UNIVERSITY OF NAIROBI

SEED ENTERPRISE MANAGEMENT INSTITUTE (SEMIs) SHORT COURSES

2015 SERIES OF LECTURES, PRACTICALS AND FIELD TOURS

1.Seed Production

2.Seed Drying, Processing and Storage

3.Seed Business

4.Seed Marketing

5.National Plant Protection Organizations (NPPOs) and Seed Quality Regulators

6.Seed Production Field Diagnostics

7.Seed Quality Assurance and Seed Quality Management

Compiled By:

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Acknowledgements:
School of Business, University of Nairobi
Seed Centre, Iowa State University
CYMMIT, Zimbabwe
International Consultants – Aline, F. O'Connor, Dilip Gokhale
KALRO
KEPHIS
Seed Companies: Kenya Seed, Leldet, Drylands Seed
University of Nairobi Library – Mugo, H. and Mioru, G.

SEED ENTERPRISE MANAGEMENT INSTITUTE (SEMIS)

OVERVIEW OF SEMIS TRAINING MODULES

Mwang'ombe, A. W., Olubayo, F. M., Njoroge, K.

Growing Africa's Agriculture

IOWA STATE UNIVERSITY

CIMMYT
International Maize and Wheat Improvement Center

Project Implementation

Alliance for a Green Revolution in Africa-AGRA

Total funding:4,495,432.00 USD

Phase 1: 3 years (2010-2013),Phase 2-2014-2016

Institutions

University of Nairobi

PI: Prof. A.W. Mwang'ombe

Management: Prof. F. Olubayo, Prof. Kiarie Njoroge

Daniel Wasonga –Project Manager, Florence Kiwunja-Admin. Asst., Francis Maina, Caroline Ndumi, B. Kirangu -Field Assts

CIMMYT:	KEPHIS:	KARI:	Consultants	ISU
Dr. John MacRobert (Author-Seed Business Mgt In Africa)	DR. Esther Kimani-Director KEPHIS Mr. Kibet	Dr. Riungu and Dr. Ragwa	Aline O'Connor Funk Paul Seaward Paul Okete	Dr. Misra Dr. Y. Shyy Dr. Joe Cortes Dr. Mike Stahr

SEED ENTERPRISE MANAGEMENT INSTITUTE (SEMIs)

Overall Goal

•Eradication of food and nutrition insecurity through capacity building of seed actors .

- •quality seed
- •affordable seed

Objectives:

1. To produce seed production and marketing management expertise in SSA region

2. To train seed industry practitioners on the best practices to efficiently produce adequate high quality seed for farmers.

3.To enhance production of seed of improved varieties for the SSA

- Efficient production
- Marketing
- Good distribution

4. To strengthen the capacity of the SSA region to train on seed production and marketing management strategies

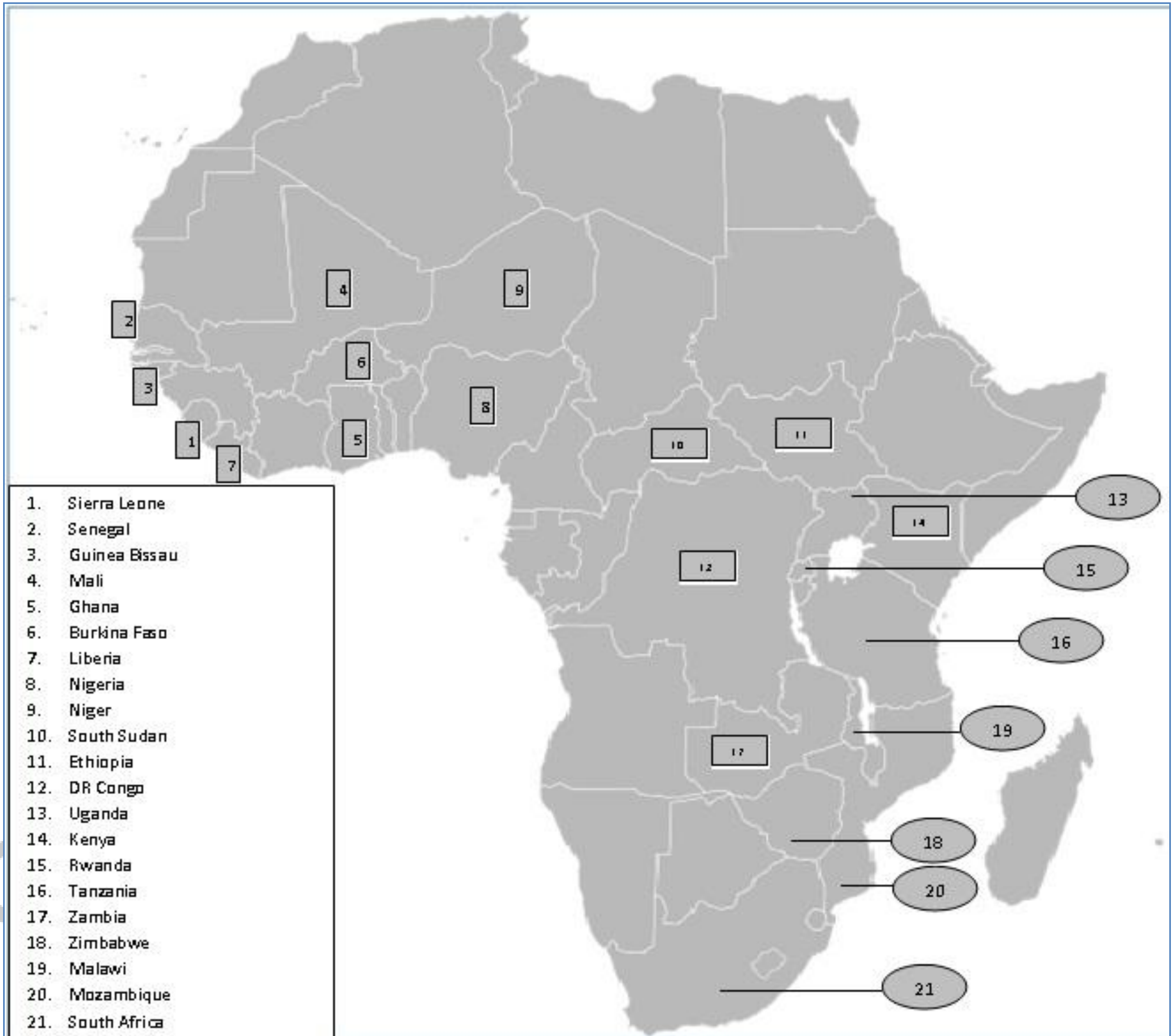
- Enhanced technology

5.To develop a regional capacity to facilitate information sharing on seed issues and related disciplines in SSA.

Growing the Seed Industry in Africa


SEMIs PARTNERSHIPS
agra-alliance.org
uonbi.ac.ke
UoN
CIMMYT
ISU
SEMIs
KARI, KEPHIS
KENYA SEED
CONSULTANTS
AGRA
cimmyt.org
iastate.edu
kephis.org
kenyaseed.com
GROWING THE SEED INDUSTRY IN AFRICA

SEMIs in 21 African Countries!!!



SEMIs COURSES AT UON:

Course	Collaborators	Coordinators
Seed production	UoN, CIMMYT, KEPHIS, KALRO, Leldet seed co.	Prof. Kiarie Njoroge/ Prof. Olubayo
Seed drying processing and storage	UoN, ISU, KEPHIS, KALRO, Kenya seed Co.	Dr. Onyango Mbunge, Prof. Kiarie Njoroge, Prof. Olubayo
Seed marketing	UoN (sch of Bus), Aline O'Connor, Kenya seed Co.	Dr. Justus Munyoki, Prof. Kiarie ,
Seed Business Mgt.	UoN (Sch. Of Bus.) Aline O'Connor, Kenya seed Co.	Prof. Evans Aosa, Prof. Olubayo, Mr. Herick ondingo
Seed Quality assurance and Seed Enterprise Quality Management	UoN, ISU, KEPHIS, KALRO, Kenya Seed Co.	Prof. Olubayo, Prof. Muthomi, Prof. RD. Narla,
Seed Production Field Diagnostics	UoN, KEPHIS, KALRO, Kenya Seed Co.	Prof. Olubayo, Prof. Muthomi/Prof. Narla/Prof Mwang'ombe
National Plant Protection Organizations (NPPO)	UoN, KEPHIS, KALRO, Kenya Seed Co.	Prof. Kiarie, Prof. Olubayo

SUMMARY OF TRAINED PERSONNEL IN PHASE I – 2010-2013

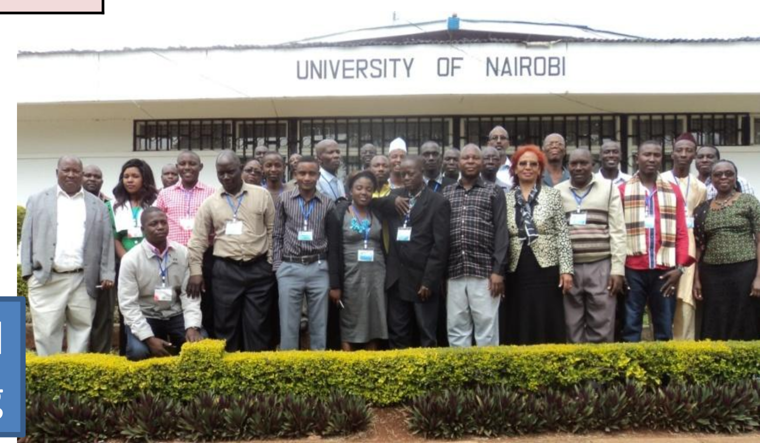
Course	2010	2011	2012	2013	Total Per Course
Seed Production	29	27	30	0	**86**
Seed Drying Processing and Storage	31	28	30	0	**89**
Seed Business Management	29	26	29	25	**109**
Seed Marketing	28	25	30	27	**110**
Seed Quality Assurance	30				**30**
Seed Legislation and Accreditation	25				**25**
Seed Quality Assurance and seed Enterprise Quality Management		26	29	0	**55**
Total(Yearly)	**172**	**132**	**148**	**52**	**504**

SUMMARY OF TRAINED PERSONNEL IN PHASE II – 2014-2016

Course	2014	2015
Seed Production	23	26
Seed Drying Processing and Storage	23	25
Seed Business Management	19	30
Seed Marketing	20	31
Seed Quality Assurance and seed Enterprise Quality Management	19	30
National Plant Protection Organizations and Seed Quality Regulators	21	24
Seed Production Field Diagnostics	18	24
Total(Yearly)	**143**	**190**

Seed processing and drying

Seed production



Seed Marketing

Long Term courses in Seed Technology and Business:

Curriculum already in place for:

I. Certificate-Seed Technology and Business
II. Diploma -Seed Technology and Business
III. Post-graduate Diploma-Seed Technology and Business
IV. MSc.-Seed Technology and Business

15 Students have enrolled for the MSc. Seed Technology and Business program

SEMIs Curricula

- Involvement of stakeholders in the development;
- ISU, Consultants, CIMMYT, UON, KARI, Seed Companies
- Annual Review every year to keep abreast on seed Issues and changing trends in the seed industry

Result

One of the best "thought-through" and relevant curricula in Africa focused on seed

World Class Facilitators:

John MacRobert-CIMMYT

Kiarie Njoroge-UON CAVS

Jenny Leakey-Leldet

Dr. Yuan Shyy-ISU

Aline O'Connor –Seed Business mgt

Dr. Joe Cortes-ISU

KEPHIS

TRAINED PERSONNEL ARE A GREAT ASSET FOR SEED COMPANIES:

The training at SEMIs is helping Scaling up production of high quality seed for farmers around Africa

Dry Land Seed co.

So far over 100 seed companies from 21 African Countries have benefited from training at SEMIs

Other Activities at SEMIs:

Foundation seed production at CAVS:

Varieties:

- Meizi mbili
- Kenya Wonder
- Kenya Red Kidney
- Kabete Super
- Kenya Sugar Bean
- Super Rosecocco

Provision of foundation seed for seed co.

White label seed produced at SEMIs

Year	Tonnage	Variety
2013	1.76 tonnes	Kenya Red Kidney, Meizi Mbili
2014	4.3 tonnes	Kenya Red Kidney, Kabete Super, Miezi Mbili

Presentation of White label breeder seed to Kenya seed company CEO. Mr. Soi at a ceremony at CAVS

"Seed companies all over Africa indicate foundation seed availability and access as a major contributor to low seed production"

SEMIs INFRASTRUCTURE DVPT

Modern Seed laboratory and Seed Processing facility being constructed at CAVS with SEMIs funds

Phase 1: Seed Processing Unit.

•Seed from UNISEED and other seed companies to be processed

Phase 2: Modern Seed Laboratory for Seed Quality Assurance

•Seed Quality Laboratory

Phase 1: Seed Processing Unit

Construction of Seed processing factory is complete. The factory to process over 5000 MT of seed

•Installation of seed processing machines ongoing.
•Expected handover date- Early August 2015



PHASE II: LABORATORY CONSTRUCTION

- Construction of seed laboratories is ongoing- 90% is complete
- Painting works and fittings ongoing with expected handover – End September, 2015

Participation in National and Regional Workshops and Meetings on Seed Issues

Agricultural Sector Development forum- Kibaki in attendance

Kenya-Agricultural transformation Day in Nairobi

Other meetings	Year
FARA Meeting	2011
KARI congress	2012
STAK congress	2013
ASK Show	2014

H.E. Mohamed Shein Pres. Of Zanzibar at the AFSTA-Congress Zanzibar

SEMIs at the ASK show in Nairobi

Rosebenna from SEMIs talks to farmers on the New Bean Varieties

SEMIs is a point of call for seed companies:

Seed company personnel with STAK officials call in at SEMIs

- Agricultural /Seed Institutions are using SEMIs as a port of call during meetings and visits

- Point of reference for seed trends.
- Need to platform this to become the leading seed reference point in Africa

Highlights ..

Experiential training-Visit to the seed industry

Training on Finance and capital Acquisition:

-Root capital and ASIF funding Experts at SEMIs

Collaboration with Stakeholders and Experts:

Dr. Julius Kipng'etich-Director, Kenya Wildlife Services (KWS)

Guest lecture at the seed business module course

Observed Changing trends in the Seed Industry in Africa…..

"as I move across Africa, I see African Farmers have changed their strategy to improved seed"

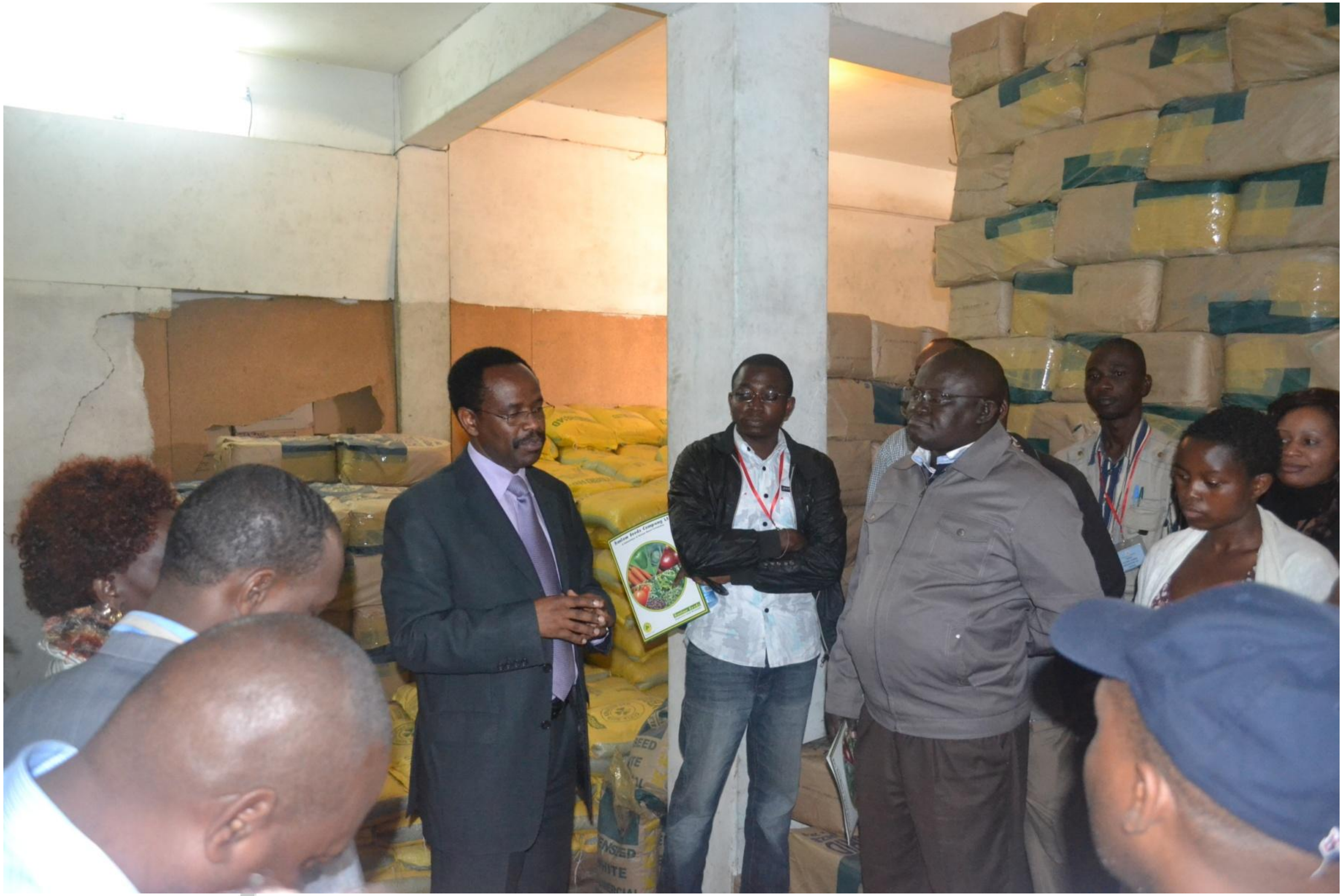
Dr. Joe DeVries-Director, PASS

Highlights contd:

Seed Production May 2012:

Visit to KARI Wheat Rust Resistance Breeding Station-Njoro

Seed Marketing Course-July 2012



Participants with the MD-Simlaw Seed company Mr. Soi

Seed Business Management-2013

Visit to Dry land Seed company seed store in Machakos

Seed Processing Course 2014

Familiarization with Certified seed packaging at a seed company in Kenya

Working with consultants to enhance capacity Building

Seed Business Class with Dilip Gokhale

Graduation –Certificate presentations:

Joe DeVries-Director Pass presents certificate and books to participants

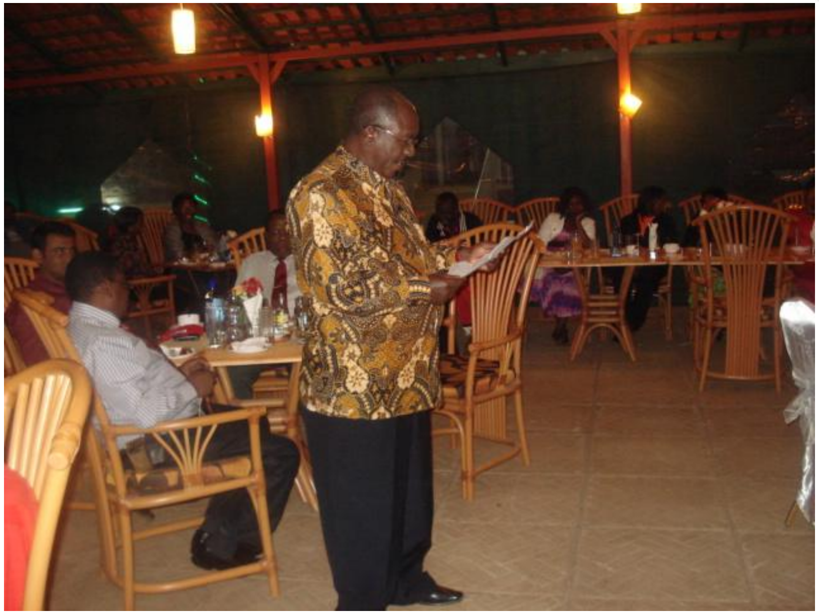
Prof. Mwang'ombe-SEMIs PI presenting a certificate to Janet Gyima from Ghana

Rewarding our Participants with certificates at the end of each course motivates them to be better "seed men"

Comments from Participants:

"I like every topic we did in this course especially seed certification and de-taselling "
Annonymous .

"The knowledge I have acquired through the course will be highly valued not only in our seed company but in the whole of Zambia"
Dorica Banda
Indigenous seed company Zambia



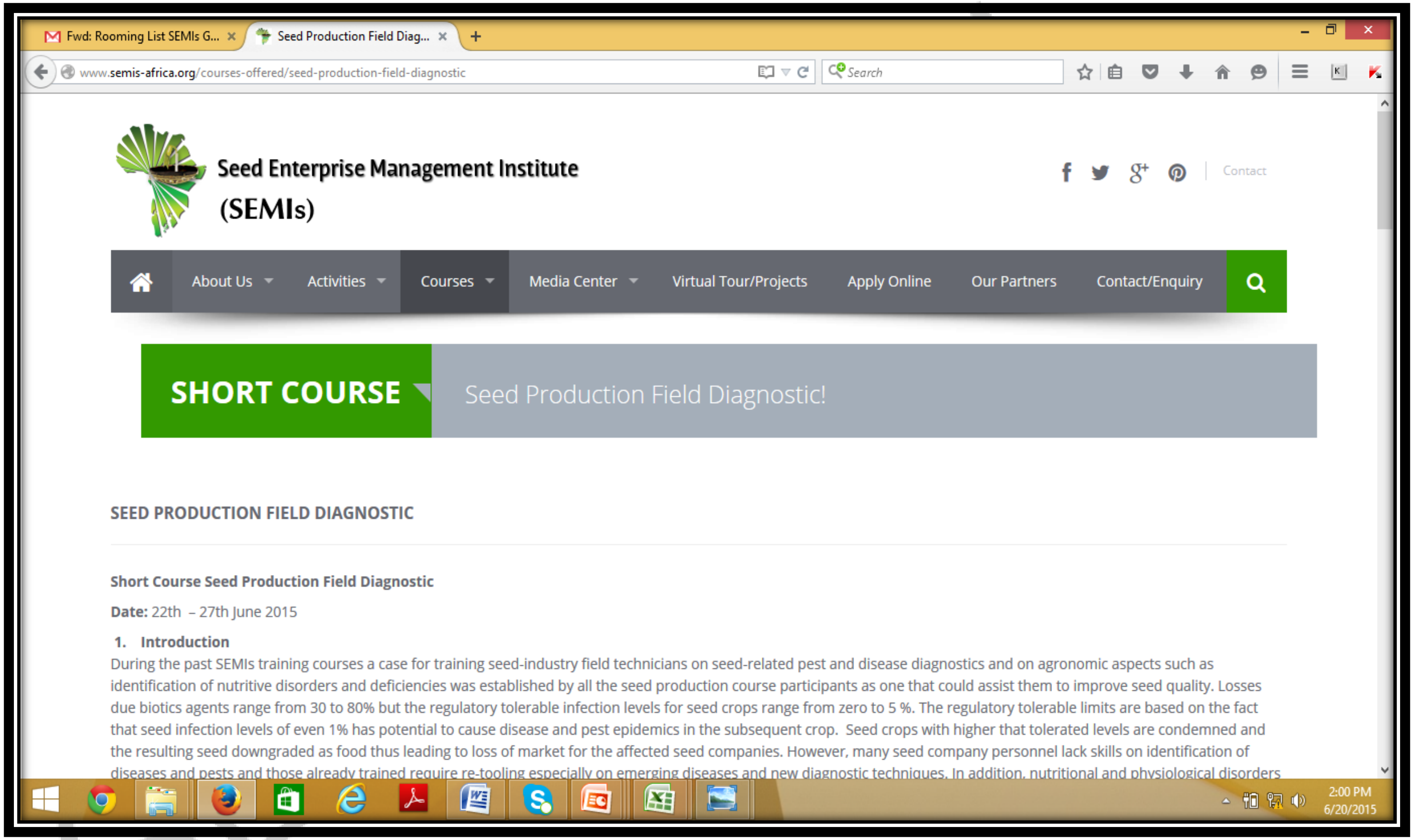
"Previously I did not know how to project seed requirements and co-ordinate backwards for procurement of basic, pre-basic seed..." Now I know"
Mr Omari Mduruma-Aminata seed company Tanzania

Monitoring and Evaluation:

A monitoring and Evaluation team from AGRA visited SEMIs on 19th February 2012 to assess the project

SEMIs Website:

www.semis-africa.org



- Sharing information on seed issues, current happenings in the seed industry in Africa
- Staying in touch with SEMIs participants
- Online registration of Students

Thank you for your attention

SEED DRYING PROCESSING AND STORAGE

- By Prof. Florence Olubayo

Contents

SOME POST HARVEST INSECT PESTS THAT THREATEN FOOD SECURITY

Prof. F. Olubayo

Introduction

- Factors such as storage duration, prevailing environmental conditions and crop varieties influence insect populations development and losses incurred.
- Inadequate storage methods lead to losses in stored grain sometimes of unacceptable magnitude in SSA.
- These pests inflict both direct and direct damage to the grain, and the most important ones start in the field.

