrium moisture content is, however, only slight within temperature ranges of approximately 10°C, so that simplifications can be made in practice. Both of the following tables thus contain average values for the temperature ranges from 20 - 30°C and 30 - 40°C which have been calculated on the basis of various publications. The equilibrium moisture contents stated are to be regarded as guidelines.

Using these tables, a thermometer, a hygrometer (or a combined thermo-hygrometer) and a grain moisture meter are needed in order to determine whether ventilation is most favourable or not.

Tables of Equilibrium Moisture Contents

Equilibrium moisture contents of important commodities at 20 - 30 °C

Commodity	relative humidity of the air 40	50	60	70	80	90 %
	equilibrium moisture content					
White maize	9.3	10.6	12.1	13.8	16.1	19.6
Yellow maize	8.4	9.7	11.3	13.1	15.5	19.2
Sorghum	9.8	11.0	12.1	13.8	15.8	18.9
Wheat	10.0	11.1	12.7	14.2	16.4	20.3
Paddy	9.2	10.4	11.6	13.0	14.8	17.6
Rice	9.0	10.4	11.7	13.0	14.6	16.7
Groundnuts	5.4	6.8	7.7	9.1	11.6	16.0

Equilibrium moisture contents of important commodities at 30 - 40 °C

Commodity	relative humidity of the air 40	50	60	70	80	90 %
	equilibrium moisture content					
Yellow maize	9.0	9.9	11.7	13.3	14.9	18.2
Sorghum	10.0	11.6	12.1	13.0	14.7	
Wheat			11.8	12.9	14.8	
Paddy	10.1	11.4	12.6	13.5	14.9	19.1
Rice			11.1	12.7	14.5	16.8

Procedure:

1. Measure the relative humidity and the temperature of the outside air using a thermometer and a hygrometer! Both instruments must be fixed outdoors and protected from rain and direct sunlight.

2. Measure the moisture content of the stored produce using a moisture meter!

3. Determine the equilibrium moisture content of the stored produce for the determined relative humidity:

   - Select the table on the basis of the temperature reading!

   - Find the point where the row of the produce in storage meets the column of the relative humidity reading!

4. Compare the moisture content reading with the equilibrium moisture content determined!

   - Ventilate if the moisture content of the stored produce is higher than the equilibrium moisture content shown in the table! Further drying can be expected.

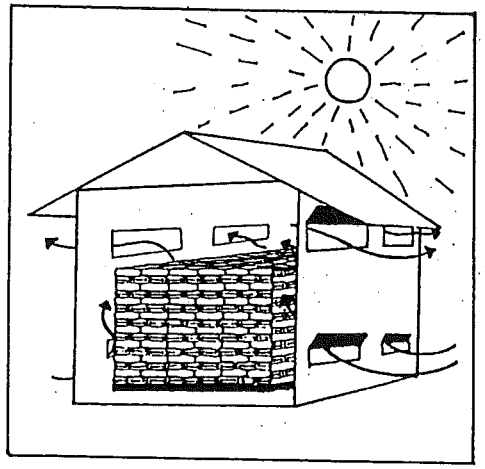
   - Close the ventilation flaps if the moisture content of the stored produce is lower than the equilibrium moisture content shown in the table! Otherwise it is to be expected that the stored produce will become more moist.

Example 1:

- outside temperature 27°C
- relative humidity of outside air 60 %
- moisture content of stored sorghum 13.5 %

In this case, the table which should be used is the one showing the temperature range from 20 - 30°C. The equilibrium moisture content for sorghum at a relative humidity of 60 % is 12.1 %. The actual moisture content of the produce at 13.5 % is **higher** than the equilibrium moisture content.

Therefore: **Ventilate!**

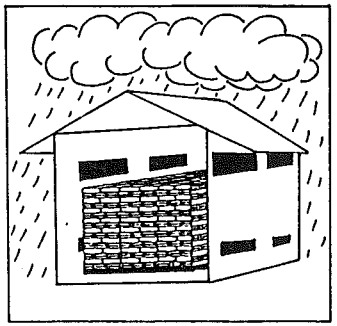


Example 2:

- outside temperature 34°C
- relative humidity of outside air 80 %
- moisture content of stored wheat 13 %

In this case, the table which should be used is the one showing the temperature range from 30 - 40°C. The equilibrium moisture content for wheat at a relative humidity of 80 % is 14.8 %. The actual moisture content of the produce at 13 % is **lower** than the equilibrium moisture content.

