



TBT PROGRAMME
OVERCOMING TECHNICAL BARRIERS TO TRADE



Training Manual

Good Manufacturing Practices

Dry Beans Dry beans (*Phaseolus spp*)



Dried Beans

- Dry Beans
 - NIS xxx:2016 Standard for dry beans



Dry Beans – Key issues

- Fungal contamination of plants during growth
 - Effective cleaning and threshing
 - Proper drying of beans
 - Fungal contamination
 - Insect and animal infestation
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- Pesticide residues
 - Chemical and other contaminants

Dried Beans

S/No.	Characteristics	Maximum limits			Method of test
		Grade 1	Grade 2	Grade 3	ISO 605
(1)	Foreign matter, % m/m	0.5	0.75	1	
(2)	Inorganic matter, % m/m	0.1	0.2	0.3	
(3)	Other edible grains, % m/m	0.1	0.2	0.5	
(4)	Pest damaged grains, % m/m	1	2	3	
(5)	Heat damaged grains, % m/m	0.1	0.2	0.5	
(6)	Contrasting varieties, %m/m	0.5	1	1.5	
(7)	Broken/split % m/m	1	2	3	
(8)	Discoloured beans, %m/m	1	1	1	
(9)	Total defectives grains, % m/m	2	3.5	5.5	
(10)	Filth, % m/m	0.1	0.1	0.1	
(11)	Moisture, % m/m	14.0	14.0	14.0	ISO 24557
(12)	Total Aflatoxin (AFB ₁ +AFB ₂ +AFG ₁ +AFG ₂), ppb max	10			ISO 16050
(13)	Aflatoxin B ₁ only, ppb max	5			
(14)	Fumonisin ppm max	2			AOAC 2001.04
NOTE 1 The parameter, total defective beans is not the sum total of individual defects. It is limited to 70% of the sum total of individual defects.					
NOTE 2 Dry beans destined for processing baby foods shall have total aflatoxin level of not more than 4pp.					

S/N	Parameter	Limit	Test method
(1)	Arsenic (As) (ppm max)	0.1	ISO 27085
(2)	Mercury (Hg) (ppm max)	0.1	ISO 6637
(3)	Lead (Pb) (ppm max)	1.0	ISO 6633 (AAS)
(4)	Cadmium (Cd) (ppm max)	0.1	ISO 6561-1 or 6561-2

S/N	Parameter	Limit
(1)	Cypermethrin (mg/kg max)	0.05
(2)	Dichlorvos (mg/kg max)	0.01
(3)	dimethoate (mg/kg max)	0.02
(4)	Trichlorfon (mg/kg max)	0.01
(5)	Chlorpyrifos (mg/kg max)	0.05

S/No.	Type of micro-organism	Limits	Test Method
i)	Yeasts and moulds, max. per g	10 ⁵	ISO 21527-2
ii)	Staphylococcus aureus per 25 g	10 ³	ISO 6888
iii)	E. Coli, per g	Absent	ISO 7251
iv)	Salmonella, per 25 g	Absent	ISO 6579

Traceability

Safety

Quality

Pre – Harvest

Harvesting

Processing

Packaging

Storage

Customer Requirements

Legal requirements

Good Agricultural Practices

- Proper site selection is very important. Select a well-drained sandy loam soil for rain fed, or inland depressions and along the shores of a lake for dry season varieties using residual moisture. Beans does not tolerate excessively wet conditions or water logging and should not be grown on poorly drained soil.
- Clear the site of shrubs and stubble. Land can also be prepared manually with the African hand-hoe. Plow and harrow the field to provide sufficient tilth for good root growth.
- Make ridges thereafter if desired. Where the soils are more fragile and prone to erosion, adopt minimum or zero tillage



Monoculture dry beans

- Choice of seed(s) variety should meet the required standards as agreed between crop producers and customers.
- All seed(s) variety should be sourced from certified suppliers.
- Records of planting materials, variety name, variety purity, batch number and seed vendor should be kept.
- All clonal seeds should be sourced from reputable vendors with known historical yield performance of the parent materials.

Recommended Practices

Pre-Harvest

- Use of green manures or nitrogen rich fertilizers should be avoided as too much nitrogen may cause excessive vegetative growth, promote diseases and slow down natural production in the root nodules.
- Weaker seedlings should be removed by cutting them off at soil level being careful not to disturb the roots of other seedlings.
- Handling of beans when wet should be avoided as this may generate spread of fungus spores.
- The garden/plantation shall be kept clean and free of debris. Diseased plants should be removed.