Damage caused

Direct damage

- Kernel damage,
- Contamination,
- Grain dust,
- Damage to wooden structures and other containers

Indirect damage

- Dry grain heating and moisture migration in storage
- Lowered germination of seed grains
- Distribution of molds and other organisms through the grain mass
- Insect fragments in cereal products

THE GRAIN MOTH(*Sitotroga cereallella* (ol.)

- Small straw coloured moth (wing span 10-18mm)
- Able to fly from infested grain in store to the field
- Infests maturing cereals in the field
- Infestation can also occur at store levels.
- Damage:- small circular 'windows' and holes on the grain
- Causes severe damage to cereals stored mainly in unthreshed form
- Grain attacked:- maize, sorghum, wheat, paddy & barley.

SITOTROGA CEREALELLA
(Angoumois Grain Moth)

MAIZE AND RICE WEEVILS (*Sitophilus* spp.)

- Dark brown weevils (2.5-4.5mm long)
- Able to fly from infested grain in store to the field.
- Infests maturing cereals in the field
- Infestation can also occur at store level
- Damage: Small circular holes on the surface of the grain
- Causes severe damage to grain stored in both threshed and unthreshed form
- Grain attacked:- maize, millet, sorghum, wheat, barley and rice

***SITOPHILUS* spp.**
(Maize and Rice Weevils)

LARGER GRAIN BORER (*Prostephanus truncantus*(H.)

- A dark brown cylindrical beetle (3-4.5mm long)
- Able to fly form infested grain in store to the field
- Infests maize in the field before harvest
- Infestation can also occur at store level
- The beetle eats tunnels and holes in the husks, grain and cob.
- Very serious pest that also eats into the wooden store structures
- Also feeds on dried cassava

PROSTEPHANUS TRUNCATUS
(Larger Grain Borer)

PULSE BRUCHIDS (BEETLES)

- THE BEAN BRUCHID (*Acanthoscelides obtectus* (say)).
- Grey to brown oval beetles (3 – 4.5mm long)
- Able to fly from infested grain the the store to the field
- Infestation can also occur at store level
- Damage:- small dark 'windows' and holes on the grain
- Causes serious damage to stored beans

ACANTHOSCELIDES OBTECTUS
(Bean Beetle)

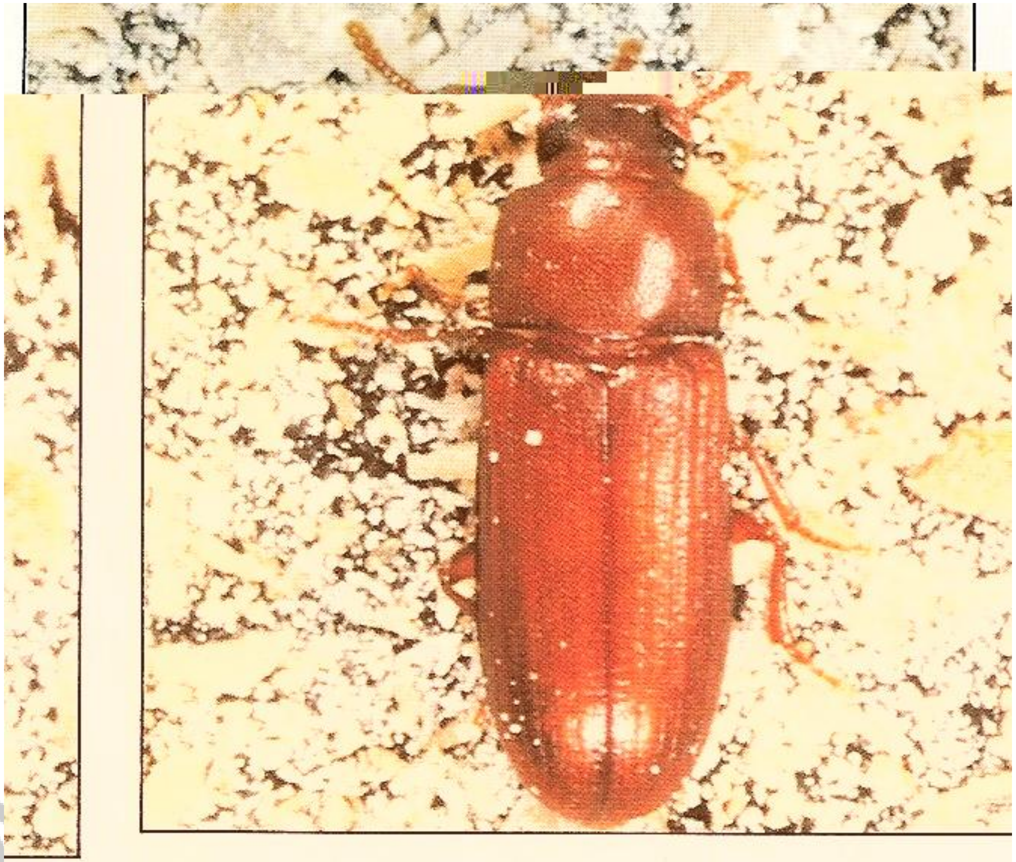
THE COWPEA BRUCHIDS (*Callosobruchus* spp)

- Light to dark brown beetles (2.0-3.5mm long)
- Able to fly from infested grain in stores to the field
- Infests maturing legumes (cowpea, pigeon peas, chick peas and grains) in the field
- Infestation can also occur at store level
- Small dark 'windows' and holes on the grain indicate infestation by the bruchids
- Causes serious damage to stored pulses.

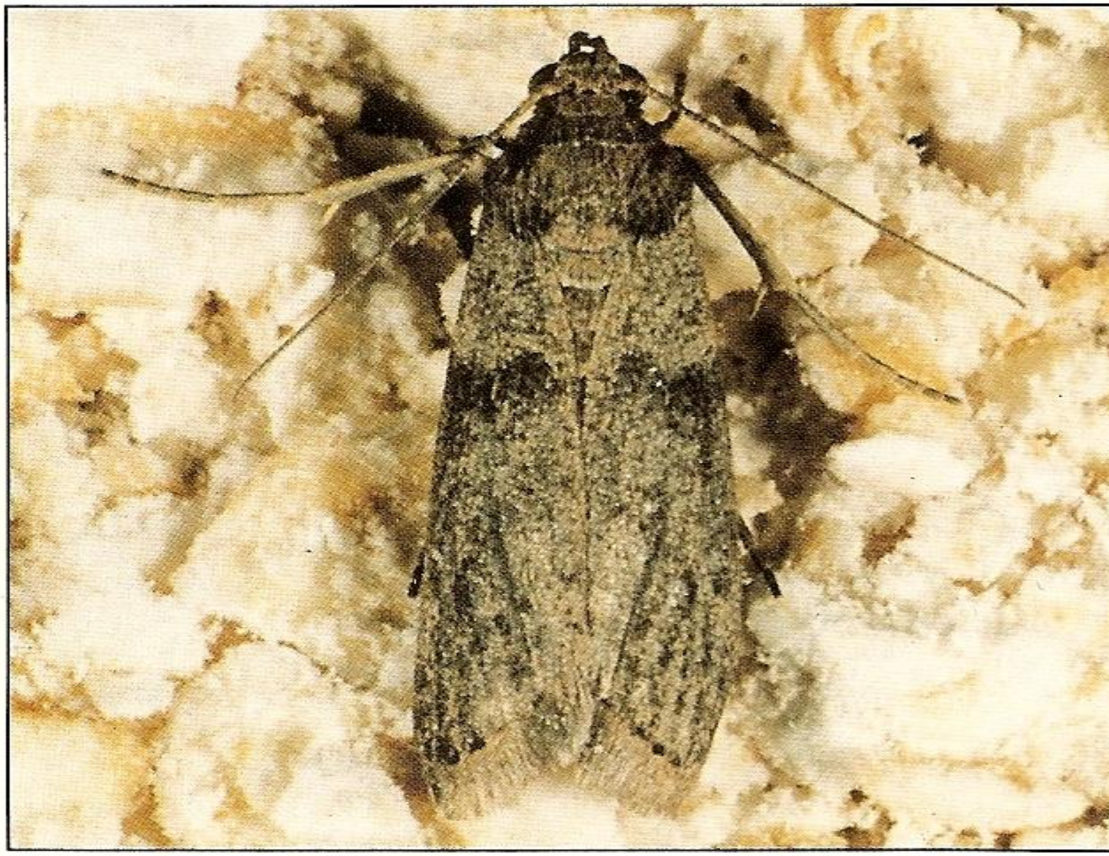
Callosobruchus spp.

THE FLOUR BEETLE (*Tribolium* spp)

- Reddish brown flat beetles (2.5 – 4.5mm long)
- Infests stored (broken) grain and milled products
- Causes high level of gram contamination
- Presence of reddish brown beetles, cast skins and faecal pellets on damaged grain and milled products indicates infestation by these beetles.
- Serious secondary pests of all stored grain and milled grain products



TRIBOLIUM CASTANEUM
(Rust-Red Flour Beetle)



***EPHESTIA* spp.**
(Tropical Warehouse Moths)

Several species of *Ephestia* may be encountered in tropical stores. They attack a wide range of products particularly damaged or processed cereals, dried fruit, nuts, cocoa and even tobacco. Only the larvae feed. They also leave trails of silk which can form a thick webbing over and in the stored food. Reconditioning food to remove webbing can be very costly.
(Wing span 11-28 mm)

Some Management Practices

Post- havest Insect pest control should begin before the crop is mature and must definitely begin before it is harvested and put in drying structures.

Proper program for insect control include:

- Select plant varieties with good husk cover and inherent resistance to field and storage pests

- Repair the store and thoroughly clean before the new crop is mature.
- Clear the surroundings of the store of any waste that can harbor insect pests
- Harvest early to avoid field infestation
- Dry the grain as fast as possible and shell it when dry
- Shell carefully to avoid damage to the kernels
- Treat the dry grain with an appropriate insecticide

- Carry out regular inspections of the stored grain to detect any infestation and take control measures as necessary
- Carry out principles of good store management , including maintenance, stock rotation and hygiene.

- **By Dr. Yuh-Yuan Shyy**

Contents

1. Seed Processing - Basic Concepts & Techniques in Seed Processing
2. Pre-Cleaning and Air-Screen Cleaning
3. Sizing and Texture/Surface Separation
4. Gravity Separation
5. Seed Plant Design
6. Seed Treating Equipment

Introduction of

Seed Processing

- Basic Concepts & Techniques in Seed Processing

Dr. Yuh-Yuan Shyy

Scientist/Sr. Engineer/IT Management
Seed Science Center
Iowa State University, Ames, Iowa USA

192 Seed Science Center, email: yshyy@iastate.edu

Seed Processing – Why?

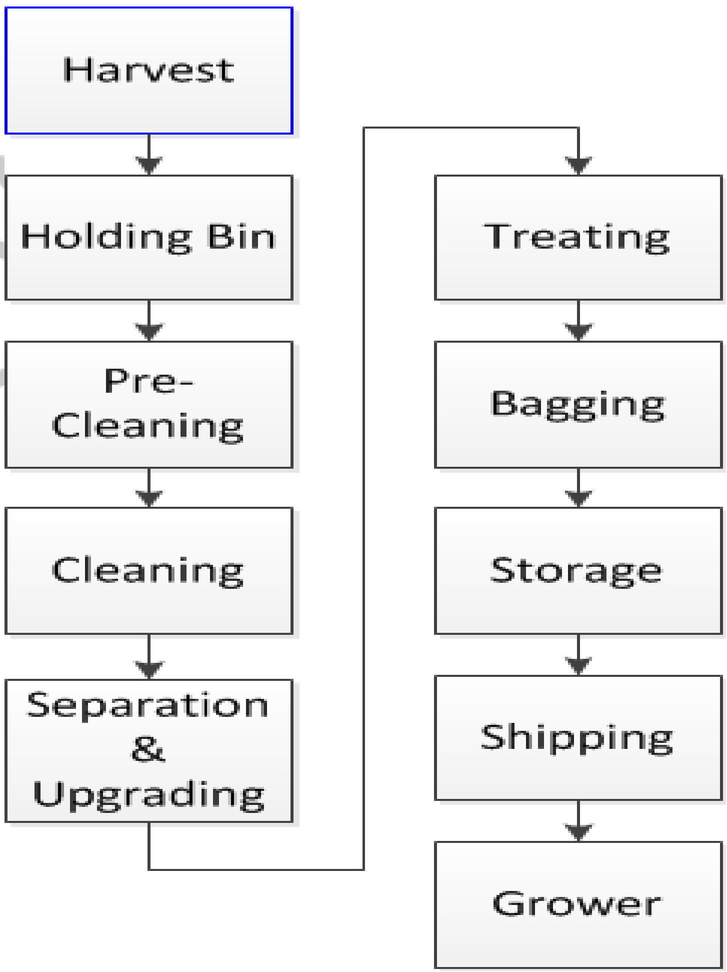
1. **Complete separation:**
   - Removal of all contaminating or undesirable material from the seed and improve appearance/uniformity
2. **Minimum seed loss:**
   - Keep good seed loss at a minimum
3. **Upgrading quality:**
   - Removal of bad, injured, or low quality crop seed
   - Add protective or remove moisture to maintain seed quality
4. **Efficiency:**
   - Highest capacity with effectiveness of separation
5. **Minimum labor requirement:**
   - Labor is direct operating cost and not recoverable

“Seed” vs “Grain”

SEED	GRAIN
Planted and reproduce	Consumption & industry
Embryonic structure is critical	Dry matter, foreign material, MC%
Germination, purity, health, and vigor	POS (Protein, Oil, Starch), and fiber
Slow drying to minimize heat damage	Fast drying to save cost
Chemical treatment to maintain quality	Hardly any chemical treatment
Sold by … corn)	Sold by …
Seed P…	**Food P…**

Flow Diagram for Seed Processing

- Limiting mechanical damage:
  - Reduce speed (RPM)!
  - Avoid at partial capacity
- Avoid varietal contamination
- Maintain quality in storage:
  - Limit incoming moisture
  - Limit FM or damaged seeds
  - Pre-clean seed before storage
  - Properly aerate
  - Careful drying to reach safe MC

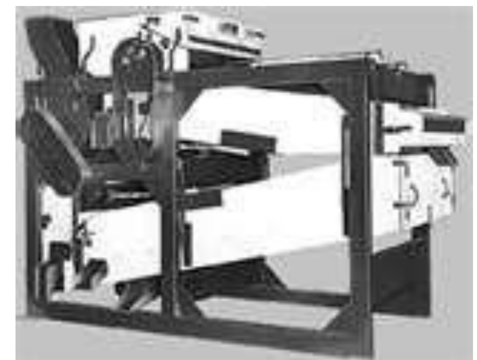


Basis of Separation:

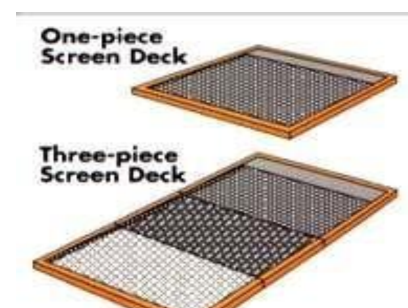
- Seed processing is based on differences in physical properties between the desirable seed and the contaminating weed, other crop seeds or foreign material
- The "difference" can be in:
  - SIZE
  - LENGTH
  - WIDTH/THICKNESS
  - WEIGHT/SPECIFIC GRAVITY/TESTWEIGHT
  - SHAPE AND SURFACETEXTURE
  - COLOR
  - OTHERS??

Basic of Separation - Size

- Size is the most common difference among seeds, and between seed and undesirable material
- The air-screen cleaner uses a series of perforated sheet metal or woven wire screens to separate seed of different sizes
- Seed size distribution and screen selection
- Two types of screen sizing are made:
  - SCALPING - Oversize material is removed
  - SIFTING – Undersize material is removed



- A series of scalping and sifting operations remove all material larger or smaller than the crop seed
- Factors effect "Screen efficiency" and "Capacity"
  - Openings, feed rate, slope, and RPM



Basic of Separation - Length

- Length differences are common among crop seed and weed seed, and are frequently used to upgrade and improve quality
- Both the indented cylinder (A) and the disc separator (B) make length separations.

A. Indented cylinder

B. Disc separator

Basic of Operation – Width/Thickness

- Width and thickness are special size dimensions used in operations such as sizing seed corn into specific widths and thickness for space-planting
- Thickness separations are made by turning the seed on edge or standing it on end to present its thickness dimension to perforations of specific size (A) cylinder
- Width separations are made by round-hole perforations at the cup-like depressions in cylinder (B)

A. Slot-hole cylinder

B. Round-hole cylinder

Basic of Separation - Weight

- Many seeds differ in weight, specific gravity, or test weight
- Weight or specific gravity is the effective separation principal in the air-blast separation in air-screen machines (TerminalVelocity?)
- Gravity separator, stoner, and the aspirator are all designed to make specific separations by differences in weight or specific gravity of seed (Fluidization? Specific Gravity of water=?)

Gravity Separator

Stoner

Aspirator


Gravity Separation

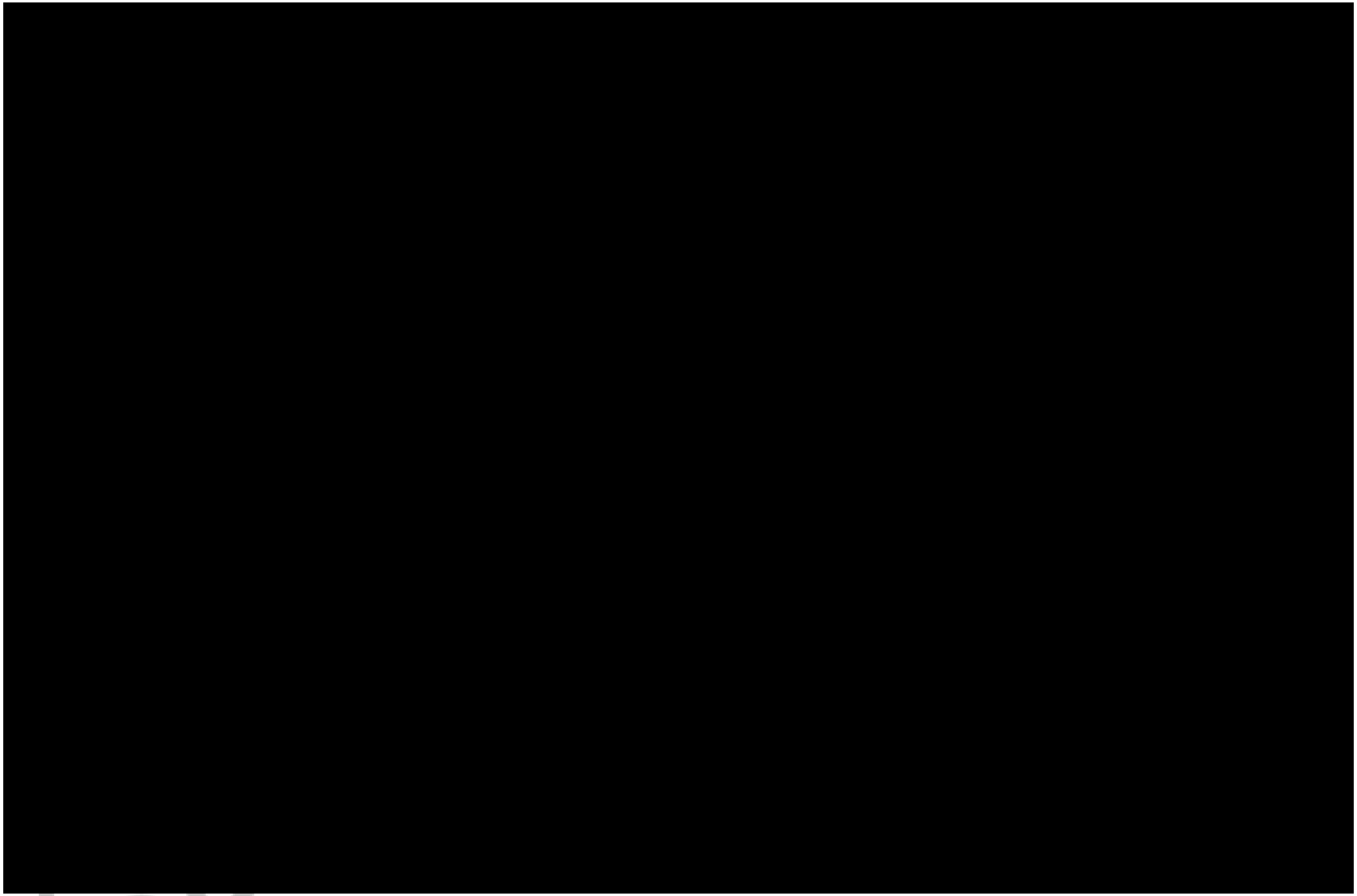
Basic of Separation – Shape & Texture

- Spiral separator is designed especially to separate round from flattened seed or round whole seed from the splits
  - A simple vertical series of spirals flights to allow seeds to roll or slide down by gravity. Round one will roll over the inclined edge of the inner flight of spirals

- Relative roughness or smoothness of the seed coat – surface texture – is a common difference between seeds.
  - The roll or dodder mill, the draper belt , the magnetic separator, the buckhorn machine and vibrator separator all effect separations of seeds differing in surface texture

Basic of Separation – Color

- Many seeds differ in color or reflectivity. Color separations are used more and more in processing, particularly with the larger crop seeds
- Electronic color sorters make color separations. These machines present each seed to electronic sensing devices which compare the seed with an electronic pattern or a given color background. If the seed is color hue or reflectivity is acceptable, it is allowed to continue to a discharge spout. Seeds not in the acceptable range of color hue or reflectivity are divided from the main stream by compressed air or other devices.