Therefore: **Keep the ventilation flaps closed!**



Controlled ventilation is particularly necessary where the moisture content of the stored grain is close to the permissible maximum values for long-term storage (see Section 2.2.6). This is generally the case in humid regions and often also in arid regions with imported grain.

If the moisture content is well below the maximum value, which is generally the case with local grain in arid regions, ventilation need only take place if condensation occurs in the store or if the inside temperature is too high.

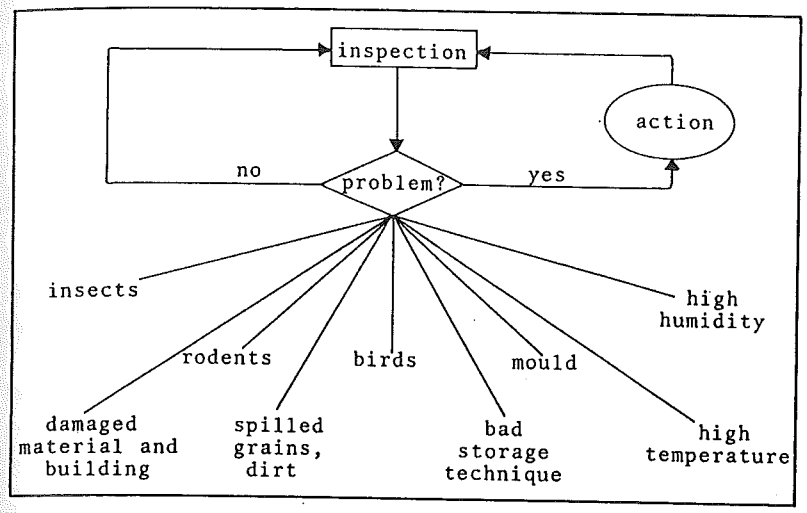
If no thermometers and hygrometers are available, the following rules of thumb apply:

- Ventilate the store only during the daytime, using the hours of sunlight when experience has shown that the relative humidity is comparatively low! This is the period from 11 a.m. to 3 p.m., or longer in dry regions.

- If it rains, keep the store closed for a number of hours or for the entire day following the end of the rainfall.

5.2.4.3 Monitoring, Sampling and Quality Control

Monitoring is a constant programme of control with the aim of maintaining the quality of the stored produce. A brief visual inspection is by no means sufficient, rather it is important that a systematic search for possible sources of damage is performed. Should such sources be identified, measures must be taken (see Section 3.3) and the success of these measures then examined.



Monitoring comprises regular inspection of the store as well as continuously sampling of the stored produce.

Inspecting the Store

Inspect the store daily!

- **Damage to the store**

  Losses in the quality of the stored produce are in many cases caused by damage to the store building.

  Pay particular attention to damage to the roof, to the junctions of roof and walls, cracks and holes in the walls and the floor, damage to doors, windows,

ventilation openings and their gauzes and grilles! Take immediate action if you notice any damage on walls or the floor or leaks in the roof!

Keep the rainwater drainage system and gutters in good function!

- **Presence of rodents and birds**

Rodents betray their presence in the store by leaving various traces.

Pay particular attention to droppings, footprints in the dust, holes in bags, spilled grain, damaged material and grain left-overs (see Chapter 11)!

Birds also leave excrements, food prints and damage to bags.

- **Presence of insect pests**

Look for insect pests at dusk, as they then have an active flying phase and are more easily noticeable!

Moths are generally noticeable when their population density is already considerable.

Traps using pheromones or attractants can be of great service for identifying a low population in the store (see Section 10.2).

Pheromone traps are available for monitoring Trogoderma, Tribolium, Rhizopertha and Prostephanus, as well as the most important species of moths (see Section 10.2).

Food attractants are less specific in their function to monitor infestation (see Section 10.2)!

Brush stacks of bags with a stick or a broom to disturb and discover resting moths!

Lift bags in order to detect moth cocoons along the line where the bags touch one another.

When looking for **beetles** pay particular attention to cracks, bag seams and ears where they often hide!