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Dry beans and maturing pods

- A good number of pods may ripen while most of the leaves are still green.
- Seed moisture content is around 30-40 % physiological maturity.
- Pods are ready to be harvested as they turn light straw in colour and the seeds within turn brown or mottled in colour.
- At this stage air dry pods during 1-2 sunny days, pods become brittle and easy to break with pliable bamboo sticks.
- At threshing, the seed moisture content should be about 12 percent





Environmental hygiene in Harvesting Areas

- Potential sources of contamination from the environment should be identified.
- Primary production should not be carried out when there are potentially harmful substances that may contaminate the beans during harvest.

- Contaminants, pests and diseases of animals and plants shall be controlled in such a way as not to pose a threat to food safety.
- Materials needed for harvesting should be made clean and ready for harvest.
- Indeterminate varieties with an uneven maturity are usually harvested in several pickings, while determinate bush types are harvested all at once when most of the pods are dry. e moisture content of seeds will be about 18 percent.

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Module 1 : harvesting and handling

Exercise 1: **Harvest beans**

Suggested minimum instructional time: **40 minutes**

Learning outcomes

1.1 Identify the signs of maturity in beans

1.2 Harvest beans

Teaching strategy:

Learning activities for the trainee must include the instructor to:

- Identify and explain the signs and maturity of beans.
- Explain and demonstrate the methods of harvesting bean crops and state the advantages and disadvantages of each.

Assessment condition: Trainee must be given access to:

- i) information and handouts
- ii) mature bean field

Assessment criteria:

1.1.1 Signs of maturity in beans are identified correctly

1.1.2 Beans are harvested using the methods specified in the instructional notes of this module.

Assessment method: To demonstrate achievement of the above criteria the trainee will be given:

- oral questions
- or written questions
- Practical demonstration¹

Harvesting

- Depending on temperature and fresh market demands, beans are ready for harvest 16-17 days after bloom (60-90 days after planting).
- Harvesting should be done before the crop is too dry to avoid seed damage.
- The harvesting process shall be determined by cultivar choice and the harvesting season may continue over a 1-3 weeks period

Method of Harvesting

Dry beans can be harvested in three ways;

1. The beans are pulled by hand and threshed using a tractor
2. Partially mechanized system: the beans are pulled by hand and loaded into windrows where they are threshed with a stationary threshing machine.
3. Fully automated system: the beans are pulled mechanically and raked in windrows and threshed by means of an automated combine.



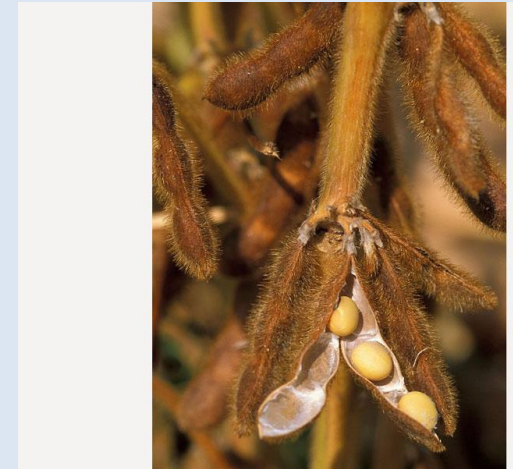
- If the harvest is mechanized and combine is used, a low drum speed is required to avoid splitting and cracking of beans.
- Beans should be harvested when the moisture content of the pods are temporarily high (to prevent shattering) i.e. early in the morning before the dew has evaporated.
- The pods should be opened to remove the beans within a few days after harvesting.

Storage after harvesting

- Harvested green dry beans will "heat" resulting in spoilage unless kept cool. Post-harvest facilities have to provide shade and adequate ventilation on the way to the cooler. Cowpeas cooled below 7°C may show chilling injury.
- It is recommended the grain be stored short term at around 12 % moisture or less, with 8 to 9 % recommended for long-term storage.
- Some buyers will want the seed cleaned and bagged, while others will take the grain in bulk form and clean it themselves

Causes of dry beans losses during maturity and harvest

- **pod shattering:** spillage of seeds from drying pods that split can be a problem, but losses are not usually serious unless harvest is delayed;
- **bruchid weevils:** these insects are not only serious storage pests of pulse crops but also they can fly to the fields to infest dry beans by laying eggs in cracks or cuts in the pods;
- **seed deterioration:** can occur soon after maturity if rainfall continues and seeds are not kept dry.