Pre-Cleaning and Air-Screen Cleaning

Dr. Yuh-Yuan Shyy

Scientist/Sr. Engineer/IT Management
Seed Science Center
Iowa State University, Ames, Iowa USA

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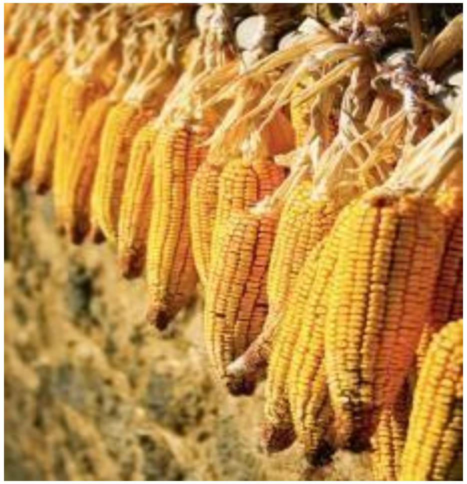
Pre-Cleaning Operation:

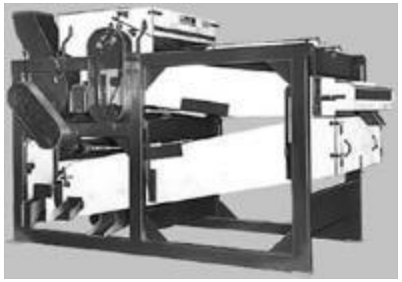


- Before harvest
- Before cleaning
- After cleaning

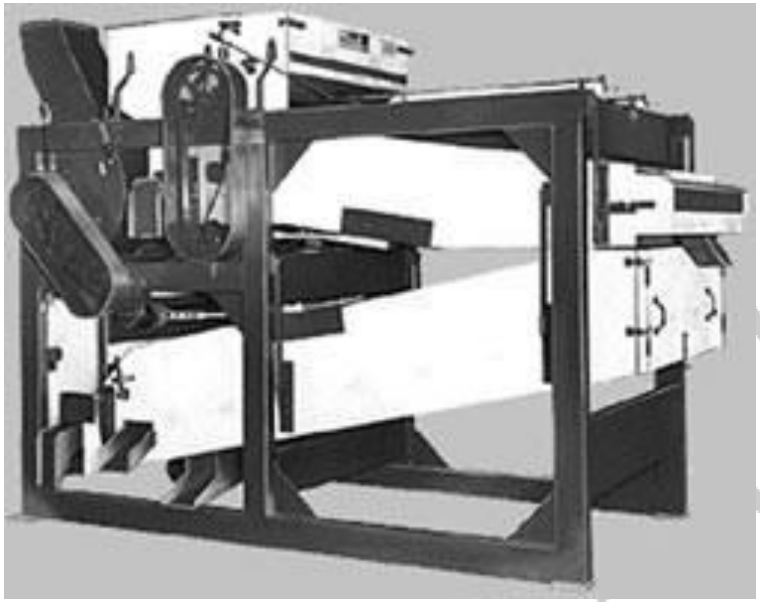
SEEDPROCESSING

Pre-Cleaning Operation:

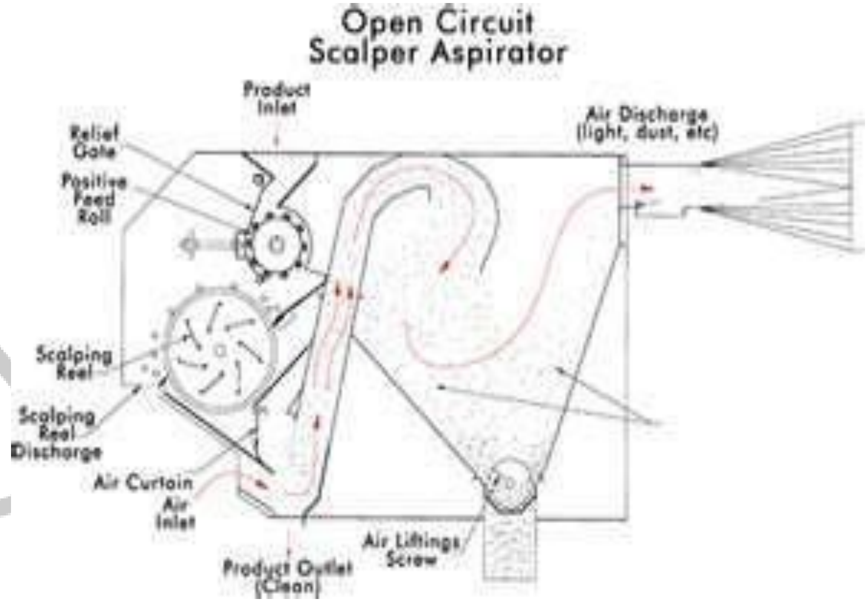
- Why?
  - Enough trash is removed to permit bulk storage and processing
  - Seed feed more evenly through down-stream equipment
  - High moisture, green material is removed decreasing time and cost of drying
  - Removal of bulk of trash permits finer top screens to be used resulting in precise separations
  - Cleaning machines are more efficient
  - Most commonly done by a **scalper**
- **What is a scalper?**



Pre-Cleaning Operation:



Pre-cleaning air-screen cleaner, is designed for high capacity pre-cleaning and market cleaning of seeds. This model is designed for effective removal of light, large, and small waste. It begins with two screens that allow the top screen always serves as a scalper and the bottom screen functions as a sifter.



Aspirator can be used with scalper for both before and/or after product enters to pre-cleaning cleaner. It is also designed for high capacity removal of trash from seed.

Pre-Cleaning Operation: 1,500 AC China

天工開物

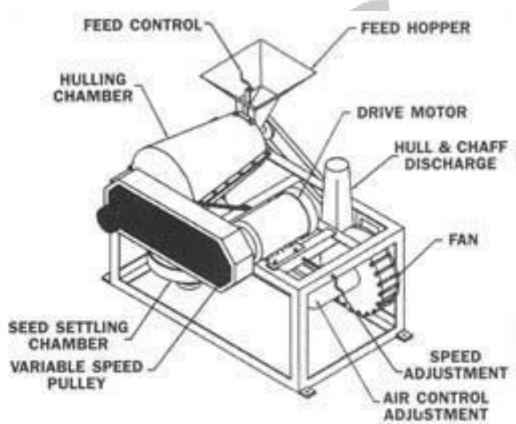
八〇

Pre-Cleaning Operation:

Debeaders:

- Seeds with awns, hairs or other chaffy appendages reduce flowability in cleaning equipment
- It removes these unwanted appendages with rotary and beating arms

Huller-Scarifier



- Removes hull or pods and scarifies hard seeds
- Throws seed against sandpaper or rubber concaves
- Harsh process with potential for seed damage

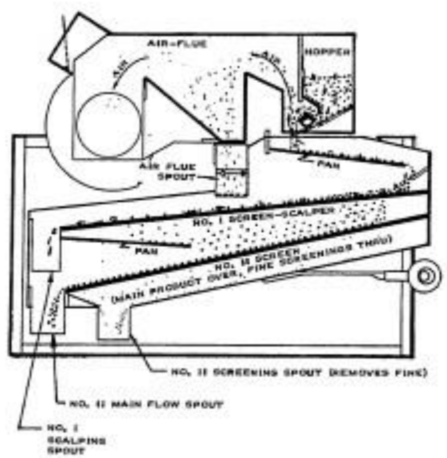
Products after Pre-Cleaning:

- Seeds need to be precisely cleaned for improving quality and make it legal to sale as 'seed' - Germination, purity, health, and vigor
- Air-Screen Separator is the most common machine in the seed processing operation
- It combines the principles of screen and air separation. This combination of principles separates the over/under size and fine/light debris from the seed

Air-Screen Cleaning

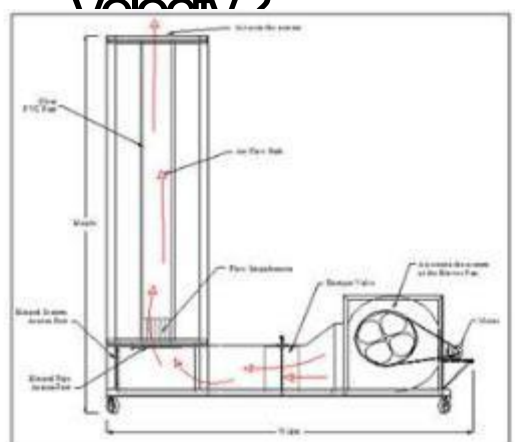
- Basic machine in most seed processing plants
- Combines air separation with sieve operations
- Based on differences in size and weight of seeds
- Three cleaning elements:
  - Aspiration: Removal of *light material* from the seeds
  - Scalping: Removal of *oversize material* from seeds
  - Sifting: Removal of *undersize material* from seeds

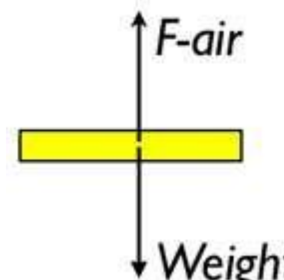


Air-Screen Cleaning - AIR

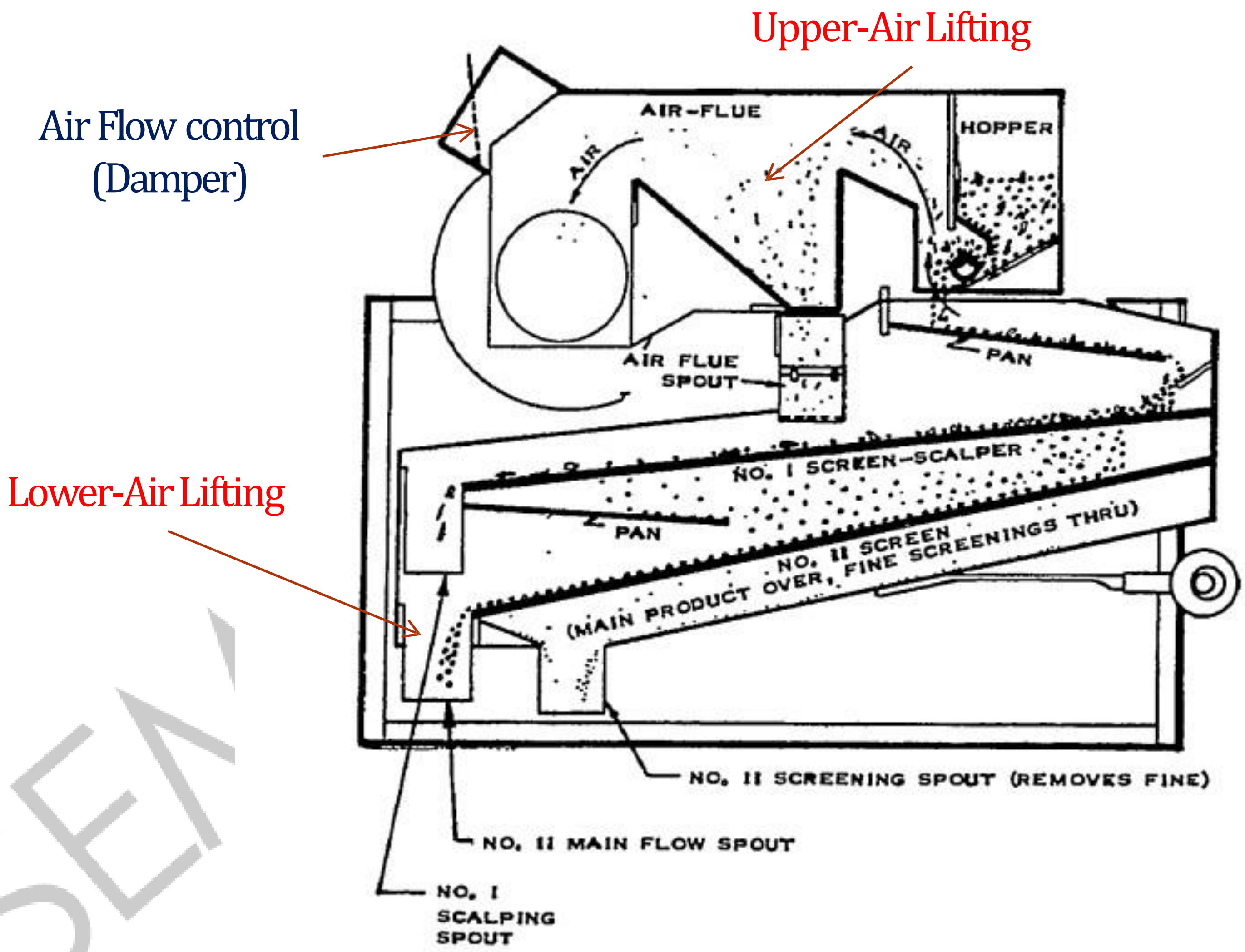
Air Separation, 1,500 AC China

- The air separation is based upon the terminal velocity difference of material
- The light material is removed from the seed by air flow since it has smaller terminal velocity
- How to measure'Terminal Velocity'?





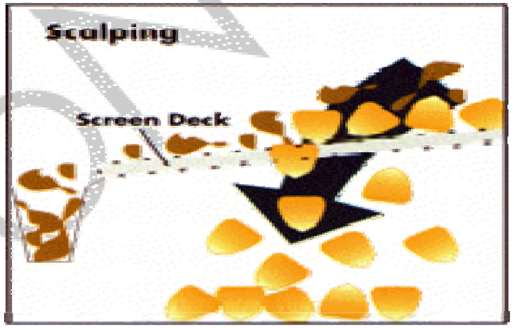
Air-Screen Cleaning - AIR



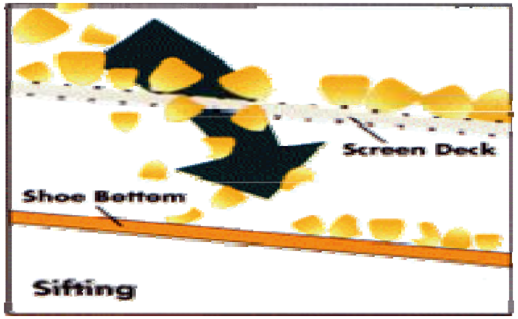
Air-Screen Cleaning - SCREENING

Screen Separation, 1500 AC, China

- Scalping: Good seeds are dropped through screen openings, larger material carried over screen



- Sifting: Good seeds ride over screens while small seeds drop through screen and moved to separate spout by shoe bottom



Air-Screen Cleaning - Cleaner

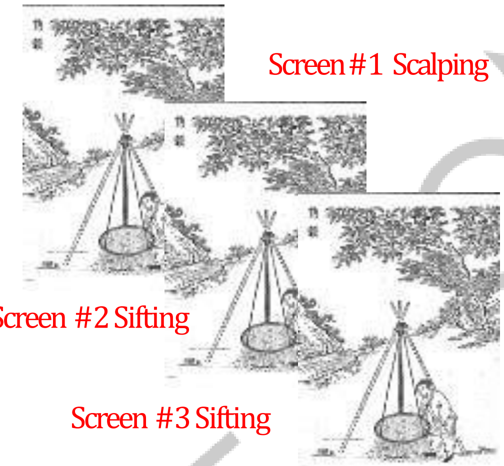
Upper
Air

Lower Air

Air Separation

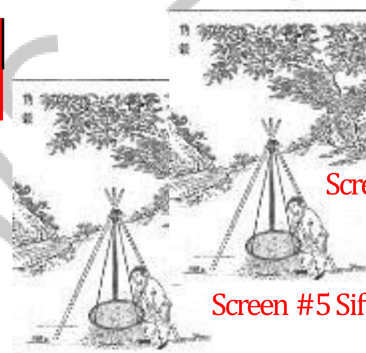
+

Screen #1 Scalping



Screen #2 Sifting

Screen #3 Sifting



Screen #4 Sifting

Screen #5 Sifting

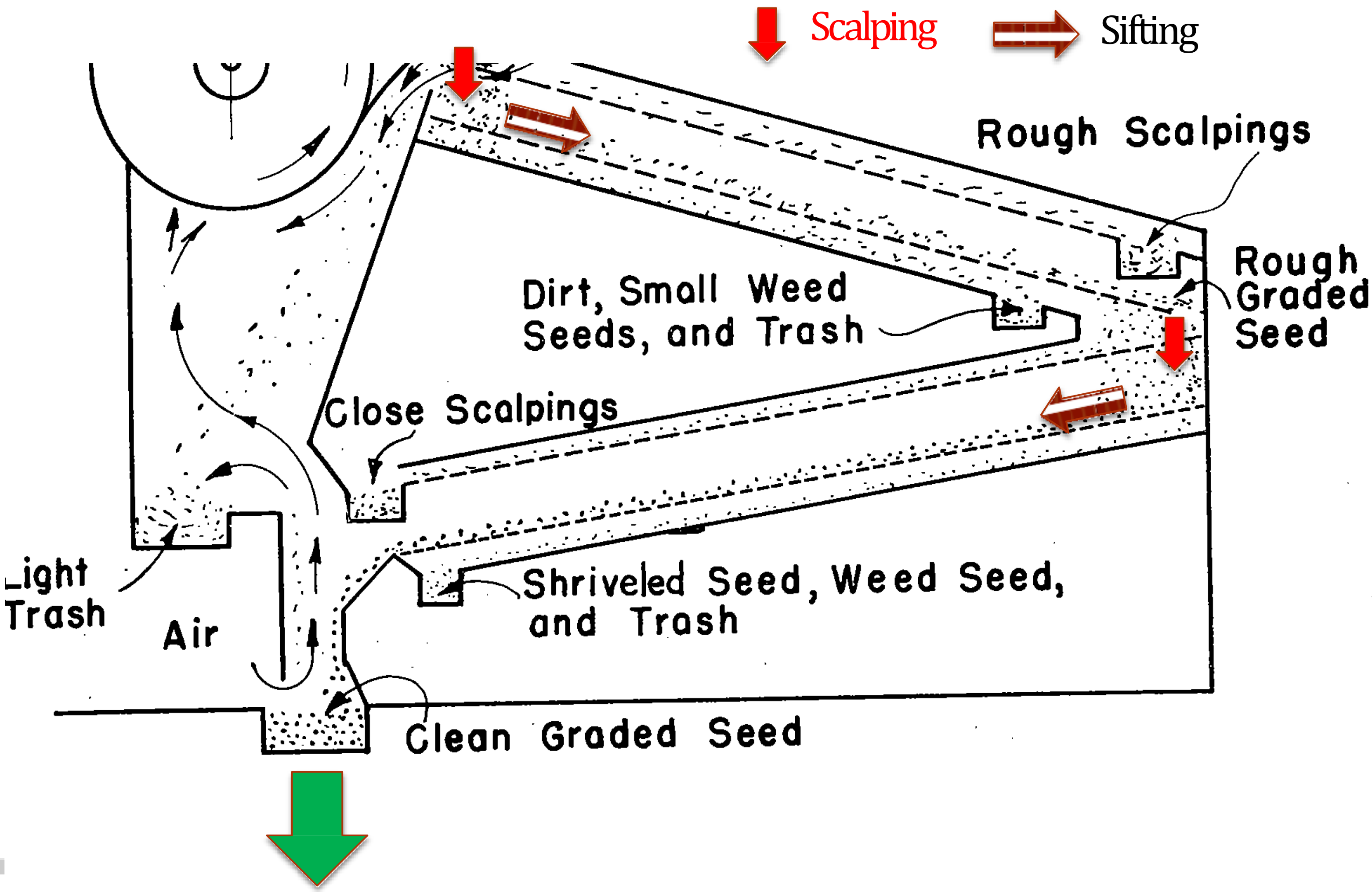
Screen Separation

=

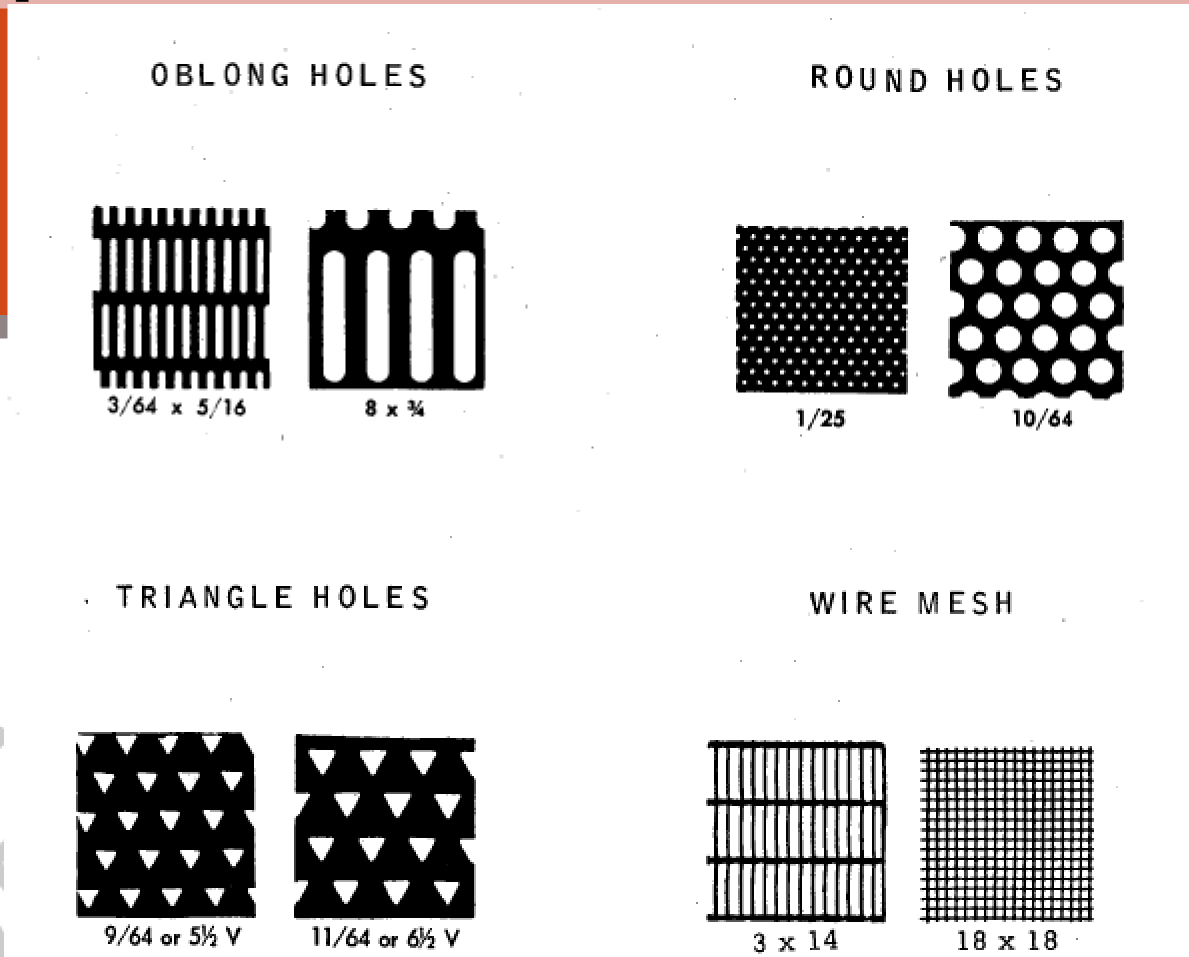
A 5 T/H 2-Air, 5-Screen
Air-Screen Cleaner