Empty individual bags in a thin layer onto a sheet and examine the contents for beetles and larvae! This should be done in the shade so that the insects do not flee immediately.

It is, however, more effective to sieve out any insects present using a box sieve with a mesh of 1 - 2 mm.

Higher infestation can be noticed by an increase in the temperature of the stored produce as a result of the metabolic activity of the insects, or in certain cases by a characteristic smell (e.g. Tribolium). Very important infestation can be noticed by feeding noise produced in the stack.

Identify the insects found as far as possible in order to perform the correct treatment.

- **Mould**

Pay attention to the mouldy smell which is noticeable in the case of fungi infestation even before any visual changes can be seen to the products!

- **Moisture damage**

  Attention has to be made to water marks on the bags which can still be seen after the bags have dried!

Taking samples

The most reliable method to establish moisture damage, insect or fungus infestation is by examining the stored produce itself. In order to do so, it is essential to take a sample. The method of taking samples presented below serves for use in routine controls:

- for infestation by pests
- of the moisture content
- for other changes to the stored produce.

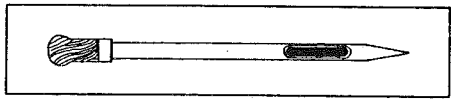
The controls should be made regularly by the storekeeper during the storage period. Regulations for laboratory examinations of samples, e.g. of seeds, remain unaffected.

Take samples of every lot in a weekly to fortnightly rhythm! Draw up a schedule for regular sampling.

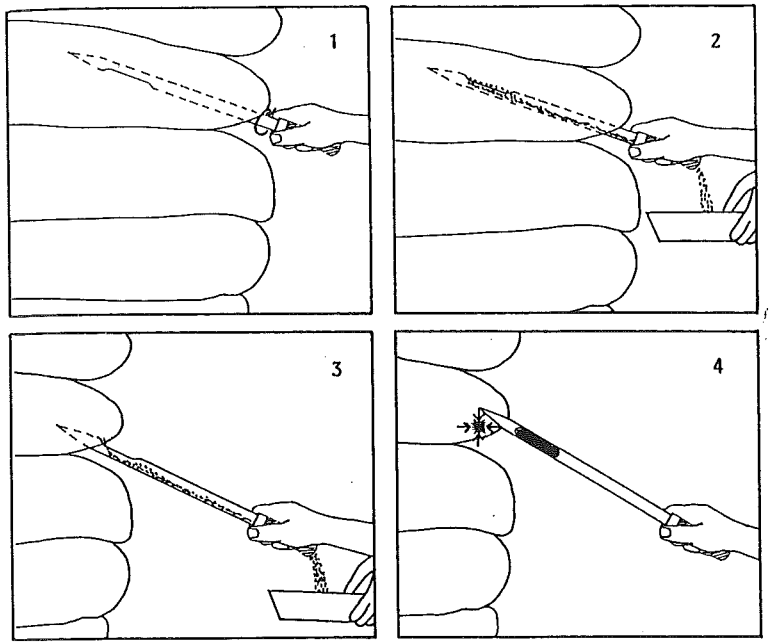
- **Sampler**

  The samples are taken by means of a sampler, of which there are two different kinds:

  - Bag sampler



It reaches to the center of the bag and is quick and easy to use:

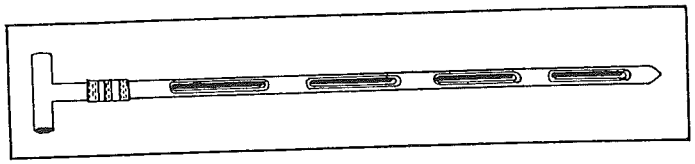


Use the sampler to pierce the bag from below (1), turn it in the bag so that the produce can fall into the opening and run into the recipient (2). Withdraw the sampler (3) and close the hole with its tip (4).

The necessary diameter of a bag sampler depends on the type of produce being sampled. The following rough values apply:

- for small seeds	12 mm
- for cereals	15 mm
- for grain legumes	20 mm
- for rough produce	25 mm

- Grain sampler



It is longer than the bag sampler and is able to cover the entire cross-section of the bag. Its use is more complicated and slower. The grain sampler consists of two parts; an outer and an inner tube. Turning the inner tube opens and closes the sampler.