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EXERCISE 2: THRESH BEANS

Teaching strategy:

Learning activities for the trainee must include the instructor to:

- Explain the purpose of threshing bean pods

EXERCISE 3: DRY BEANS

Learning outcomes

3.1 Dry beans to the required moisture content

Teaching strategy:

Learning activities for the trainee must include the instructor to:

- Explain the reasons for drying beans
- Explain the required moisture content of properly dried beans
- Explain and demonstrate the ways for testing dryness of beans

Post- Harvest handling

Threshing

- Beans should be threshed to remove the seeds from the surrounding plant material.
- Seeds should be air-dried to 12% moisture level to avoid molding and decay of the seeds.
- Threshing should be done when humidity is low and soil on beans and weeds is thoroughly dry.
- Care should be taken during threshing not to break or damage the seeds.
- Threshing should be on a threshing rack to protect the beans from damage and dirt and prevent them from scattering.



threshing machine (URPATA/SAHEL)

- ✓ Dry beans can be threshed manually by beating the plants or bagged pods with sticks once they are dry enough.
- ✓ Or mechanically using a suitable threshing machine.

Drying threshed beans



- Threshed beans should be dried further to avoid molding during storage.
- Drying shall be done on mats, plastic sheets or wire mesh trays raised on a platform
- Beans should be turned intermittently to avoid overheating.



Dry beans minimum requirements

See the NIS standard



- a) The dried mature grains of *Phaseolus vulgaris* Linn; be well-filled, clean, wholesome, uniform in size, shape and colour
- b) Free from substances which render them unfit for human or animal consumption or processing into or utilisation thereof as food or feed;
- c) Free from abnormal flavours, musty, sour or other undesirable odour, obnoxious smell and discolouration;



d) Free from micro-organisms and substances originating from micro-organisms, fungi or other poisonous or deleterious substances in amounts that may constitute a hazard to human health.

The bean can be stored short term at around 12% moisture or less, with 8 to 9% recommended for long term Storage.

Sorting

Dry beans should be sorted after threshing to separate defective, split, shriveled and damaged beans from the bulk before storage. Sorting can be done in two ways;

- I. By Handpicking or
- II. By the use of treadle operated picking machines.

Grading

Seed must be graded at 8-9 percent moisture content or lower using 4.8 mm diameter round perforated sieve and 4.0 mm diameter for small seeded varieties.

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Packaging

- Dry beans shall be packed in suitable packages which shall be clean, sound, free from insect, fungal infestation and the packing material shall be of food grade quality and shall be securely closed and sealed.
- Dry beans shall be packed in containers which will safeguard the hygienic, nutritional, technological and organoleptic qualities of the products.



- Each package shall contain dry beans of the same type and of the same grade designation.
- If dry beans are presented in bags, the bags shall also be free of pests and contaminants.

Labelling (See Standard)

Each package shall be legibly and indelibly marked with the following:

- i) product name as “Dry beans”;
- ii) variety;
- iii) grade;
- iv) name, address and physical location of the producer/packer/importer;
- v) lot/batch/code number;
- vi) net weight, in kg;
- vii) the declaration “Food for Human Consumption”



- viii) storage instruction as “Store in a cool dry place away from any contaminants”;
- ix) crop year;
- x) packing date;
- xi) instructions on disposal of used package;
- xii) country of origin;
- xiii) a declaration on whether the dry beans were genetically modified or not.

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Importance

- Maintaining regular supply throughout the year,
- Sale in times of scarcity at high prices to fetch more money,
- Preservation of seeds for planting at the next cropping seasons and it also encourages Price stabilization when Governments buys surplus cowpea at time of harvest at low prices and release them periodically in times of scarcity to force prices down and prevent inflation

RECOMMENDED PRACTICES FOR DRY BEANS STORAGE

- Dry beans should be harvested promptly as soon as they mature to avoid infestation on the field.
- Beans should be dried properly to moisture contents below 12%. Properly dried grains are less easily attacked by insects and fungi.
- Stored beans should not be kept on the bare floor to avoid migration of moisture to the cowpea.
- Dry beans for storage should be healthy, not broken or damaged as this encourages insect infestation.