Modern Air-Screen Cleaner

Air-Screen Cleaning – Clean seed flow



- Shape:


OBLONG HOLES
3/64 x 5/16
8 x ¾
ROUND HOLES
1/25
10/64
TRIANGLE HOLES
9/64 or 5½ V
11/64 or 6½ V
WIRE MESH
3 x 14
18 x 18

Air-Screen Cleaning – Screen Selection

- Size:

PERFORATED METAL SHEET									WIRE CLOTH			
ROUND HOLES			OBLONG HOLES		TRI-ANGLES	OBLONG CROSS SLOT	ROUND HOLE HALF SIZES	OBLONG HALF SIZES	SQUARE OPENINGS	OBLONG OPENINGS		
Fractions	64ths		Fractions	64ths	64ths	Finished Screens Made Only in "9" and "8" Model Widths. Sheet Sizes 36" x 61¼" and 36" x 55¾"						
1/25	5½	24	1/24x½	5x¾	5	6x¾	6½	8½x¾	3x3	2x8	4x8½	6x14
1/24	6	25	1/22x½	5½x¾	8	7x¾	7½	9½x¾	4x4	2x9	4x15	6x15
1/23	7	26	1/22x½ Diag.	6x¾	9	8x¾	8½	10½x¾	5x5	2x10	4x16	6x16
1/22	8	27	3/64x5/16	6½x¾	10	9x¾	9½	11½x¾	7x7	2x11	4x18	6x18
1/21	9	28	1/20x½	7x¾	11	10x¾	10½	12½x¾	8x8	2x12	4x19	6x19
1/20	10	29	1/18x½	8x¾-D		11x¾	11½	13½x¾	9x9	3x14	4x20	6x20
1/19	11	30	1/18x¾	9x¾		12x¾	12½	14½x¾	10x10	3x16	4x22	6x21
1/18	12	31	1/16x½-A	10x¾-E		13x¾	13½		12x12	3x16 SP.	4x24	6x22
1/17	13	32	1/16x½	11x¾-F		14x¾	14½		14x14	3x18	4x24 SP.	6x23
1/16	14	34	1/15x½	12x¾-G		15x¾	15½		15x15	3x20	4x26	6x24
1/15	15	36	1/14x½-B	13x¾-H		16x¾	16½		16x16	3x21	4x28	6x25
1/14	16	38	1/14x½	14x¾-I		18x¾	17½		17x17		4x30	6x26
1/13	17	40	1/13x½	15x¾-J		10½x¾	18½		18x18		4x32	6x28
1/12	18	42	1/12x½-C	16x¾-K		11½x¾	19½		20x20		4x34	6x30
	19	44		17x¾		12½x¾	20½		22x22		4x36	6x32
	20	48		18x¾			21½		24x24			6x34
	21	56		19x¾			22½		26x26			6x36
	22	64		20x¾					28x28			6x38
	23	72		21x¾					30x30			6x40
		80		22x¾					32x32			6x42
				24x¾-L					34x34			6x50
									36x36			6x60
									38x38			18x20
									40x40			20x22
									45x45			
									50x50			
									60x60			

1/25 | 10/64 | 3/64 x 5/16 | 8 x ¾ | 9/64 or 5½ V | 11/64 or 6½ V | 3 x 14 | 18 x 18

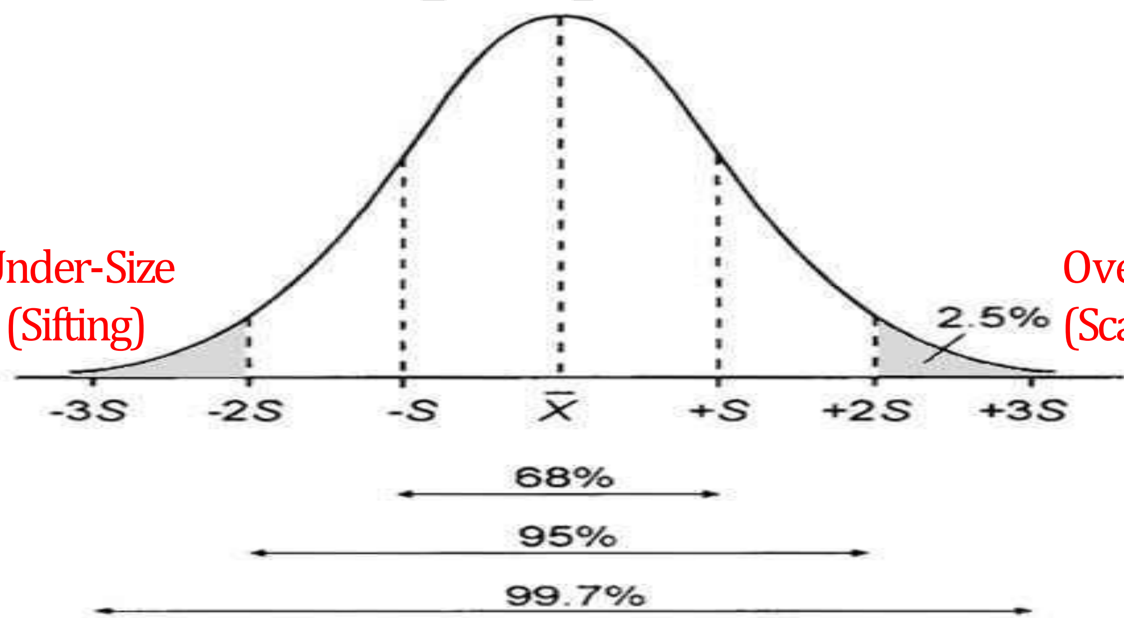
Air-Screen Cleaning – Screen Selection

- Screen must be selected according to the shape of the crop seed being cleaned -
  - Round seeds: A round-hole top screen and a slotted bottom screen are generally used to clean round-shaped seeds. The round-hole top screen prevents straw, trash, pods and other large and long material (*bolts/nuts, tools*) from dropping through while the slotted bottom screen drops broken seeds and weed seeds thinner than the round crop seeds.
  - Oblong seeds: An oblong top screen and an oblong bottom screen are generally used to clean long seeds. (how?)
  - Lens-shaped seeds: An oblong top screen and a round-hole bottom screen are generally used to clean lens-shaped seeds.

Air-Screen Cleaning – Screen Selection

- Screen size must be selected according to the result from hand-screen analysis. The bottom line is that to remove most of undesirable material without losing too much good seeds
- The shape of hand-screen should match the screen on the machine
- How much to cut??

Under-Size
(Sifting)



Over-Size
(Scalping)

Air-Screen Cleaning - Adjustments

- Rate of feed: Although the feed gate on a feed hopper is adjustable for large changes of rate of feed, the basic adjustment is made by increasing or decreasing the speed of the feed roll
- Screen knockers and tappers: An adjustable knocker or tappers that slightly tap the screens which vibrates screens so that seeds will pass through close and small openings, and will jar loose long weed seeds that wedge so tightly in the perforations that the brushes can't remove them
- Upper and lower air suction: The suction is regulated by an adjustable damper in the air passage
- Variable screen shake: This permit the operator to adjust the screen vibration speed from slow to very rapid
- Screen pitch: Common range in pitch adjustment is from 4 to 20 degrees

Air-Screen Cleaning - Installation

- It should be installed properly on and securely fastened to a firm foundation.
- Proper air ducting from the cleaner is extremely important. Sharp turns, improper junctions, poor connections and poor collectors all contribute to poor air separations in a cleaner. Improper air exhaust also causes a very dirty, dusty plant
- A good system to manage good seeds and different discards–both air-lifting and screening products.
- Operator safety and friendly environment!
- Computerized Air-Screen Cleaner (Dr. Shy's US patent)….

Dr. Shy's US Patent on Automation of Air-Screen Cleaner - 1991

United States Patent [19]

Misra et al.

[11] **Patent Number: 4,991,721**

[45] **Date of Patent: Feb. 12, 1991**

[54] **AUTOMATION OF AN AIR-SCREEN SEED CLEANER**

[75] Inventors: **Manjit K. Misra; Yuh-Yuan Shyy,** both of Ames, Iowa

[73] Assignee: **Iowa State University Research Foundation, Inc.,** Ames, Iowa

[21] Appl. No.: **231,946**

[22] Filed: **Aug. 15, 1988**

[51] **Int. Cl.**[5] **B07B 9/00;** B07B 4/02; G05B 13/02

[52] **U.S. Cl.** **209/31;** 209/37; 209/139.001; 209/257; 209/546; 209/557; 364/502; 364/552

[58] **Field of Search** 209/21, 30–37, 209/44.1, 44.2, 134–139.1, 146, 147, 149, 153, 154, 237, 238, 255, 257, 546, 549, 552, 555, 557, 629, 639; 55/215, 218, 270, 279, 413, 423–426; 364/500, 502, 552, 555; 406/28, 168, 169, 173

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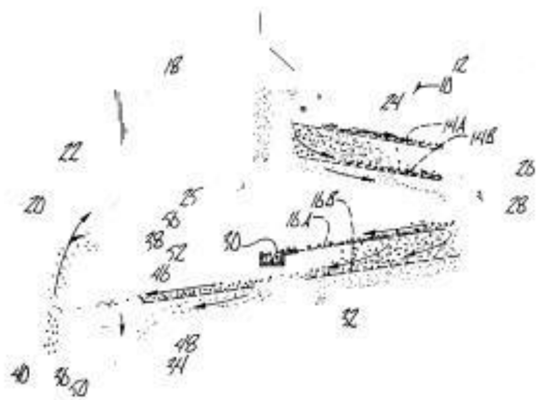
Primary Examiner—Margaret A. Focarino
Assistant Examiner—Edward M. Wacyra
Attorney, Agent, or Firm—Zarley, McKee, Thomte, Voorhees & Sease

[57] **ABSTRACT**

A cleaning system is provided for separating desired material from undesirable material in a mixture of particulate materials. The system includes an inlet for receiving the mixture of materials and an outlet for discharging the desired materials. At least one screen is provided for separating undersized material from oversized material within the mixture, and at least one vacuum air-lift is provided for separating the lighter material from the heavier material within the mixture. A first sensor is mounted below the discharge end of the screen for sensing the quantity of undersized material separated by the screen and a second sensor is mounted in the air-lift for sensing the quantity of lighter materials separated by the air-lift. The signals generated by the sensors can be received by a processing unit which adjusts the extent of separation by the screen and by the air-lift to achieve the desired efficiency of the cleaning system.

16 Claims, 23 Drawing Sheets



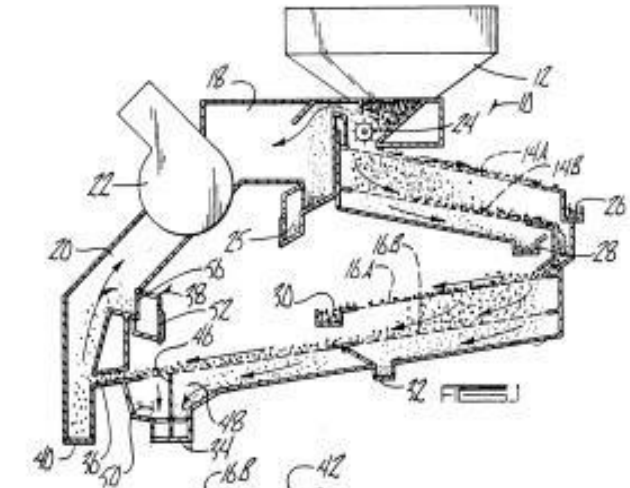


FIG. 1

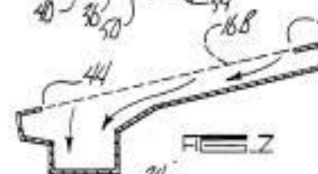


FIG. 2

(PRIOR ART)

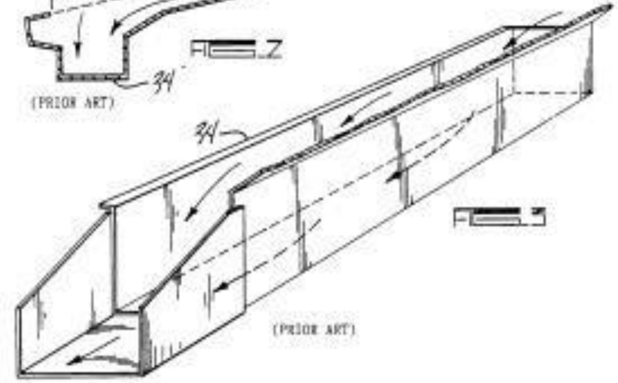
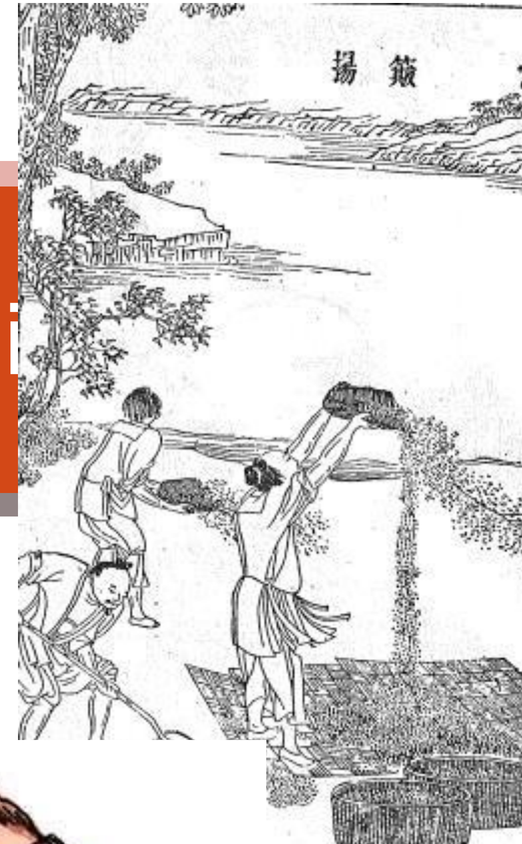


FIG. 3

(PRIOR ART)

Air S



Questions?

Basic of Separation:

Questions?

Prepared by:	Date:
Crop:	
Variety or hybrid:	
Parents (if applicable):	
Grower premium:	
Bag:	
Conditioning:	
Treatment:	
Labels:	
Basic seed:	
Bag pallet:	
Royalties:	
Re-bagging:	
Seed transport:	
Sales:	
Advertising:	
Certification/Inspection:	
Cleanout:	
Interest:	
Other direct costs:	
Total product cost:	

Form number: Date:	Version number:	
Crop:	Variety:	
Base price/ton:	Weight:	Sales zone:
	Weight discount (1):	Price increment by location (2):

1) Weight discounts

AGRO-DEALER DISCOUNT		
From	To	%
1	10	1%
11	20	2%
21	30	3%
31	40	4%
41	50	5%
51	60	6%
61	70	7%
71	80	8%
81	90	9%

2) Price increment by location*

ZONE	INCREMENT
1	0%
2 and 3	0.5%
4	1.2%
5	2.0%
6	2.6%

* Location increments to be determined by considering distance and accessibility of roads.

PD01 ANNEXE C. PRICE ANALYSIS REPORT TEMPLATE

TOTAL PRODUCT COST (from PD01 Annexe A):	$
OTHER COSTS:	
– Carryover costs (interest, storage, re-conditioning)	$
– Management overhead (salaries, rent, training)	$
– Financial overhead (interest on investment and capital)	$
TOTAL COSTS: (Total Product Cost + Other Costs)	$
Total Income: Base Price/ton x Number of tons (from PD01 Annexe B)	$
Gross Profit:	$
Taxes:	$
NET PROFIT: (Gross Profit minus Taxes)	$

SC01 ANNEXE B. SAMPLING CARD TEMPLATE

Crop species:
Variety:
Field number:
Seed lot number assigned:
Contract Grower:
Class: ☐ Pre-basic ☐ Basic ☐ Certified (1st generation) ☐ Certified (2nd generation)
Seed lot total weight at reception (Kg): Seed lot total weight after conditioning (Kg): Number of bags in seed lot: Weight per bag (Kg): Number of certified seed tags requested: Seed lot storage location:

Sampler: ____

Signature Date

Conditioning Plant Leader: ____

Signature Date

SC01 ANNEXE D. SEED CONDITIONING OPERATION TEMPLATE

Crop:
Variety:
Field number:
Lot number:
Contract Grower:
Initial weight (kg):
Final weight (kg):
Final number of bags:
Pre-cleaning discards (kg):
Drying notes:
Moisture content reduced from______% to_%
Cleaning discards (kg):
Treatment material name and amount:
Labeling number of tags from tag number____________to tag number___:
Storage location number:
Additional remarks:

Conditioning Plant Leader:____

Signature Date

Production and Quality Manager: ______________________________________

Signature Date

Crop:	
Variety name:	
Lot number:	
Sample number:	
Tests requested:	
Contract Grower:	
Date sample received: Signature:	Date tests concluded: Signature:
Test results Purity: Germination: Moisture: Stress: Seed health:	
Remarks:	

Production and Quality Manager: ______________________________

Signature Date

SC01 ANNEXE A. SEED RECEIPT AT CONDITIONING PLANT TEMPLATE

Receipt number:

Contract Grower information
Name:
Address:
Field location:
Production in hectares:
Crop:
Variety:
Class of seed:
Planting date:
Harvest date:
Weight:
Moisture content:
Notes:

Conditioning Plant Leader: ______________________________

Signature Date

Sizing and Texture/Surface Separation

Dr. Yuh-Yuan Shyy

Scientist/Sr. Engineer/IT Management
Seed Science Center
Iowa State University, Ames, Iowa USA

192 Seed Science Center, email: yshyy@iastate.edu

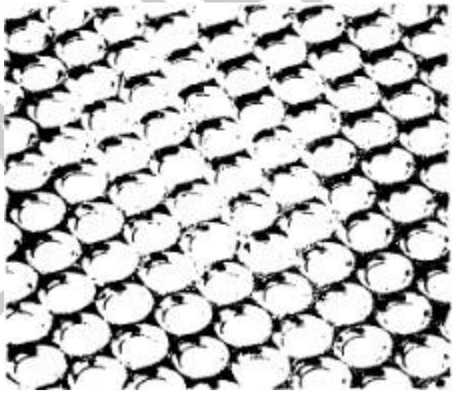
Sizing and Texture/Surface Separation

- Size between different crops and seed quality

- Texture/surface difference of good and bad seeds

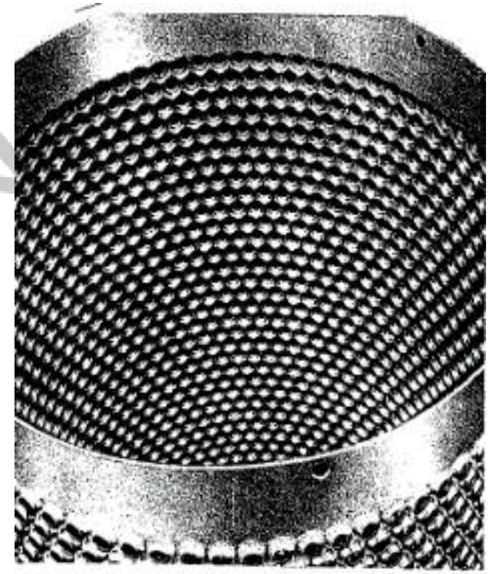
Sizing – Width and Thickness

- Width and thickness separators are commonly referred to as ‘graders’ or ‘sizers’
- The separation is similar to, but generally more accurate than, the separation performed on the screens in Air-Screen Cleaner
- Two principles apply:
  - Seeds are sized for width by using round-hole screen openings
  - Seeds are sized for thickness by using slotted screen openings



Sizing – Width Separator

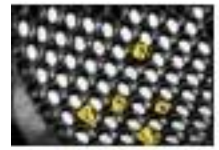
- The indented round hole screen is used for width sizing, and differs from the perforated round hole screens used in air-screen cleaner in that the hole is ringed by a ‘seat’. Why?
- If the seed is narrower than the diameter of the hole, it passes through and is termed a ‘through’. Conversely, the wider seed is termed ‘over’
- Machine fraction and total fraction:
  - Through % = 100*Through/Total
  - Through (Size) % of Total



Sizing – Width Separator

Flat Screen Separator -Vibration

Cylindrical Screen Separator - Rotation

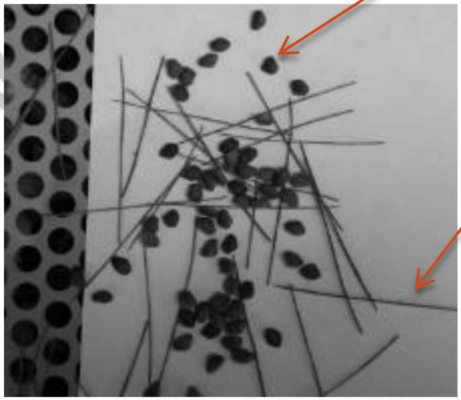


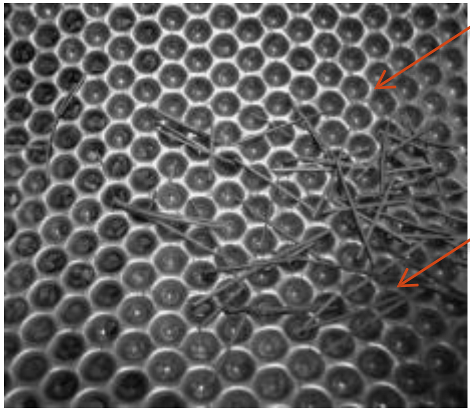
Flat Screen Separator -Vibration

Cylindrical Screen Separator - Rotation

Sizing – Length Separator

- Length separators are specifically designed to effect separations of particles differing in length
- Cylinder and disk separators are machines to separate seed on a pure length difference basis
- Both machines effect this separation by lifting the short particles out of a mixture containing both log and short particles
- Efficiency of length separation?