Grain samplers are available as entirely hollow constructions or with intermediary sections. The latter enable the produce to be examined layer by layer.

Grain samplers are available in various sizes. Larger ones are mostly used for taking samples from bulk produce.

Grain samplers are used as follows:

Pierce the bag with the closed grain sampler. Turn the inner tube to open and fill the sampler. Then reclose it by turning the inner tube again. Shake the sampler as you do so to avoid any broken grain! Draw out the sampler and empty the sample into a recipient or on a sheet!

- **Representative samples**

A sample only consists of a tiny portion of the overall amount of grain contained in a single lot. The sample must therefore be taken with the greatest care in order to obtain a sample which is **representative** of the entire stack.

In order to ensure this

- a sufficient number of primary samples must be taken;
- the points from which the samples are taken must be evenly distributed throughout the entire lot and
- the primary samples are put together to form a composite sample (with the exception of those samples which serve to determine the presence of moisture!).

The composite sample should weigh 1 kg, or less in the case of small seeds.

- **Number of primary samples**

The minimum number of primary samples depends on the size of the bag stacks. Proportionately more samples have to be taken from smaller stacks than from larger ones, as in the former more bags are placed on the outside and thus exposed to damaging influences.

The number of primary samples depends solely on the number of bags, regardless of their weight.

Minimum Number of Primary Samples
for Small Stacks of Bags

Number of Bags (B)	Minimum Number of Primary Samples (P)
up to 10	every bag
11 - 25	every second bag
26 - 50	every third bag

Minimum Number of Primary Samples (P) in Stacks with a Large Number of Bags (B)

B	P	B	P	B	P
50-100	10	800- 900	30	2500- 3000	55
100-150	12	900-1000	32	3000- 3500	59
150-200	14			3500- 4000	63
200-250	16	1000-1200	35	4000- 4500	67
250-300	18	1200-1400	37	4500- 5000	71
300-400	20	1400-1600	40	5000- 6000	77
400-500	22	1600-1800	42	6000- 7000	83
500-600	24	1800-2000	45	7000- 8000	89
600-700	26			8000- 9000	95
700-800	28	2000-2500	50	9000-10000	100

The number of primary samples in stacks containing more than 10.000 bags is calculated as the square root of the number of bags in the stack.

When produce is delivered a primary sample should be taken out of every second bag on the vehicle.

- **Distribution of the sampling points**

The sampling points must be evenly distributed over the total stack surface. If the total stack surface area is 120 m², for example, and the surface area of one side 40 m², 1/3 of the samples must be taken from this side.

It is advantageous to have standardised stack sizes in the store.

An example should serve to demonstrate the distribution of sampling points all over a single stack:

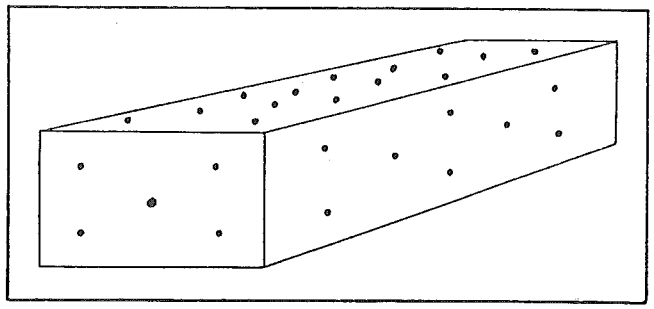
Number of bags in the stack	1580
Number of primary samples (see Table)	40
Length x Breadth x Height of stack	8 m x 5 m x 3 m

Calculating the surface area:

Individual Surfaces	Proportion of Overall Surface	Number of samples*
Front 3 m x 5 m = 15 m²	1/8	1/8 of 40 = 5
Back 3 m x 5 m = 15 m²	1/8	1/8 of 40 = 5
Left 3 m x 8 m = 24 m²	1/5	1/5 of 40 = 8
Right 3 m x 8 m = 24 m²	1/5	1/5 of 40 = 8
Top 5 m x 8 m = 40 m²	1/3	1/3 of 40 = 14
Overall surface = 118 m²		Total = 40

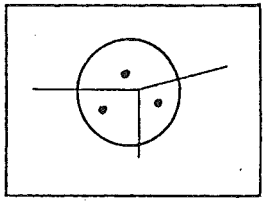
(* As it is not possible to work with fractions, figures must be rounded)