- Storage of dry beans may be done in rumbus, steel drums/tins, polythene bags or silos. The storage structures should be air-tight to starve the insect of oxygen.
- Rumbus should be properly cleaned before use for storage.
- Cracks on the walls, roof and floor of rumbus should be mended to deny insects of hiding places.

Use of good storage structures

1. Breeding for storage
2. Solar dis-infestation
3. Genetic transformation
4. Hermetic storage-Air-tight storage-PLCs-

Solar dis-infestation

- The output is a simple but effective solarisation technique, which harnesses the power of the sun to reduce pest damage on stored cowpea to acceptable levels.
- In Nigeria, the sun is a powerful and reliable source of energy and simple technologies can make use of this free resource.
- Appropriate exposure of dry beans to the sun can lead to a temperature rise sufficient to kill most if not all of the pests - eggs, larvae and adults - on and inside the grains.
- Germination tests showed that beans stored for seed remains viable.



The technique are as described below:

- ✓ Dried beans are spread in a thin layer on a flat area of ground where sun exposure will be high for a whole day. The ground should be cleared of debris.
- ✓ To avoid contaminating the beans and to improve temperature retention, locally available (e.g. straw) mats are first arranged on the floor and covered with canvas or tarpaulin.
- ✓ The layer of dry beans on the canvas should not be thicker than 2 or 3 cm (1 finger's joint when probing the grain

- ✓ The spread dry beans are covered with a thin transparent polythene sheet, which is held in close contact to the bean with weights (stones etc).
- ✓ It is important to keep animals (goats, chicken etc) away from the beans during the treatment.
- ✓ Sacks or containers in which the bean is stored should be cleaned during exposure to the sun to avoid re-contamination.
- ✓ Repeated monthly during the storage season, this treatment offers very good levels of protection for a limited initial investment.

Dry beans storage (Hermetic)



- Recent evolution of pesticide-free post harvest hermetic storage for dry commodities as now used in 81 countries for the storage of grain and other commodities.
- Flexible plastic structures have been developed and applied to long-term storage. A growing number of types of such hermetic containers now exist especially for tropical conditions.

- Hermetic storage is particularly important in tropical and semi-tropical areas with their elevated temperatures and high humidity.
- Insects multiply best at 30°C, as well as at humidity levels above 65% and molds grow exponentially above the critical moisture level. Growth of mycotoxins produced by molds, including aflatoxins and ochratoxins is inhibited by both the lack of oxygen and lack of moisture.

- First introduced in the late 1980s, hermetic storage (HS) can now replace older post harvest storage methods.
- Hermetic storage has become a replacement for older storage methods, particularly in hot, humid climates because of its “green”, chemical-free technology, control of moisture content, avoidance of pesticides and of need for refrigeration. It can achieve 100% “kill” of insects and control of molds and free fatty acids (FFAs).

- Hermetic storage features flexibility of installation (indoors or outdoors), portability, and attractive cost.
- The simple principle involved in hermetic storage is to control moisture and allow depletion of oxygen with increase in CO₂ through respiration of both the commodity and insects.
- Typically at room temperature or above this creates an unbreathable, low oxygen atmosphere within a few days, and reduces storage losses to <1%.