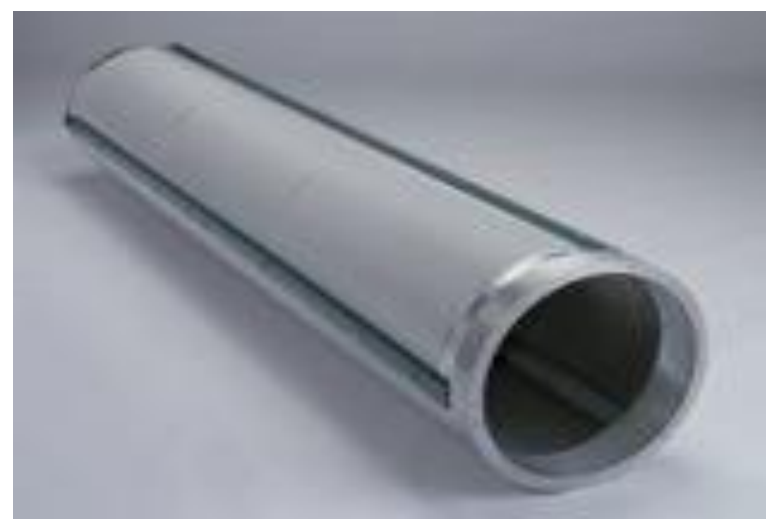
Sizing – Length Separator/Cylinder

A: Indented Cylinder
B: Short
C: Long
D: Mixture

long rejected material out of the cylinder. Interior surface of cylinder is shown at right.

Indent sizes are listed in 64ths of an inch and come in a wide range. For example, a cylinder designated by the number 22 has indents 22/64th inch in diameter. There are no other figures or letters used to describe the indents. Also, there is no way to determine the shape or depth of the indent from the number. Examples of cylinder sizes used for some separations are given in an accompanying table.

<u>Receiving trough:</u> The receiving trough is a device to receive the liftings. The configuration of the receiving trough varies from machine to machine, but its function remains the same

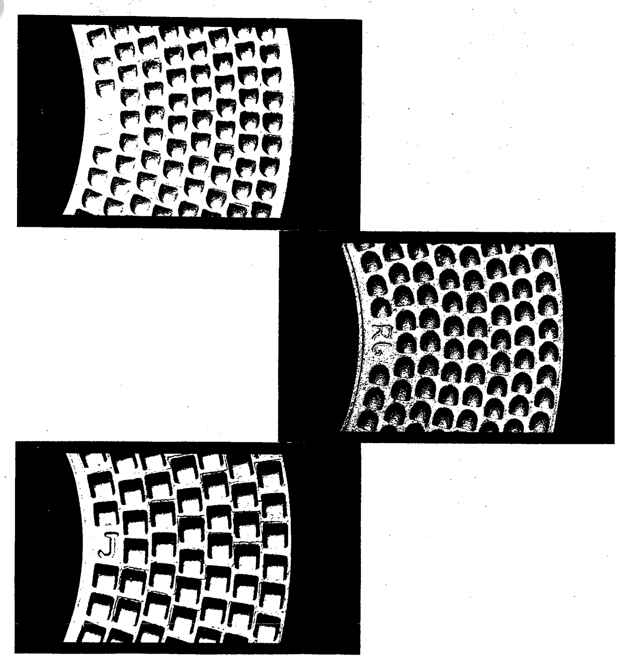


Sizing – Length Separator/Disk

Figure D15. Face and cross-section of a single disc.

lifting edge of the pocket (the bottom of the pocket is cup-shaped) so they tip out of the pocket.

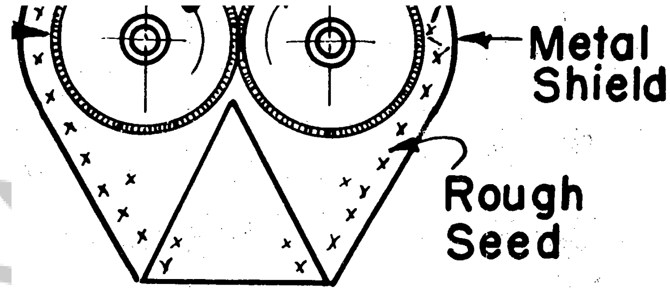
The letter designation "V" is always followed by a number, such as V4, V5 1/2 or V6. The number indicates the width dimension in millimeters, i.e., a pocket designated as V4 is a pocket with a round lifting edge which is 4 mm. wide. "V" pockets seldom exceed 6 millimeters in width.



Type of disc pockets: V, R, and S

Texture/Surface Separation

- Texture separator will separate mixtures of crop seed and contaminants that differ in surface texture
- Rough-surfaced, irregular contaminants – seed or inert material – are separated from the mass of smooth surfaced, regular shaped crop seed
- Roller or belt covered with velvet fabric can be used



ıre F4. Cross-section of a pair of rolls illustrating movement of rough seed over rolls.

eed must contact the velvet so all rough seed can be
of the mixture. Over-feeding will flood the rolls, or crowd
tween the rolls and the shield and interfere with free move-
ıidual particles. This reduces the percentage of rough seed

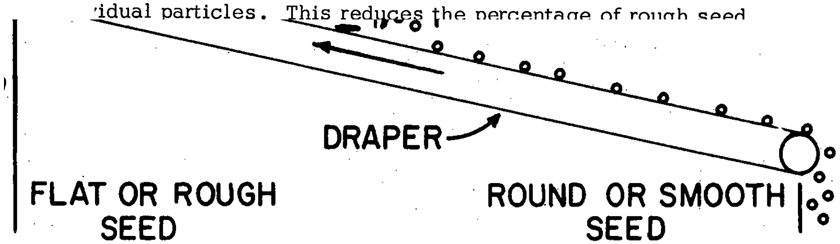


Figure F8. Schematic view of inclined draper illustrating principle of separation.

ing device which distributes seed in a thin layer across the
of the moving inclined draper belt at a point near the center of its
dimension. As the belt travels up-hill, the round or smooth seed

Texture/Surface Separation

- Texture separator is a finishing machine and shall be used on seed that have already been processed on air-screen cleaner or other machines.
- There are used to clean smooth seed such as clovers, alfalfa and beans that are contaminated with rough surface weed seed, immature seeds that are wrinkled or shriveled, broken, chipped or damaged seed that have irregular surfaces, and rough and irregular shaped inert material.
- Examples of some separations made on texture separator:

Crop Seed	Contaminant Removed by Roll Mill
Crimson Clover	Cutleaf Cranesbill, Dock
Alsike Clover	Timothy
Whole Seed	Broken Seed
Beans	Dirt Clods
Vetch	Wild Winter Peas
Hulled Lespedeza	Unhulled Lespedeza
Clovers	Sorrel, Peppergrass, Foxtail, Catchfly, Mustard, Cockle, Wild Carrot

Questions?

Gravity Separation

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Gravity Separation – Gravity Table

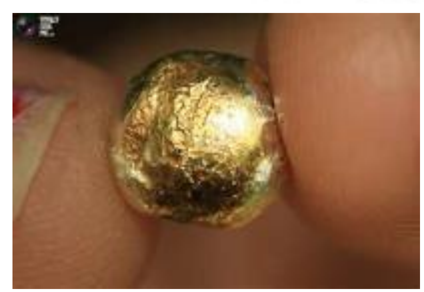
- Undesirable seed and contaminants are often so similar to the “good” seeds in size, shape, and surface textures that efficient separations cannot be achieved.
- Contaminating seeds or materials differing from the crop seed in *test weight* or *specific gravity* can be separated with a Gravity Separator/Table.

Oliver GT

Forsberg GT

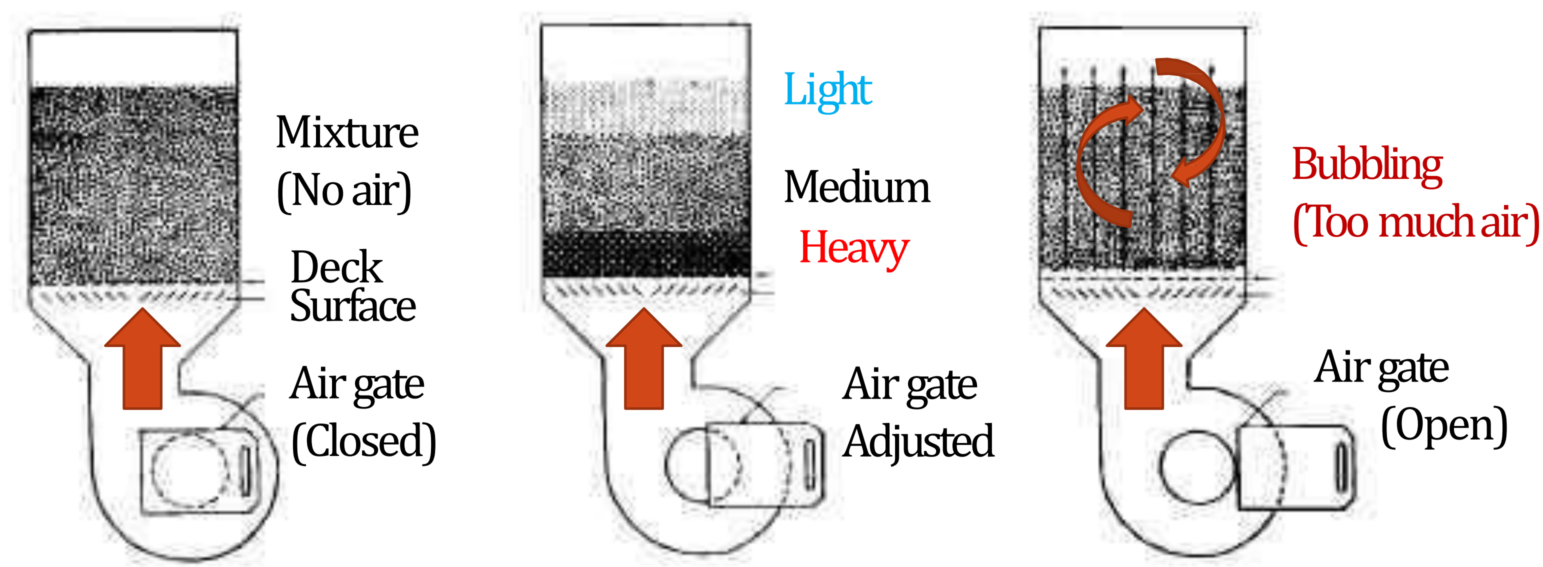
LMC GT

Gravity Separation - Fluidization



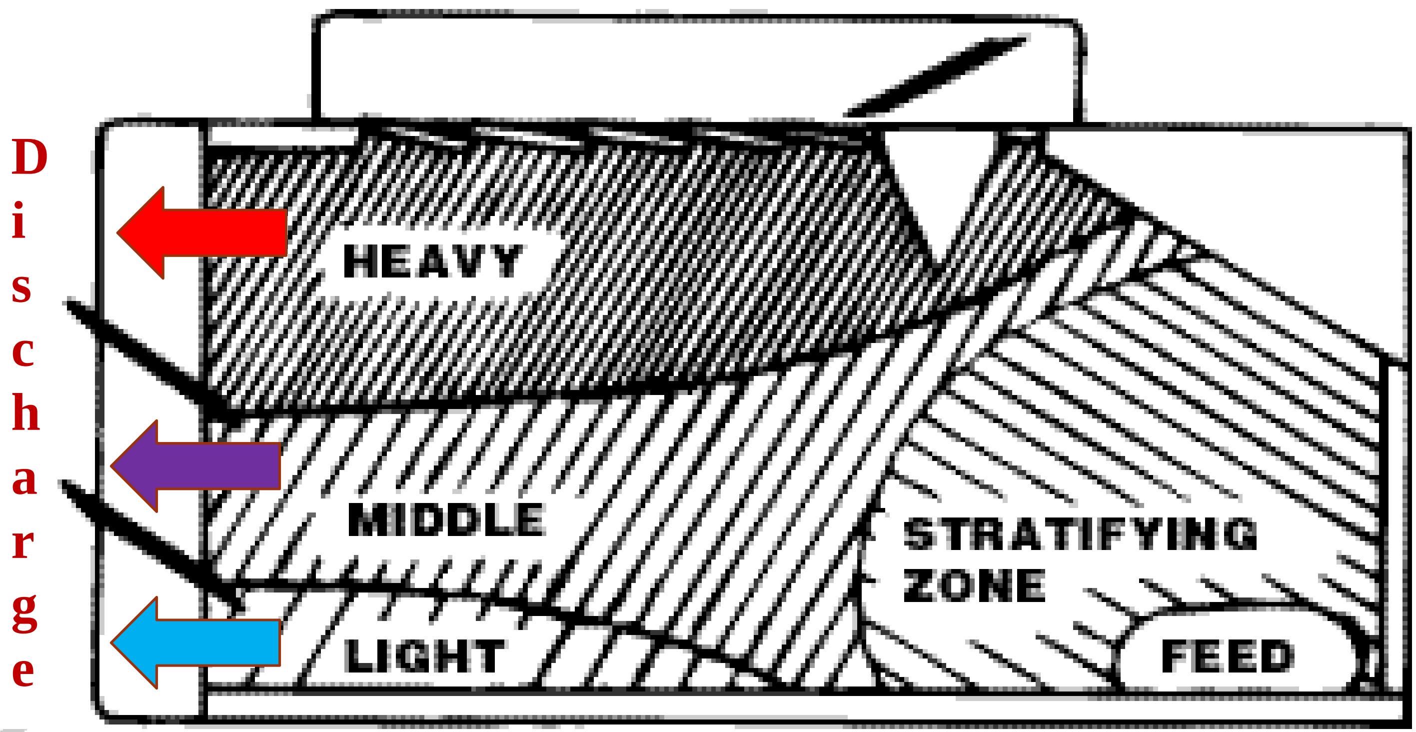
Gravity Separation – Principles

- ***Fluidization*** (Water vs Air?): Mixture is vertically stratified so that the heavier seeds are at the bottom and the lighter seeds are at the top.



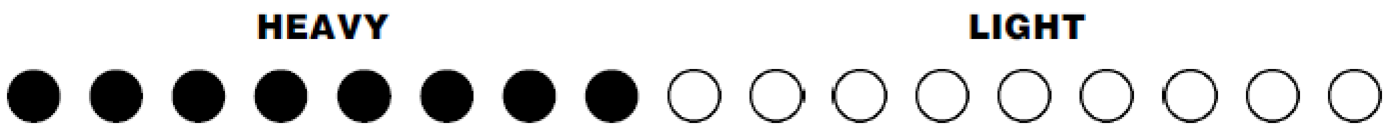
Gravity Separation – Principles

- ***Separation***: The light seeds are fluidized on a cushion of air and flow almost like a liquid, they flow toward the discharge end because of the downhill slope. And the heavier seeds move uphill with deck motion.



Gravity Separation – Rules

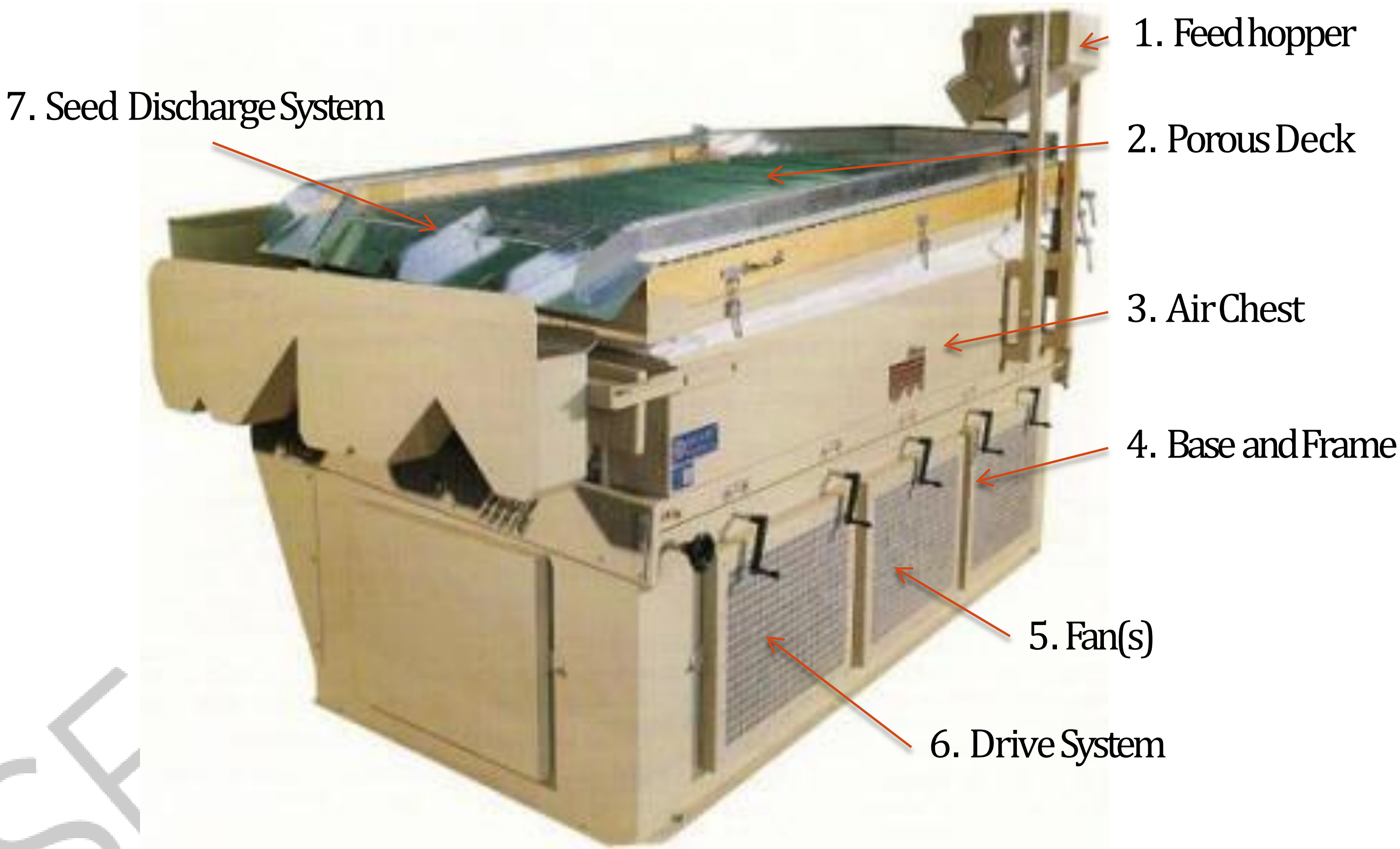
- Rule 1. Particles of the same size but differing slightly in specific gravities can be separated.



- Rule 2. Particles of the same specific gravities but differing in the size will be graded according to the size of the particles.

- Rule 3. Particles differing in specific gravities and also differing in size cannot be efficiently separated!

Gravity Separation – Machine



Gravity Separation – Parts

1. Feed Hopper: Seed flow from a surge bin to a feed hopper which meters a uniform stream of seed onto the corner of the deck opposite the discharge side. The feed hopper is adjustable for different feed rates.

2. Porous Deck: The deck is a lightweight removable and interchangeable frame which provides the surface on which seeds are separated. The deck is covered with a porous material such as cloth, wire screen, perforated sheet which allows air to pass through.

Gravity Separation – Parts

3. Air Chest: It is an airtight, shallow, boxlike plenum chamber mounted inside the frame and beneath the deck. Air pressure built up in the air chest forces air up through the porous deck.

4. Base and Frame:The base section is bolted to a solid foundation to keep the machine from shaking (walking machine?) The frame provides structural support for all other parts of the machine

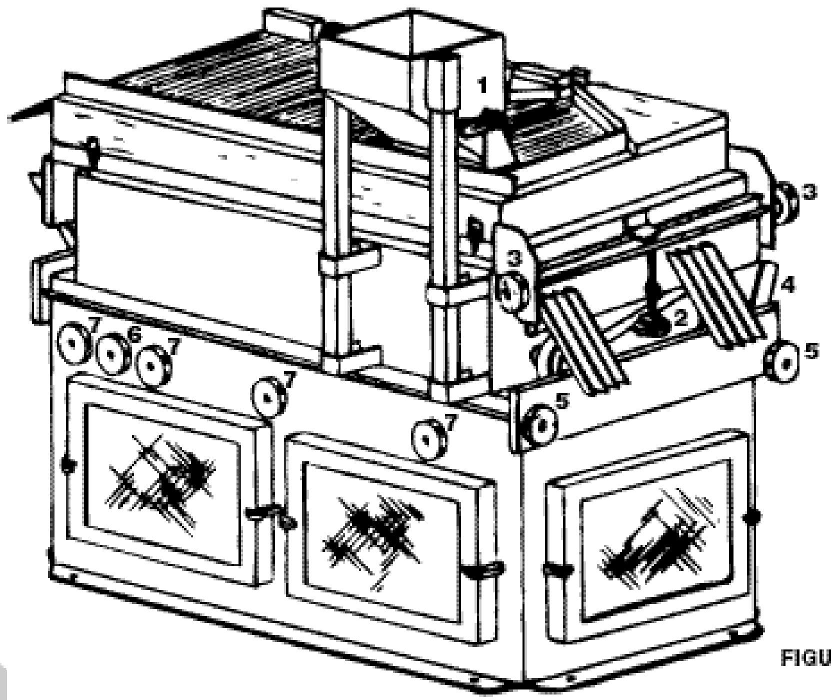
Gravity Separation – Parts

5. Fan(s): One or more fans pull air from outside the machine and force it into the air chest. Pressure and vacuum gravity separators operate on the same principle, but the fan is mounted __________(where?)

6. Drive System: The upper part of the air chest to which the deck is attached is mounted on rockers which allows it to rock back and forth with the deck. The speed of the motion can be controlled by a variable speed drive.