Distribution of sampling points on the individual surfaces:

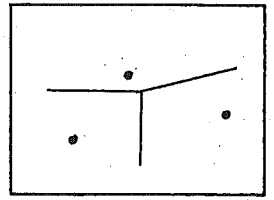


Take care that the sampling points are not all concentrated around the edges.

wrong



right



Quality control

A minimum amount of equipment must be available in every store or storage complex for quality control examinations:

- moisture meter
- set of sieves
- hand magnifying glass
- pair of scales

If there is any doubt as to the quality of a certain lot, samples should be tested in a laboratory.

The samples taken are subjected to various controls, either as primary samples or as a composite sample.

- **Visual test and smell**

  Examine the composition and smell of the produce when taking the sample!

  A mouldy smell indicates fungi festation. Any changes in the colour of the grains are also due to moisture damage or damage from heat because of high drying temperatures or "hot spots".

- **Measuring the grain moisture content**

  For detecting grain moisture content primary samples have to be analysed, as increases in the moisture

content of some bags resulting from condensation or leakages in the roof can no longer be recognized in composite samples.

Measurement should be performed immediately after taking the sample, as the moisture content can change rapidly after the sample has been taken. This test is generally done with commercially available, battery-operated, moisture meters. Take care that the produce is not filled into the apparatus by hand as this increases the moisture on the surface of the grain and leads to incorrect readings! Strictly observe the instructions for use of the moisture meters!

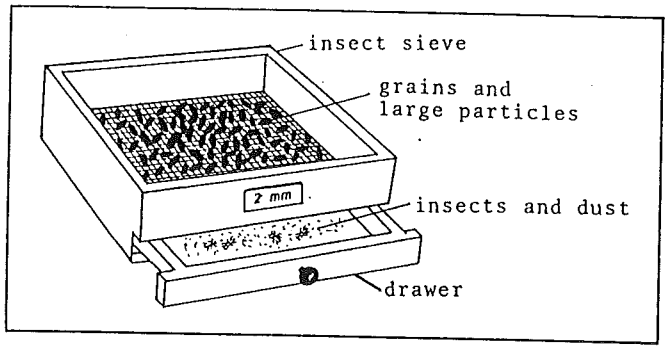
In case of exceptionally high readings, take additional measurements to determine whether the increase is limited to a certain area (e.g. as a result of rainwater penetration), or whether it affects large areas of the entire stack! Take out bags for drying if necessary!

Enter all readings in the stock journal and stack card.

- Control for Infestation by Insects

Examine the entire composite sample, as it is not of any importance where exactly the insects come from! If there is any infestation, the entire stack must be treated in any case.

Sieve out any insects which might be present using a single sieve with a mesh of 1 - 2 mm or better several sieves with decreasing mesh sizes (e.g. 3, 2 and 1 mm)! Carefully examine the remains in every sieve for insects!



A number of pests, such as Sitotroga or Sitophilus develop inside the grains and are thus not noticeable in controls of this kind. Hidden infestation can be discovered by means of a water test:

Place a sample of the grain in a container with water! Infested grains are lighter than healthy ones and will therefore float on the surface. Check whether they are really infested by cutting them open!

Estimate the degree of infestation according to the following categorisation:

No live insects in the composite sample (1 kg)*	no or only slight infestation
1 - 3 live insects/kg	medium infestation
4 - 15 live insects/kg	heavy infestation
over 15 live insects/kg	very heavy infestation

(* As a 1 kg sample is relatively small, the lack of any live insects is no absolute guarantee that the entire lot is free of infestation).

Identify any insects (see Chapter 7) in order to decide if, when and what action should be taken to deal with them!

Whether action should be taken depends on a number of factors:
- on the degree of infestation
- on the period the produce will be in storage
- the purpose the produce will be used for
- the quality standards demanded on selling the produce

- **Grain temperature readings**

Unusually high temperatures in a mass of grain are an indication of the activity of micro-organisms and pests, e.g. in a "hot spot" (see Section 2.2.3).

Grain thermometers are available with rigid thermo-probes made of metal which are used to pierce the bags.