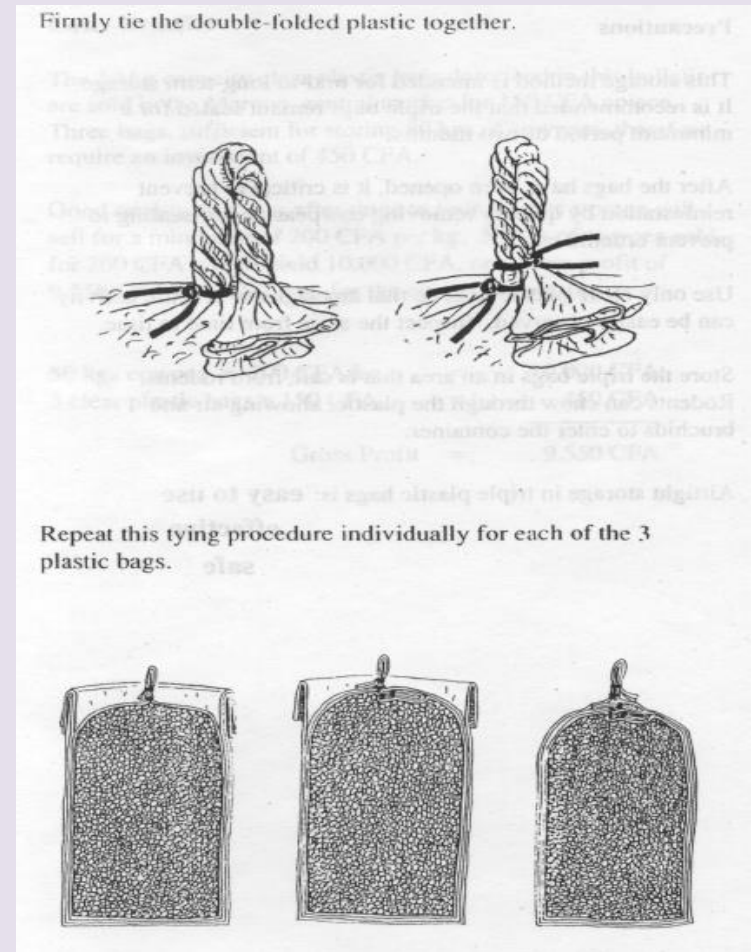
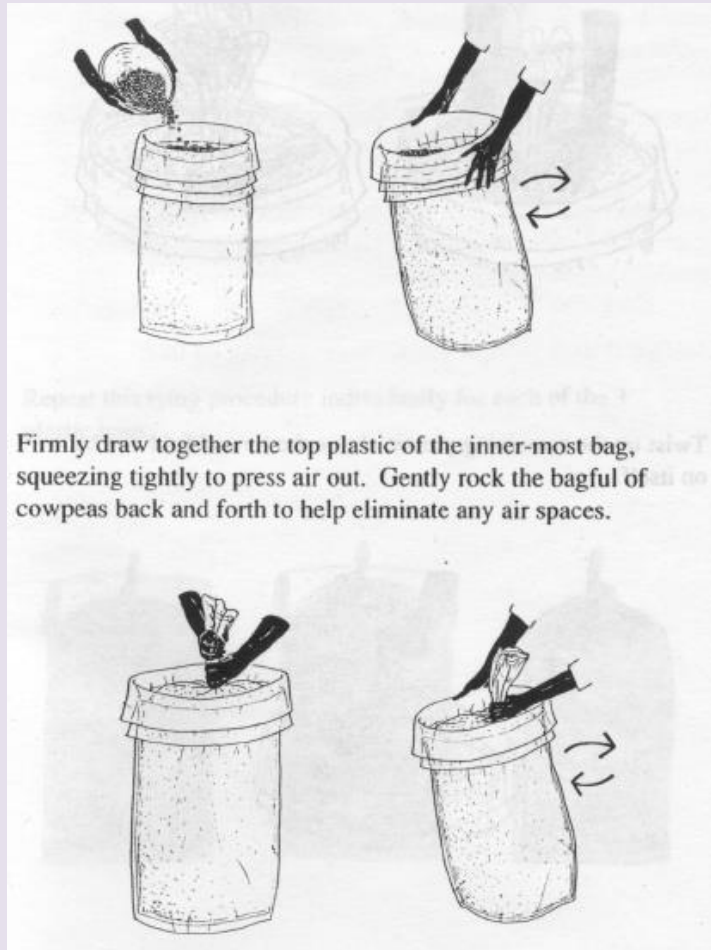
TYPES OF HERMETIC STORAGE



1. **Steel Drums/Tins**-Dry beans storage in steel drums and tins is a form of hermetic storage where the storage structures are air-tight. No chemical is used for this storage.

2. **Polythene bags-** The method like other hermetic storage structures may require no chemical
3. **Silos-** Butyl rubbers or aluminium silos may be used. These are suitable for large scale storage of threshed dry beans and are recommended mainly for companies, ministries and co-operatives. Dry beans stored in silos may be fumigated every three months starting from two or three weeks of storage

The tripple bagging (hermetic) technology





Thanks

www.acp-eu.tbt.org



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