7. Discharge System: The banking rails hold the seeds on the deck until they reach the discharge end.

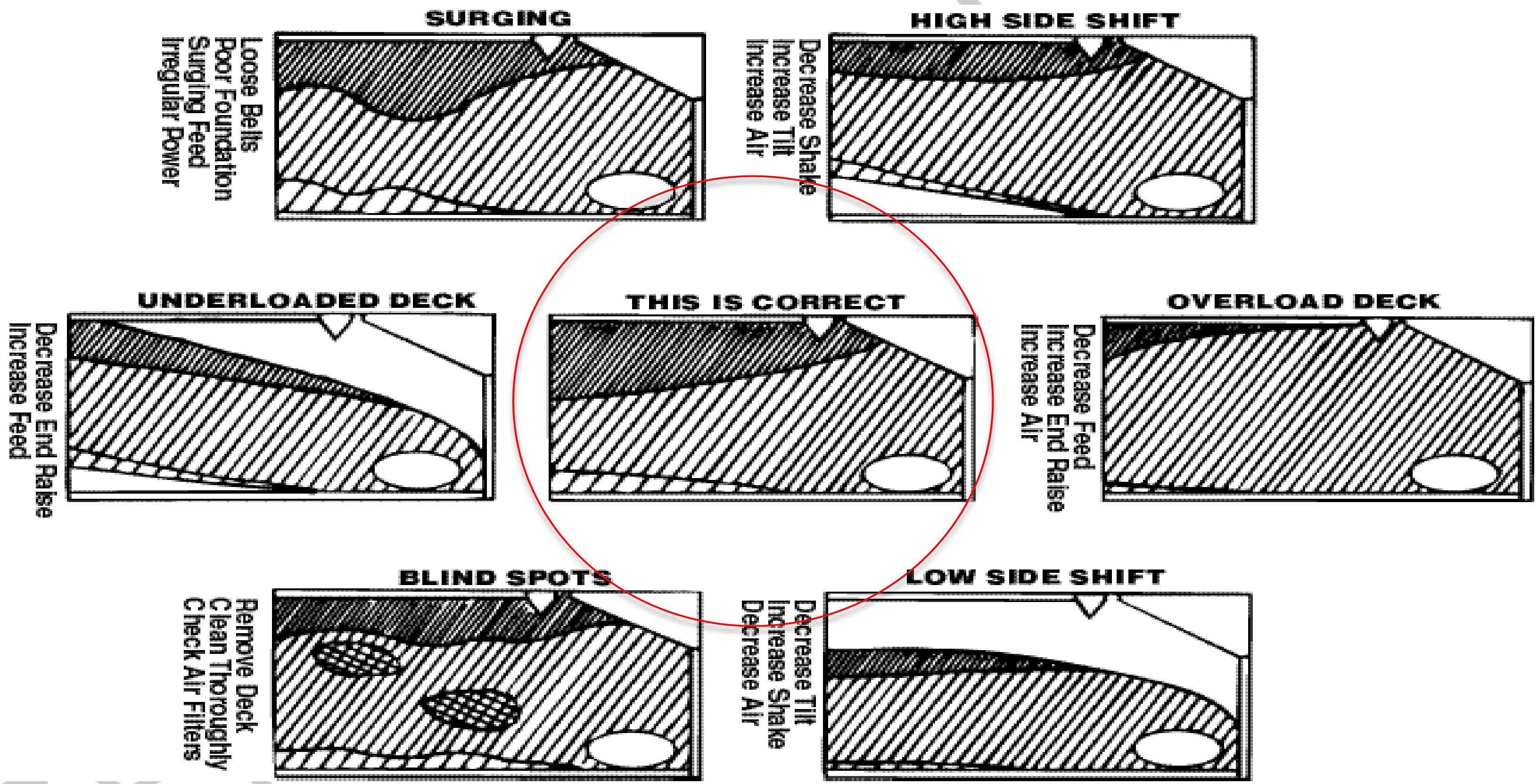
Gravity Separation – Controls



LEFT HAND MODEL

1. Feed Rate Control
2. End Raise Control
3. Clamping Knob, End Raise
4. Side Tilt Adjustment Handle
5. Side Tilt Clamping Knob
6. "More Speed" Control Knob
7. "More Air" control Knob

Gravity Separation – Adjustments



Gravity Separation – Adjustments

Same separation results can be achieved with different adjustments, it is an ART!

Rectangular, Multiple Fans

- Feed Rate
- Air Volume
- Eccentric Speed
- Deck Side Slope
- Deck End Slope
- Variable Airflow Levels
- Discharge Dividers

Trapezoidal, Adj. Pitch Posts

- Feed Rate
- Air Volume
- Eccentric Speed
- Deck Elevation
- Deck Run-off
- Feed, End, and Cull Post Pitch
- Discharge Dividers

- Eccentric Displacement is also adjustable on a few machines, and is used to help compensate for seed size variations

Gravity Separation – Deck Surface

- Deck surface is critical for traction needed to convey seed up deck slope
- Deck opening size must prevent plugging of deck openings
- Use Proper Mesh Size for Product
  - 8 or 10 Mesh - large seeds
  - 12 mesh – soybean/wheat
  - 16 mesh – small grains
  - 30 mesh – small seeds
  - Cloth deck – very small seeds
- Urethane coatings for large seeds
  - High Wear Applications
  - Better Traction, Lower Shake Speed

- Riffle strips may be used for large seeds

Gravity Separation – Automation (Dr. Shyy's US Patent)

United States Patent [19] | [11] **Patent Number: 5,024,334**

Misra et al. | [45] **Date of Patent: Jun. 18, 1991**

[54] **METHOD AND MEANS FOR GRAVITY TABLE AUTOMATION**

[75] Inventors: **Manjit K. Misra; Yuh-Yuan Shyy,** both of Ames, Iowa

[73] Assignee: **Iowa State University Research Foundation, Inc.,** Ames, Iowa

[21] Appl. No.: **363,727**

[22] Filed: **Jun. 9, 1989**

[51] **Int. Cl.**[5] **B07C 5/342;** B03B 4/00

[52] **U.S. Cl.** **209/557;** 209/467; 209/472; 209/489; 209/491; 209/502; 209/503

[58] **Field of Search** 209/557, 567, 571, 576, 209/577, 580, 586, 587, 589, 592, 598, 552, 484, 489, 491, 496, 502, 499, 422, 691, 694, 695, 471, 472, 458, 459, 490, 479, 477, 503, 474–476, 467

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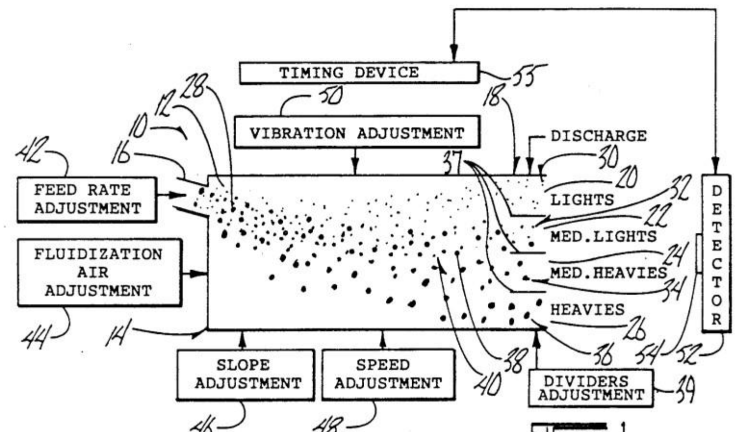
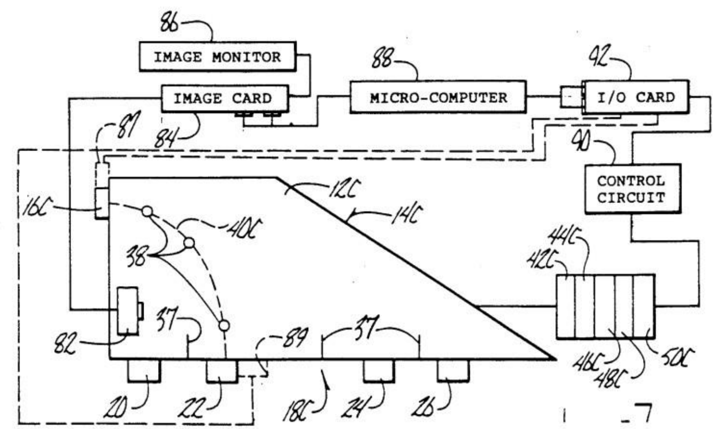
Primary Examiner—Donald T. Hajec
Attorney, Agent, or Firm—Zarley, McKee, Thomte, Voorhees & Sease

[57] **ABSTRACT**

A system for gravity table separation including a gravity table for separating materials and a detector operatively associated with the gravity table for detecting the movement of control particles with respect to the gravity table during its operation. The control particles are of a known characteristic. By calibrating the desired movement of the control particles through the table, any misalignment or deviance of that movement during operation is detected, and adjustments can be made to the operation of the table to bring the control particles back to the desired movement. The separation process can then be controlled to bring about optimum efficiency. Also, the detector can be interfaced with a control component which can automatically adjust the operation of the table in response to whether the control particles are following the desired movement through the table.

13 Claims, 6 Drawing Sheets





Gravity Separation – ISU Video

Questions?


Oliver GT


Forsberg GT


LMC GT

Seed Plant Design

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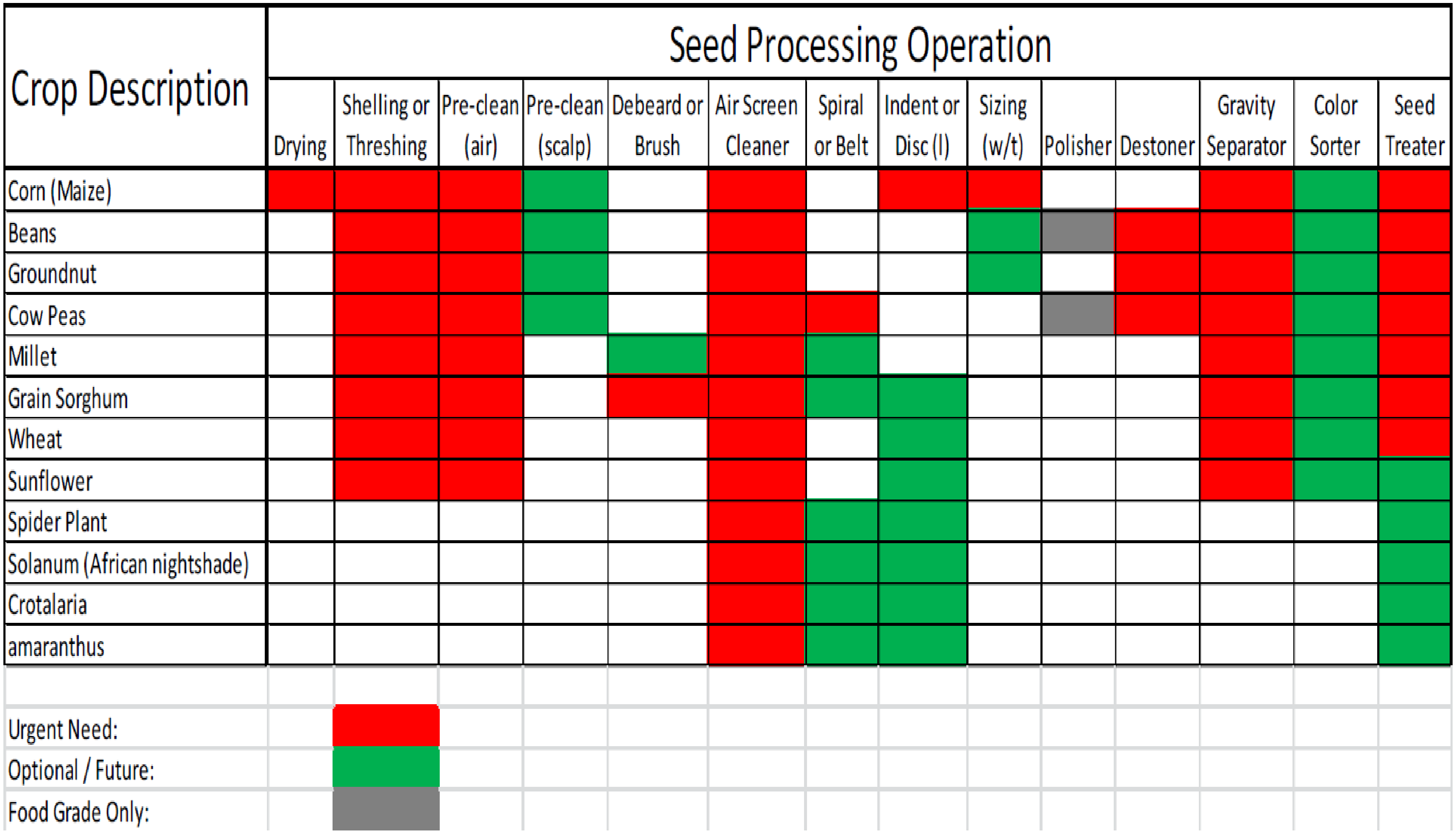
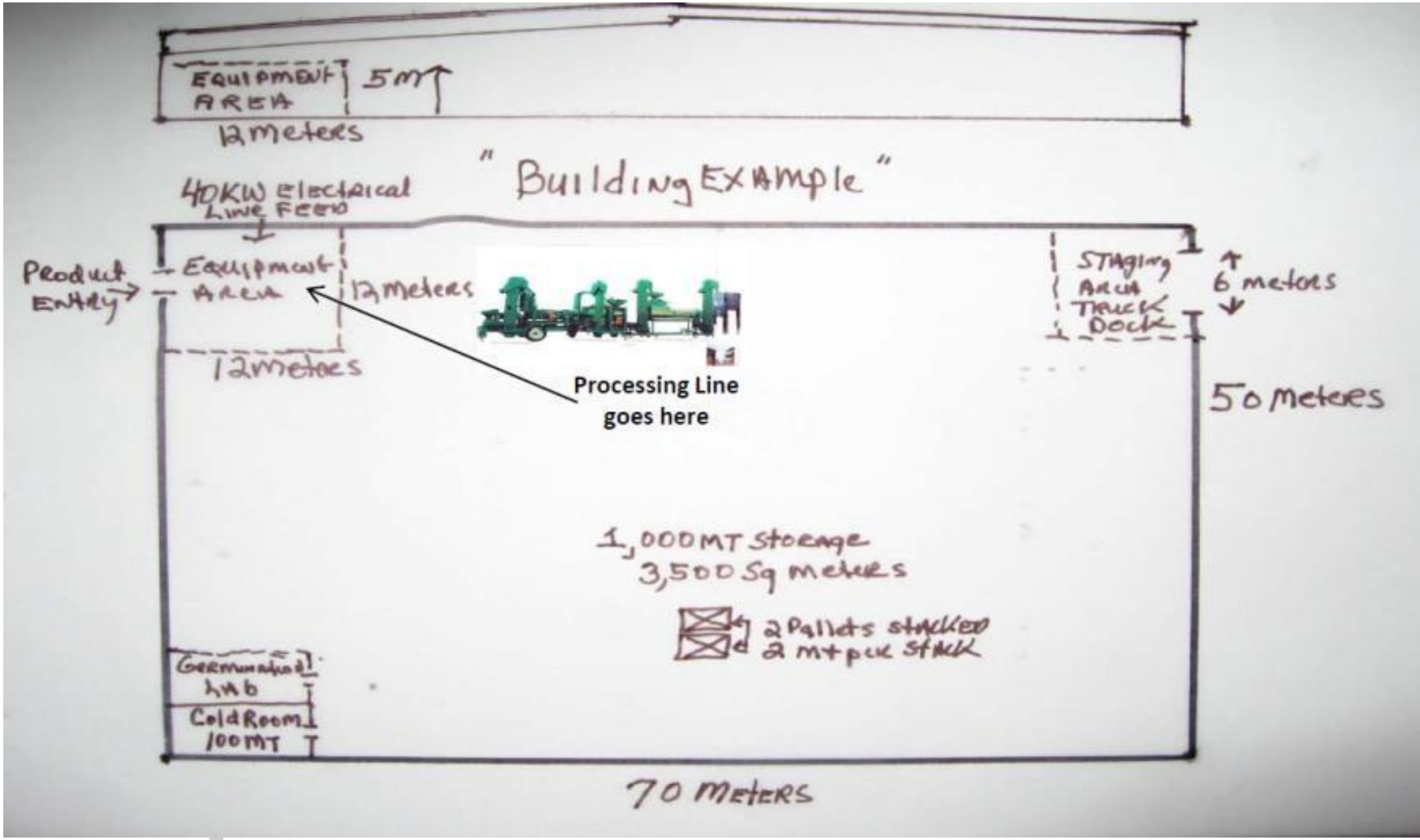
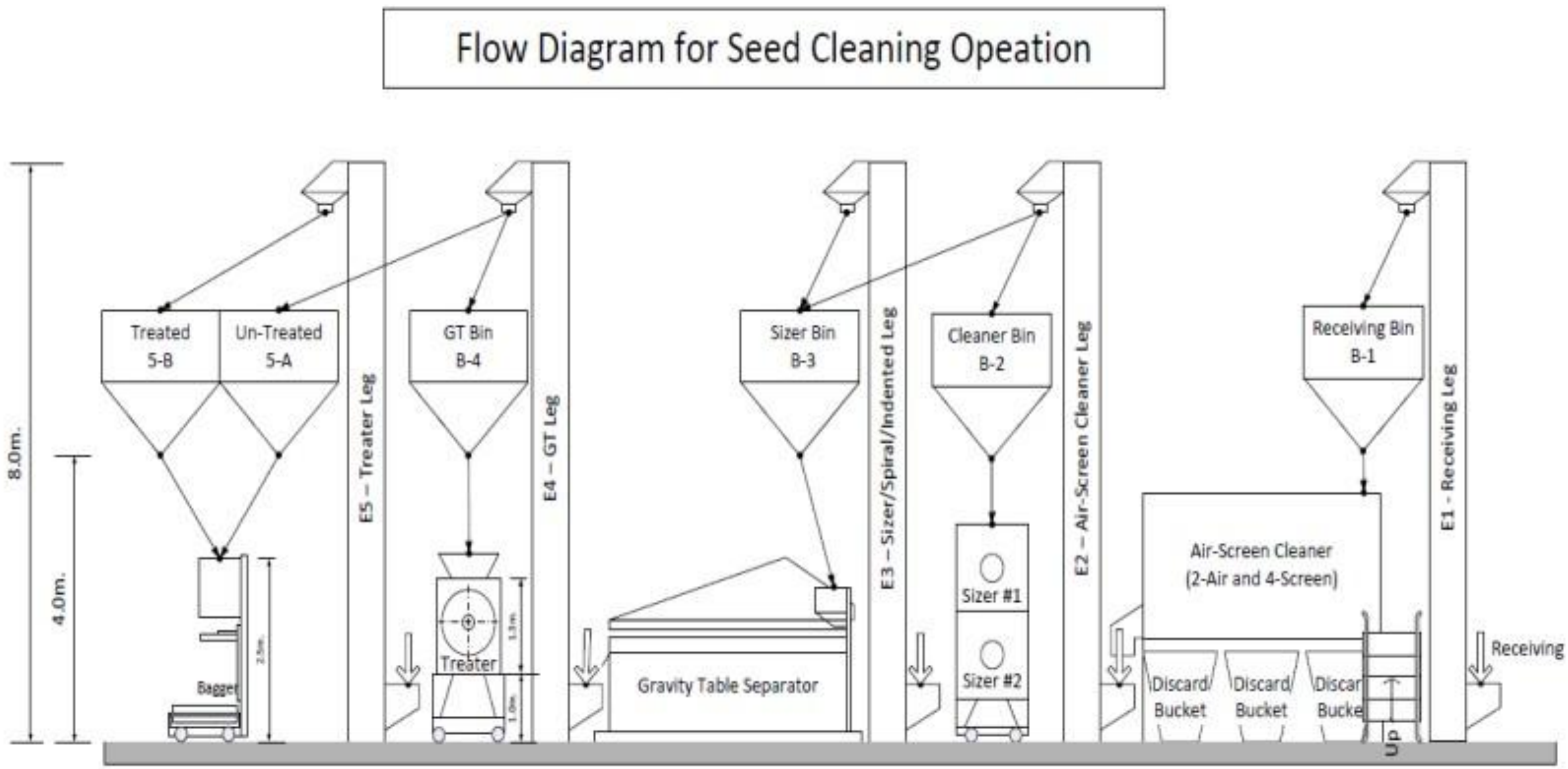
Seed Plant Design – List of Equip.



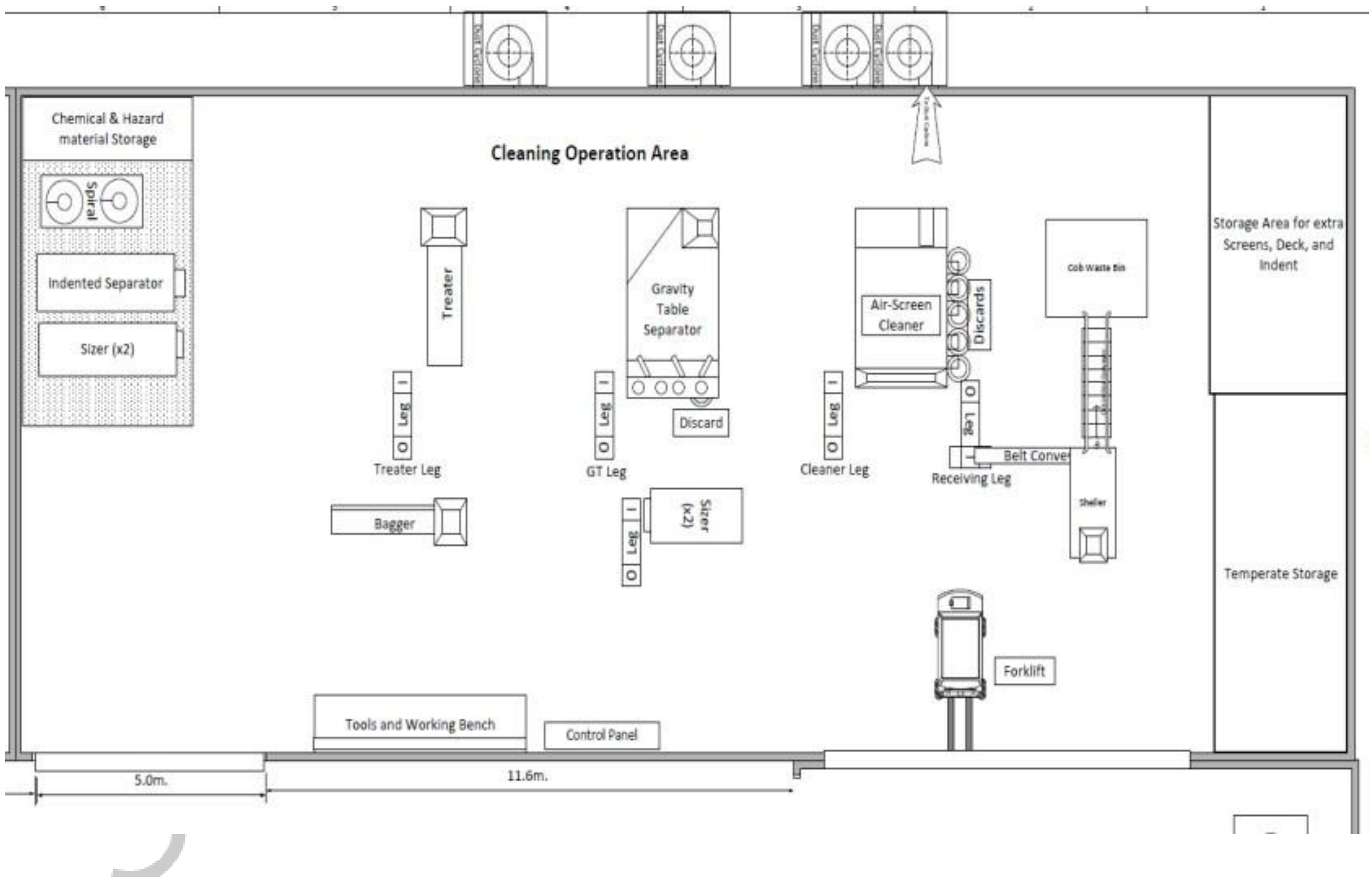
Seed Plant Design – Freehand drawing



Seed Plant Design - Flow Diagram



Seed Plant Design – Equipment Layout



Questions?