Electronic thermometers usually have a thermo-probe with a flexible lead. This is either soldered to a rigid metal rod or is placed in a bag or grain sampler.

Empty the bags with a higher temperature and examine the contents!

Determine the extent of the damage by controlling the surrounding bags!

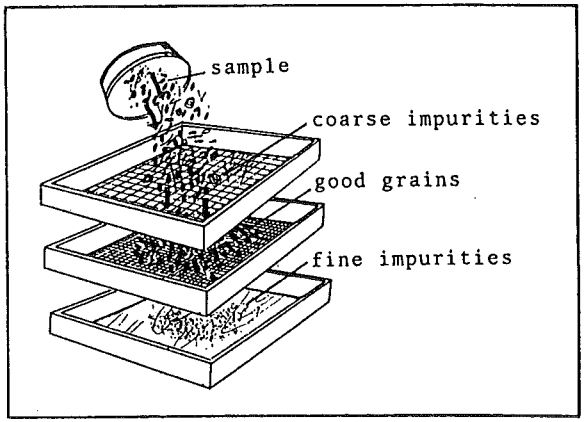
- **Checking for impurities**

An examination for impurities is particularly necessary on purchasing or accepting delivery of produce at the store.

Poorly cleaned produce has a shorter storage life than clean produce. Dust, for example, is hygroscopic and raises the moisture content of the stored produce; broken grain allows secondary pests to gain access to the stored produce (see Chapter 7). In addition, impurities reduce the storage capacity and increase the storage costs due to extra weight.

Impurities are separated by sieving the sample being examined. This is performed using two sieves, one coarse and a fine one, whose mesh sizes must be suited to the produce being examined.

Impurities such as stones, pieces of straw, parts of maize spindle etc. are sieved out by the coarse sieve whereas impurities such as sand, dust, insects, broken grains, etc. will pass through the fine sieve.



Impurities which are of the same size as the stored produce cannot be sieved out.

Sieves sets with a lid and a bottom pan are recommendable. Sieving should be performed by shaking the set of sieves for 1/2 - 1 minute.

If there are no sieves available, impurities may be separated from the stored produce by means of simple sorting out on a bright surface.

For a quantitative assessment of the impurities, a set of scales weighing accurately to 0.1 g is necessary.

This is necessary wherever:
- quality standards are prescribed
- the degree of impurity is taken into account in the price of the produce

Examinations for impurity are not necessary in the course of routine control of the stored produce during the storage period.

There are special regulations for seeds.

5.2.5 Book-keeping

The storekeeper has to record the state of the store and the produce as well as of his activities. Book-keeping is based on the following elements:

- **Store journal**
- **Stock sheets** (where suitable)
- **Stack cards**
- **Monthly report**
- **Warehouse checklist**

Models for these elements are presented below, along with explanations for their use.

- **Store journal**

The store journal contains a record of all procedures carried out in the store, such as incoming and outgoing produce, results of inspections, treatments, etc. Entries should be made daily and after any activities have been performed. The store journal consists of two tables:

- **Balance sheet**

The balance sheet contains all information on movements of the stored produce, the place of origin or destination, the stack number (or lot number in the case of seed) and reference to the relevant documents like invoices or receipts. These must be filed chronologically. The storekeeper confirms every procedure with his signature.

- **Control sheet**

The control sheet contains information on **all** activities in the store, such as inspections and their results, treatments, cleaning and ventilation, any repairs and weather data. An additional quality control book is required for seed stores in which the results of the laboratory tests which form a part of the essential internal quality maintenance programme are recorded.

STORE JOURNAL (PART 1):

BALANCE SHEET

Commodity: Warehouse:

Date	In (t)	Out (t)	Balance (t)	Number of bags	in/out stack No.	Origin/ destination	Document No.	Signature

Commodity: Warehouse:

Date	In (t)	Out (t)	Balance (t)	Number of bags	in/out stack No.	Origin/ destination	Document No.	Signature

STORE JOURNAL (PART 2):

CONTROL SHEET

CONTROLS						TREATMENTS				CONTROLLED AERATION	CLIMATE		
Date	Commodity	Stack No.	m.c. %	Insect infestation (degree, species)	Other observations (rodents, condition of warehouse, etc.)	Kind of treatment	Chemical used, application rate	Result of treatment	Cleaning and repairs	vents manipulated (time)	Temp. °C (time)	r.h. % (time)	Signature

The store journal should be firmly bound and the pages numbered. The first part should consist of the balance sheets and the thicker rear part of the control sheets. A separate journal should be kept for each store and should remain in the store.