示意图一

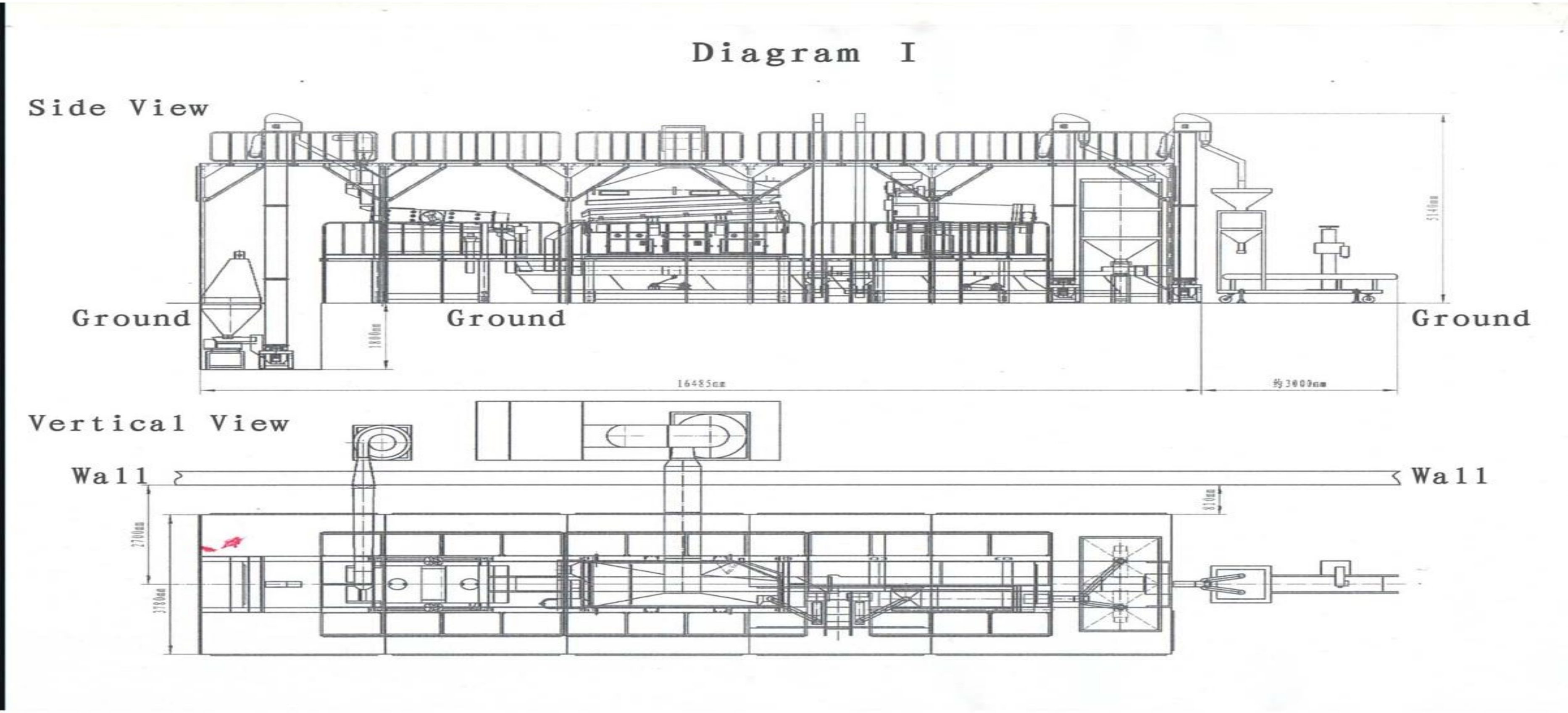
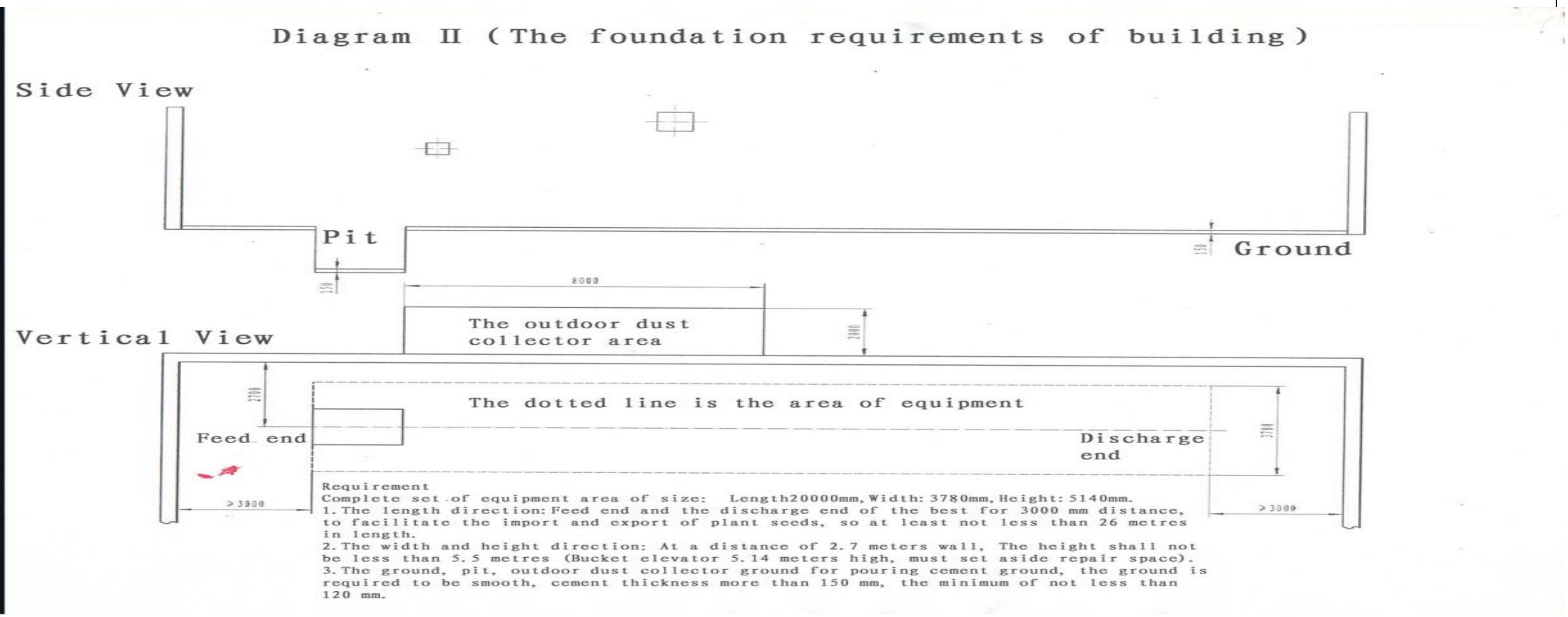


Diagram I
Side View
Ground
Ground
Ground
Vertical View
Wall
Wall

示意图二



要求：Requirement

整套设备占地尺寸为 Complete set of equipment area of size: Lenght20000mm, Width:3780mm, Height:5140mm.

1. 长度方向 The length direction

喂入端以及出料端最好预留 3000 毫米以上距离，以方便种子的运进运出，所以厂房长度最少不要小于 26 米。

Feed end and the discharge end of the best for 3000 mm distance, to facilitate the import and export of plant seeds, so at least not less than 26 metres in length.

2. 宽度方向和高度 The width and height direction

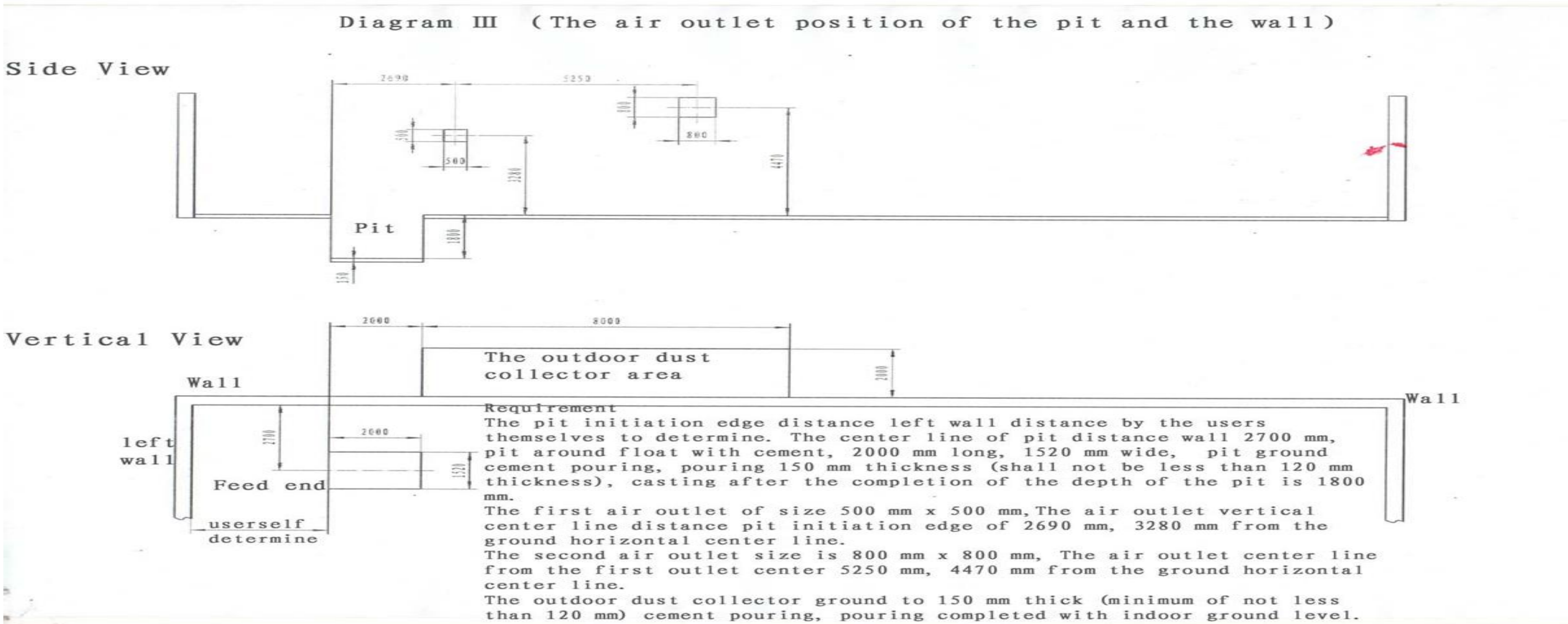
厂房宽度不得小于 6 米。Plant width shall be not less than 6 metres 在距离墙边 2.7 米处，高度不得小于 5.5 米（提升机高 5.14 米，必须要留出维 修空间）

At a distance of 2.7 meters wall, The height shall not be less than 5.5 metres (Bucket elevator 5.14 meters high, must set aside repair space)

3. 地面、地坑、室外除尘器地面要求为水泥浇筑的地面，地面要求平整，水泥厚度在 150 毫米以上，最低不得低于 120 毫米。

The ground, pit, outdoor dust collector ground for pouring cement ground, the ground is required to be smooth, cement thickness more than 150 mm, the minimum of not less than 120 mm.

示意图三



要求：Requirement 地坑起始边距离左墙距离由用户自己确定，地坑中心线距离墙边 2700 毫米，地坑四周用水泥抹平后，长 2000 毫米，宽 1520 毫米；地坑地面用水泥浇筑，浇筑厚度 150 毫米（最小不得小于 120 毫米），浇筑完成后地坑深度为 1800 毫米。 第一个出口口尺寸为 500 毫米×500 毫米，出风口垂直中心线距离地坑起始边 2690 毫米，水平中心线距离地面 3280 毫米。

The pit initiation edge distance left wall distance by the users themselves to determine. The center line of pit distance wall 2700 mm, pit around float with cement, 2000 mm long, 1520 mm wide, pit ground cement pouring, pouring 150 mm thickness (shall not be less than 120 mm thickness), casting after the completion of the depth of the pit is 1800 mm.
The first air outlet of size 500 mm x 500 mm, The air outlet vertical center line distance pit initiation edge of 2690 mm, 3280 mm from the ground horizontal center line.
第二个出风口尺寸为 800 毫米×800 毫米，出风口中心线距离第一个出风口中心 5250 毫米，水平中心线距离地面 4470 毫米。
The second air outlet size is 800 mm x 800 mm, The air outlet center line from the first outlet center 5250 mm, 4470 mm from the ground horizontal center line
室外除尘器需要 150 毫米厚（最小不得小于 120 毫米）水泥浇筑，浇筑完成后室 内地面齐平。
The outdoor dust collector ground to 150 mm thick (minimum of not less than 120 mm) cement pouring, pouring completed with indoor ground level.

Seed Treating Equipment

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Seed Treating Equipment

- The application of seed treatment materials is a specialized operation and is usually the last step in seed processing.
- Treatment materials are applied as dusts, slurries, or liquids.
- The equipment used to apply chemicals to seed are classed as seed treaters and the design can be divided into *Continuous Treating* and *Batch Treating.*

SeedTreating

The basis of selecting treatment materials, and characteristics of treatment materials will not discussed here, it is beyond the scope of this class.

Seed Treating Equipment - Treatment

- Common Seed Treatment Products:
  - Fungicides
  - Insecticides
  - Nematicides
  - Avicides
  - Polymers
  - Inoculants
  - Colorants
  - Others?

- Chemical Forms
  - Powder (Dust)
  - Slurry (Suspension)
  - Liquid film coating

** Treated seed MUST be colored and labeled to distinguish it from seed intended for human or animal consumption!!

Seed Treating Equipment – Safety

- Protective Gloves – Chemicals
  - Minimum 14 mil Thickness
  - DO NOT USE disposable Latex gloves

- Goggles – Splash & Dust Protection
  - Standard safety glasses are NOT adequate

- Face Shield – Eye & Face Protection
  - Typically used in addition to goggles

- Respirator
  - Must be rated for chemical type in use
  - Periodic fit test and employee physicals may be required for many applications

Seed Treating Equipment – Designs

- Continuous Flow System:
  - Apply treatment at a predefined rate to the *continuous* flow of seed.
  - High capacity.
  - Low to medium application rates.
  - Single treatment chemical layer.

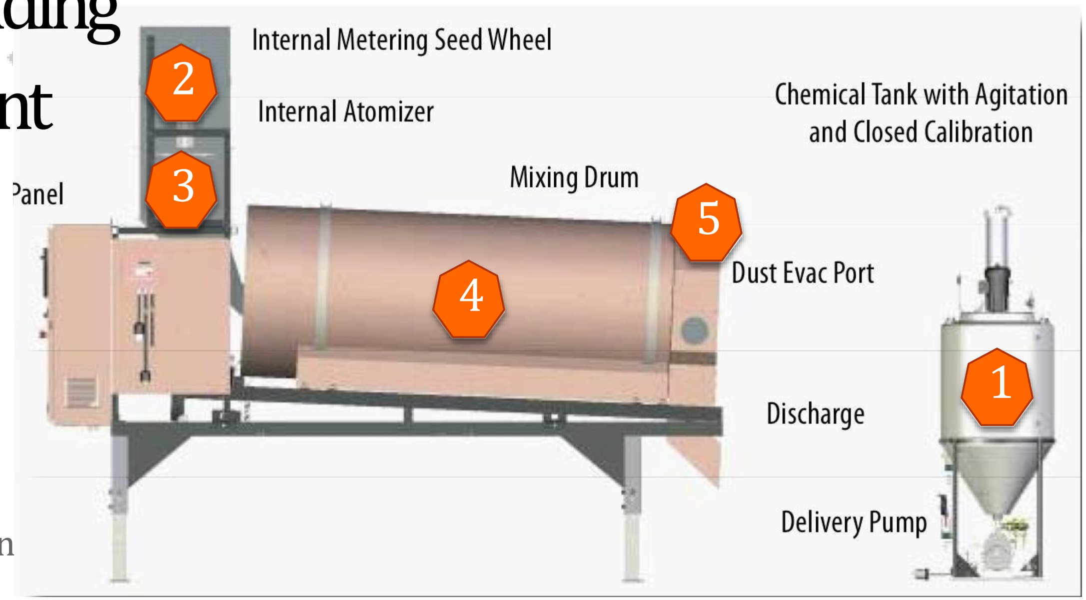
- Batch System:
  - It delivers a predetermined *batch* size into a mixing chamber.
  - Low capacity.
  - High chemical application rates.
  - Flexible – multiple chemical layers.

Closed System

Open System

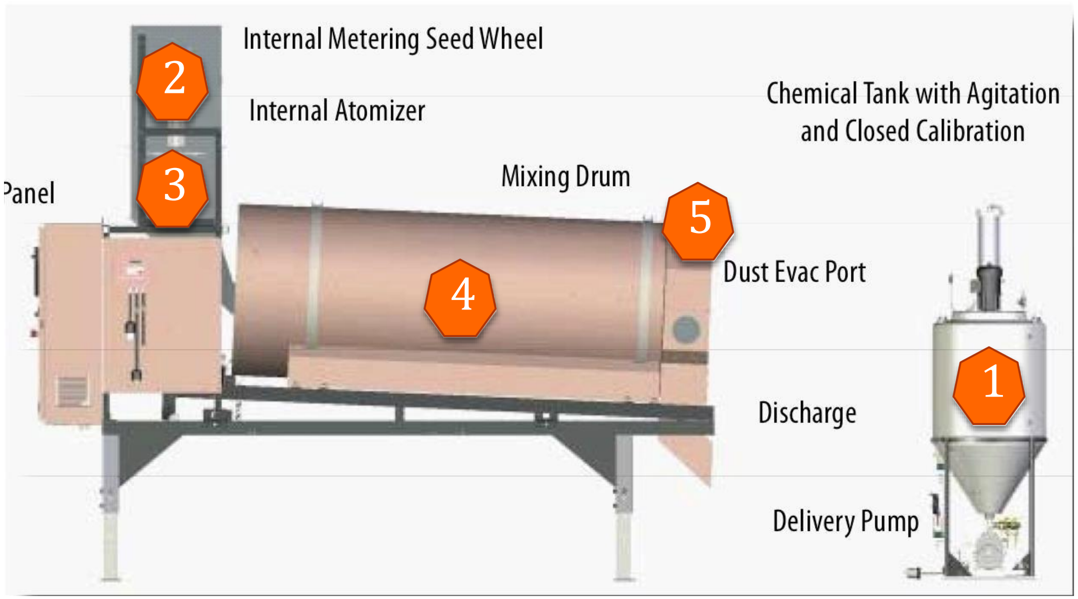
Seed Treating Equipment – Elements

- A closed treating system, batch or continuous, consist of five process elements:
  1. Storage and transfer
  2. Delivery and metering of seed
  3. Delivery and application of treatment
  4. Mixing and blending
  5. Dust containment



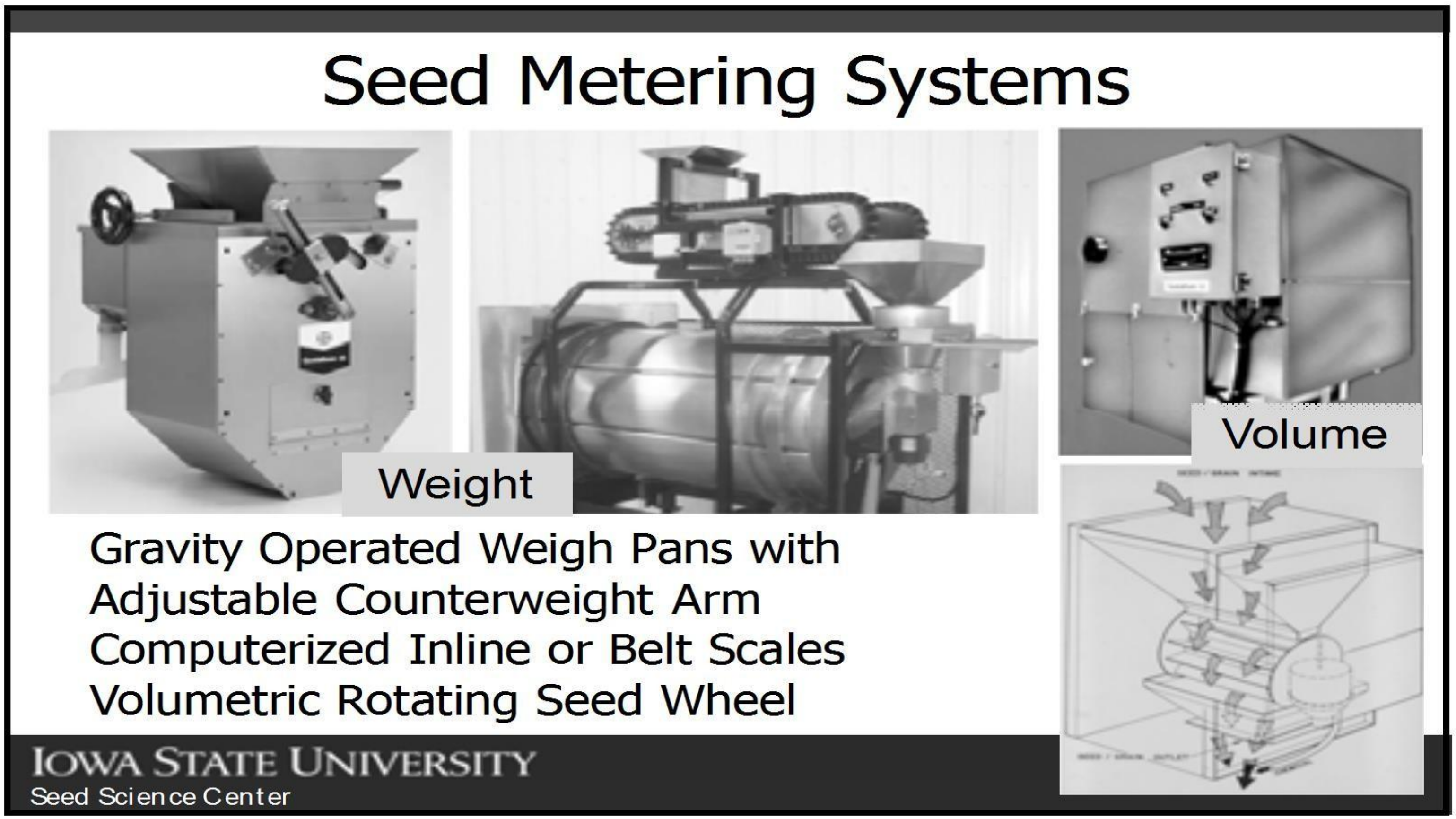
Seed Treating Equipment – Elements

- 1. Storage and transfer:
  - Seed – Holding bin
  - Chemical – Bulk container, transfer pump, and mixing tank