- **Stock sheets**

In storage centres and in seed stores, store book-keeping is composed of journals from the individual stores or lots, making it very time-consuming to calculate the actual amounts of produce present in the stores. In such cases it is practical to keep stock sheets. A stock sheet shows the current overall stock of the storage centre at any one time on a single page. The stock sheet is divided up according to the type of produce and, in the case of seed, according to type, category and state of processing.

Entries should consist of the date of any movement, the new overall total stock and the reference to the store where the movement has taken place. This enables the details of the procedure to be checked in the balance sheets of the relevant store.

Stock sheets are also kept in the form of a firmly bound book.

STOCK SHEET

Commodity

Date *	Store No. *	Balance (t)	Date *	Store No. *	Balance (t)	Date *	Store No. *	Balance (t)	Date *	Store No. *	Balance (t)	Date *	Store No. *	Balance (t)	Date *	Store No. *	Balance (t)

* Date and No. or name of store of last movement of a particular commodity.

1 Useful for storage centers with several separate stores and for seed centers to record the overall balance of the commodities stored. Details of the movement are then found in the store journal of the store where the movement has taken place.

- **Stack cards**

Every stack is given a stack card placed where it is clearly visible. This serves to identify the stack and the produce and contains details on inspections and pest control measures performed.

- **Monthly report**

The storekeeper's monthly report serves to inform superiors on amounts of produce and its state, on the storage conditions as well as on activities and any problems in the store. These reports should also be referred to on the inspections of the store regularly done by the superior.

- **Warehouse checklist**

The warehouse checklist is an instrument of control. It essentially serves as a means of evaluating the tasks mentioned in the storekeeper's job description. The checklist can also be used by the storekeeper in the course of regular controls of storage conditions, the state of the buildings and the storage management.

STACK CARD

FOOD DISTRIBUTION CORPORATION

Warehouse No./ Name: ....

Stack No.: ......

Lot No. : ......

Commodity: ....

Variety : ....

Origin : ....

Date	In (t)	Out (t)	Balance (t)	No. of bags	Signature	Date	In (t)	Out (t)	Balance (t)	No. of bags	Signature

STACK CARD

SEED CORPORATION

Warehouse No./ Name: ....

Lot No. .... raw seed 0

Commodity: .... precleaned seed 0

Origin: .... processed seed 0

.... treated with: ....

VARIETY

CATEGORY

Date	In (t)	Out (t)	Balance (t)	No. of bags	Signature	Date	In (t)	Out (t)	Balance (t)	No. of bags	Signature

Back of stack card

Stack dimensions (to be entered with pencil and to be corrected when changing):

length: ..... m Surface area: ..... m² Amount of water needed for surface treatment : l

width : ..... m Amount of chemical needed to be mixed with the water: ..... ml EC/g WP

height: ..... m Volume : ..... m³ Number of tablets needed for stack fumigation : ..... tablets

Date of inspection	m.c. %	Insect infestation other observations	Date of treatment	Kind of treatment	Chemical used	Appl.rate	Remarks	Signature

MONTHLY REPORT

WAREHOUSE

stock: ..... in ..... t, out ..... t, balance ..... t
..... in ..... t, out ..... t, balance ..... t
..... in ..... t, out ..... t, balance ..... t
..... in ..... t, out ..... t, balance ..... t

month :
location:
store(s) :

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
surrounding of store cleared and cleaned																															
floor cleaned																															
waste burned or buried																															
vents operated (controlled ventilation)																															
store checked for signs of:																															
- damage; damage found? yes*/no																															
- rodents; rodents found? yes/no																															
- birds a.o.; birds or others found? yes/no																															
- insects; - flying insects found? yes/no																															
- crawling insects found? yes/no																															
sample taken of stack number(s):																															
living insects found in sample(s)? yes/no																															
moisture content below safe storage level? yes/no*																															
grain temperature normal? yes/no																															
stack(s) number(s) ... sprayed																															
stack(s) number(s) ... fumigated																															
store sprayed																															
fogging																															
rodent control in operation																															
repairs																															

*explain:

remarks:

name of storekeeper:

signature :

date :

MONTHLY REPORT

PEST CONTROL

stock: ..... in ..... , out ..... , balance .....
..... in ..... , out ..... , balance .....
..... in ..... , out ..... , balance .....
..... in ..... , out ..... , balance .....

month :
location:
store(s) :

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
code-number of warehouse visited																															
store checked for signs of:																															
- damage; damage found? yes*/no																															
- rodents; rodents found? yes/no																															
- birds a.o.; birds or others found? yes/no																															
- insects; - flying insects found? yes/no																															
- crawling insects found? yes/no																															
sample taken of stack number(s):																															
living insects found in sample(s)? yes/no																															
moisture content below safe storage level? yes/no*																															
grain temperature normal? yes/no																															
stack(s) number(s) ... sprayed																															
stack(s) number(s) ... fumigated																															
store sprayed																															
fogging																															
rodent control in operation																															

*explain:

remarks:

name of pest control officer:

signature :

date :

WAREHOUSE CHECKLIST

Location:.....Name of store:.....Capacity.....t

Products stored:.....Amount stored.....t

1. Condition of warehouse surrounding

	YES	NO
Is the surrounding of the warehouse free of:		
a) - accumulation of grains, old bags, junk and trash?	0	0
b) - weeds, tall grass and bushes?.....	0	0
c) - evidence of rodents?.....	0	0
d) - standing water?.....	0	0

2. Condition of warehouse exterior

a) Is the roof intact?.....	0	0
b) Is the water drainage intact?.....	0	0
c) Are the walls without holes or cracks?.....	0	0
d) Do the doors close hermetiqually?.....	0	0
e) Are the ventilation openings protected against the penetration of insects, rodents and birds?.....	0	0

3. Condition of warehouse interior

a) Are the walls, the floor and the roof undamaged?.....	0	0
b) Is the floor and the roof clean?.....	0	0
c) Is the floor free of spilled grain, dirt, and trash?.....	0	0
d) Do the ventilation openings function properly?.....	0	0
e) Is the store free of residues of former treatments (empty phosphine tubes, phosphine residues, rodent baits, etc.).....	0	0

4. Storage practices

a) Are all empty bags stored on paletts?.....	0	0
b) Are all stacks at least 1 m apart?.....	0	0
c) Are insecticides, fertilizer and other products stored seperately from the grain?.....	0	0
d) Are all bags in the stacks without holes?.....	0	0
e) Are all stacks built in a safe way?.....	0	0
f) Are stack cards in use for all stacks?.....	0	0
g) Are the stock journals kept up to date?.....	0	0

5. Presence of pests

a) Is the store free of flying insects?.....	0	0
b) Are the walls free of crawling insects, larvae and pupae?..	0	0
c) Are the bags	0	0
d) Is the store free of evidence of rodents?.....	0	0
e) Is the store free of evidence of birds?.....	0	0

6. Pest control

a) Has any pest control treatment been done shortly before or during the inspection?.....	0	0
b) If so, what kind of treatment?.....		
c) Which pesticide has been applied?.....		
d) In case, bait stations against rodents are in use, are they furnished with fresh baites?	0	0

7. Recommendations

.....

.....

.....

.....

.....

.....

Inspector	Storekeeper
Name:.....	Name:.....
Signature:.....	Signature:.....
Date:.....	Date:.....

5.2.6 Equipment

The following equipment is necessary in order to correctly run a store:

- Pallets
- Brooms
- Shovel
- Rubbish bin (e.g. oil drum)
- Rake
- Bucket
- Sampler
- Sample container
- Magnifying glass
- Forceps
- Set of sieves (1.5 mm, 2 mm and 3 mm, plus other mesh sizes if necessary)
- Air thermometer
- Hygrometer or combined thermo-hygrometer
- Grain thermometer
- Grain moisture meter
- Torch
- Decimal scales (up to 1000 kg)
- Ladder
- Tape measure (20 m)
- Tool kit, containing
  - Saw
  - Hammer
  - Screwdriver
  - Pincers
  - Trowel
  - Nails, screws, etc.

The equipment required for pest control is listed in Chapters 8 and 9.

5.3 Further Literature

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