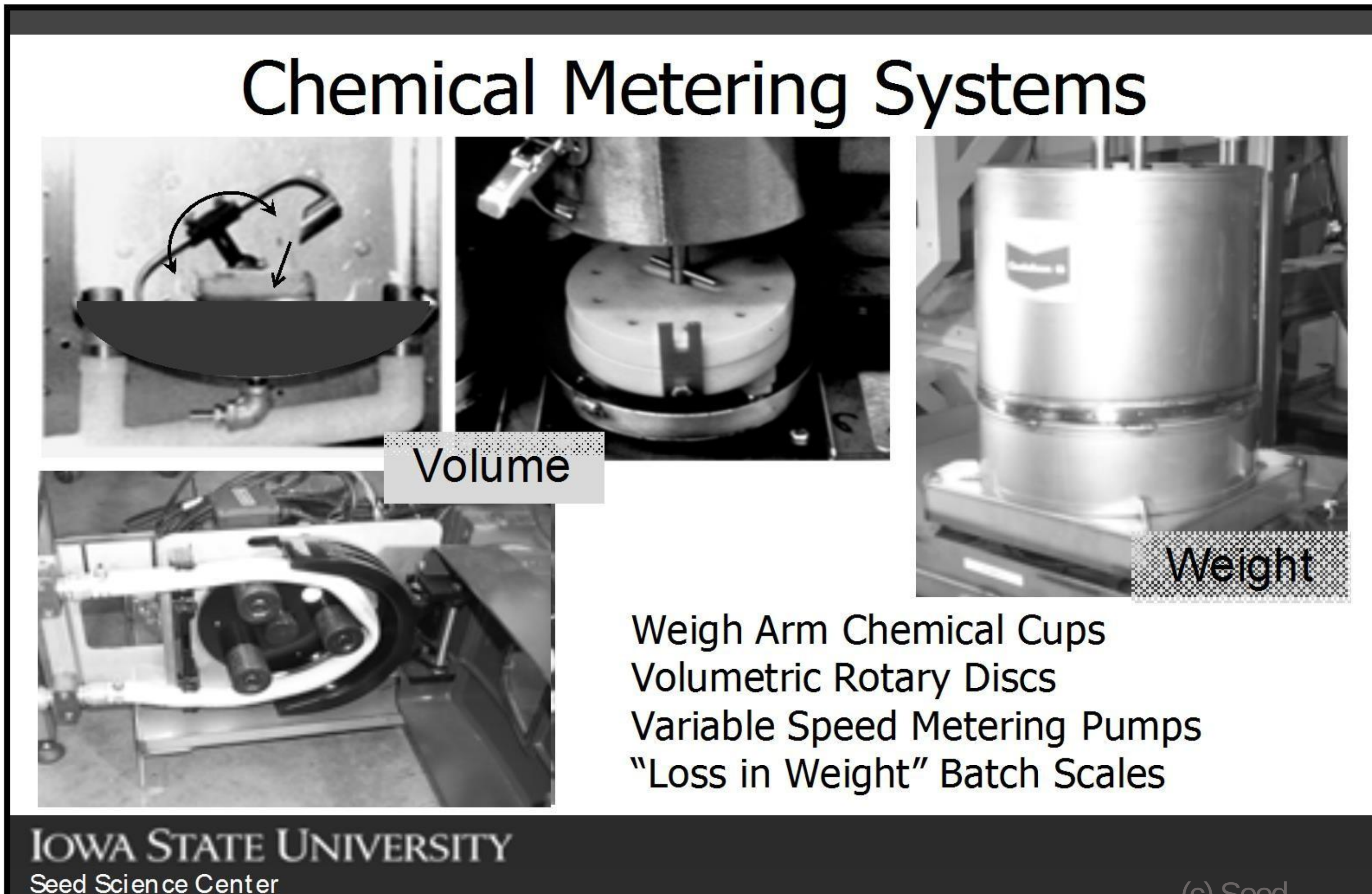
Seed Treating Equipment – Elements

- 2. Delivery and metering of seed:



Seed Treating Equipment – Element

- 3. Delivery and application of treatment:



Seed Treating Equipment – Element

4. Mixing and blending:

Mixing Drum

(shown with treating head)

Mixing Drum

(view inside drum)

Mixing Bowl

(shown inside CBT Bowl)

- Primary Mixing: Direct application to seed
- Secondary Mixing: Seed contact transfer, blending action effects
- Drying and absorption: Ambient or artificial drying equipment

Seed Treating Equipment – Element

Fan/Blower Motor

Dust Evacuation Port

Dust Evacuation System

Seed Treating Equipment – Calibration

Weigh Arm Calibration Example

- Label Rate Range: 10-12 Fluid Oz/Cwt
- Converted Range: 296-355.2 CC/Cwt
- Trip Count for 100 lbs = 20 Trips/Cwt
- Seed/trip:

$$\frac{\mathbf{100\ Lb}}{\mathbf{1\ Cwt}} \times \frac{\mathbf{1\ Cwt}}{\mathbf{20\ Trip}} = \frac{\mathbf{5\ Lb}}{\mathbf{Trip}}$$

- Cup Size:

$$\frac{\mathbf{296\ CC}}{\mathbf{1\ Cwt}} \times \frac{\mathbf{1\ Cwt}}{\mathbf{20\ Trip}} = \frac{\mathbf{14.8\ CC}}{\mathbf{Trip}}$$

$$\frac{\mathbf{355.2\ CC}}{\mathbf{1\ Cwt}} \times \frac{\mathbf{1\ Cwt}}{\mathbf{20\ Trip}} = \frac{\mathbf{17.8\ CC}}{\mathbf{Trip}}$$

- Chemical Cup Size: 15 CC/Cup

IOWA STATE UNIVERSITY
Seed Science Center

- Images courtesy of Gustafson (BCS)

Seed Treating Equipment – On Farm

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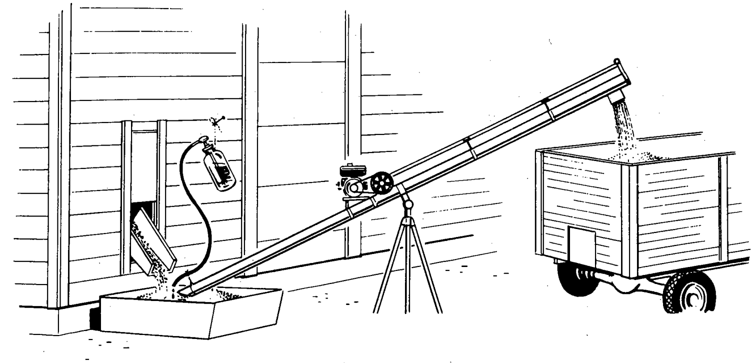

Figure J6. The application of seed treatment during conveying of seed.

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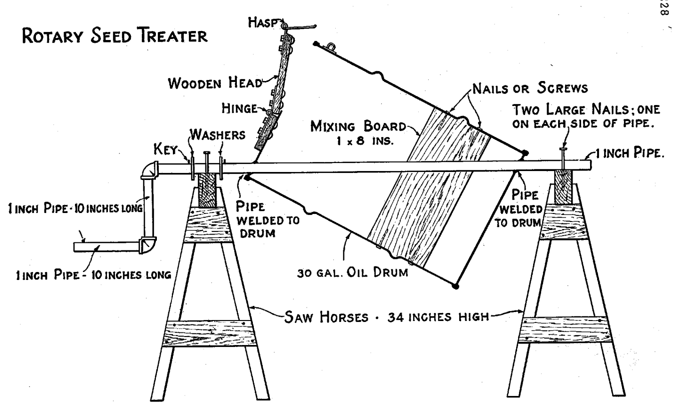


Figure J5. On-the-farm rotary seed treater used to apply seed treatment materials.

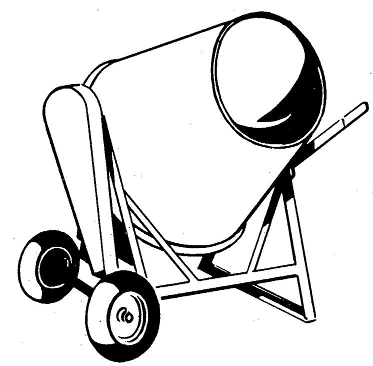
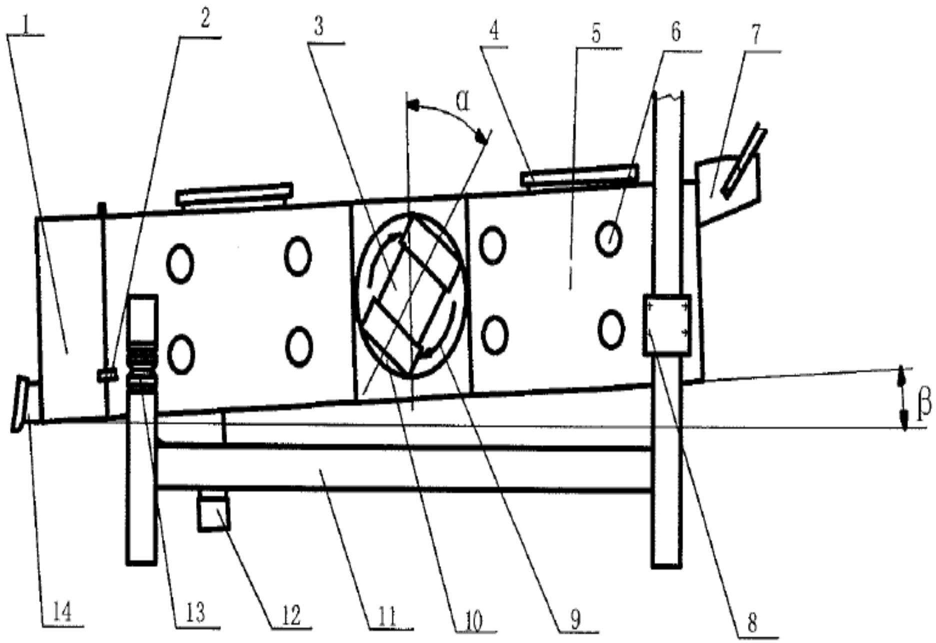


Figure J7. A small cement mixer can be used as a seed treater.

Questions?

5XZC-5BX Air-Screen Cleaner

5XZC-5BX种子加工车



1.出料箱 2.出料箱锁紧机构 3.振动电机 4.观察窗 5.振幅指示牌 6.大旋钮 7.进料箱
8.螺栓 9.螺栓 10.调向盘 11.机架 12.小杂出口 13.橡胶弹簧 14.合格种子出口

筛选机结构示意图　图三

5XZC-5BX Air-Screen Cleaner

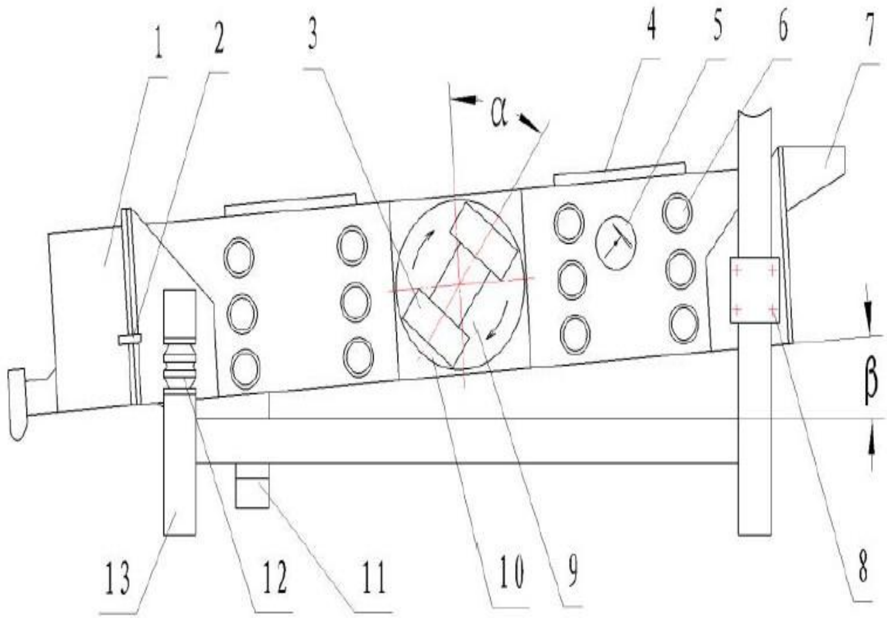


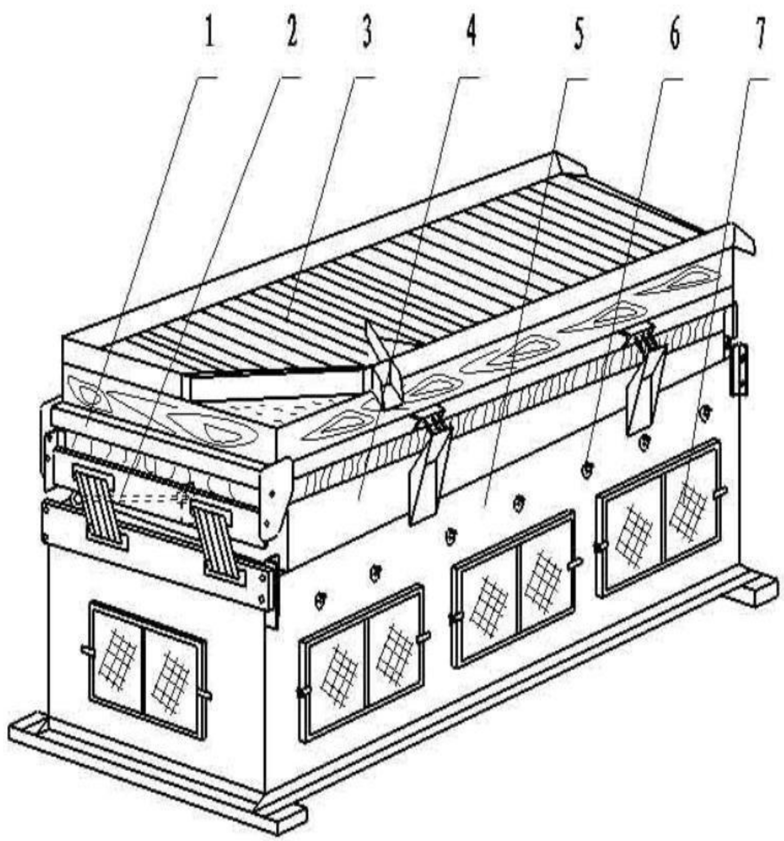
Figure 3 Screen machine instruction sketch

1.Material output-box 2.Locking device 3.Vibration motor 4.Observation window 5.Amplitude signs 6.Large knob 7.Material input box 8.Screw bolt 9.Screw bolt 10.Adjustment direction brand 11. Small impurity exit 12.Rubber spring 13. Rack

5XZ Gravity Table Separator

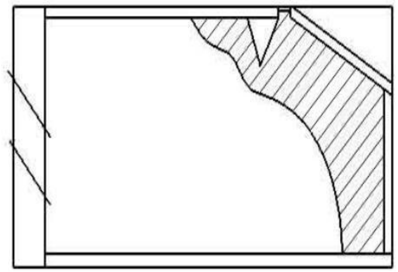
5XZ Gravity Table Separator

The structure of the total machine（Figure 1）

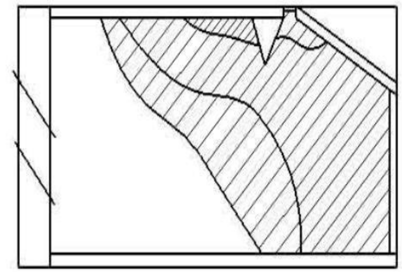


1. Brackets 2. Off center eccentricity-driven 3. Screen 4. Air chamber 5.Fan chamber
6. Air volume adjusting handle 7. Dust screen

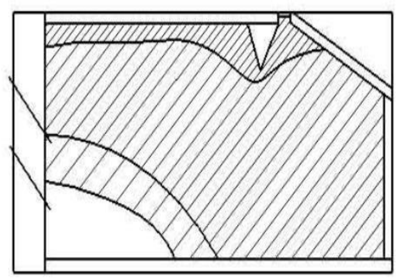
5XZ Gravity Table Separator



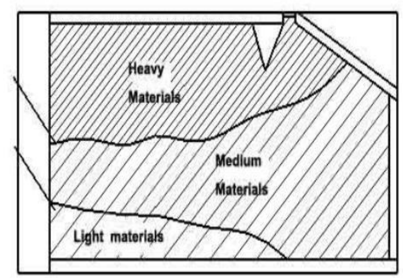
The first step



The second step



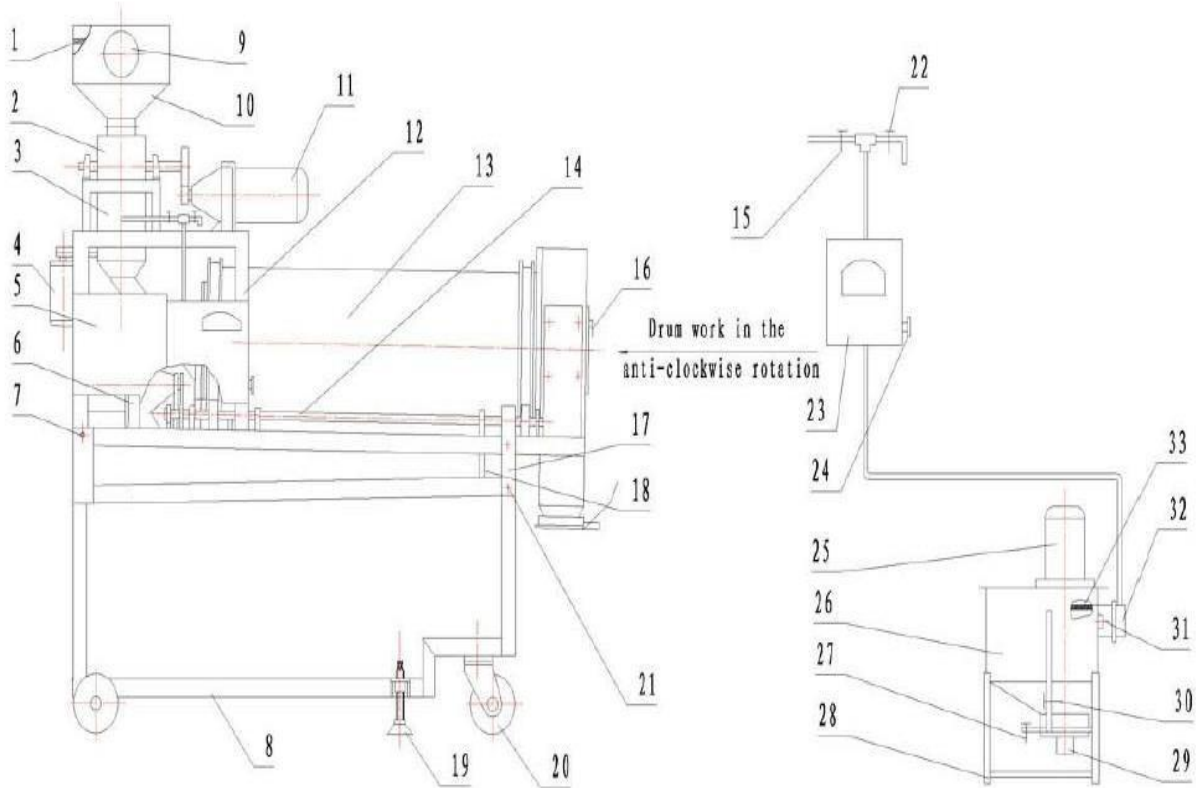
The third step



The fourth step

5BXY-5 Seed Coating Machine

5BXY-5 Seed Coating Machine



1. Baffle guard 2. Rotation input plate 3. High speed centrifugal throw disk atomizing drug material mixed device
4. Throw disk motor 5. Power distribution box 6. Drum reducer 7. Pivot pin 8. Supporting structure
9. Observation glass 10. Seeds box 11. Feeding reducer motor 12. Feeding bracket 13. Drum 14. Driven system
15. Drug maxture input ball-valve 16. Tool box 17. Securing plate 18. Adjustment-pole 19. Support post 20. Wheel
21. Securing plate bolt 22. Drug volume test ball-valve 23. Flowing control box 24. Flowing adjustment handle
25. Motor of drug liquid pump 26. Drug liquid box 27. Drug liquid ball-valve 28. Bracket 29. Drug liquid pump
30. Return liquid ball-valve 31. Fix bolt for filter box 32. Drug liquid filter box 33. Drug liquid filter screen

Structure diagram of 5BXY-5 type seed coating machine

5BXY-5 Seed Coating Machine

- By Dr. Duncan O. Mbuge

Contents

1. **Seed Quality Control In Seed Processing**

SEED QUALITY CONTROL IN SEED PROCESSING

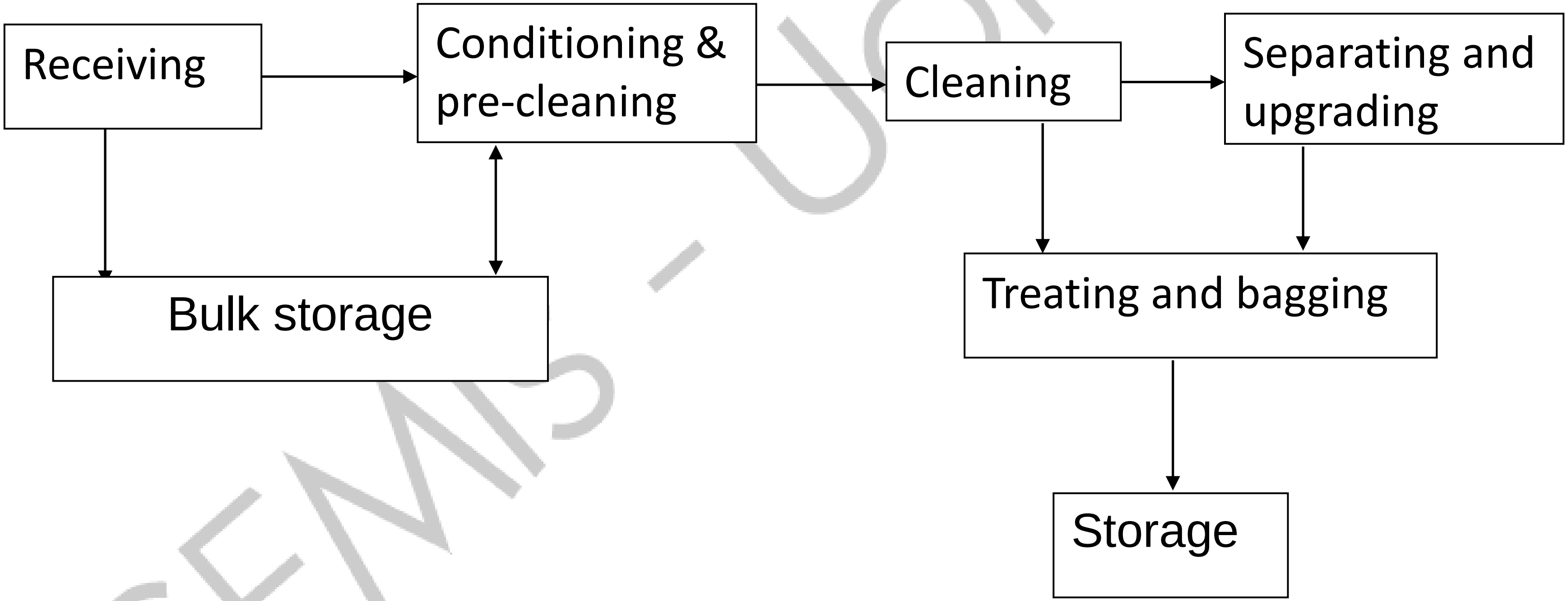
Dr. Duncan O. Mbuge

University of Nairobi

School of Engineering

Department of Environmental and Biosystems Engineering

BASIC FLOW AND ESSENTIAL STEPS IN SEED PROCESSING



1. MECHANICAL DAMAGE

May occur during the following operations:

(a) HARVESTING

- Machine harvesting for grain
- Hand harvesting for root crops

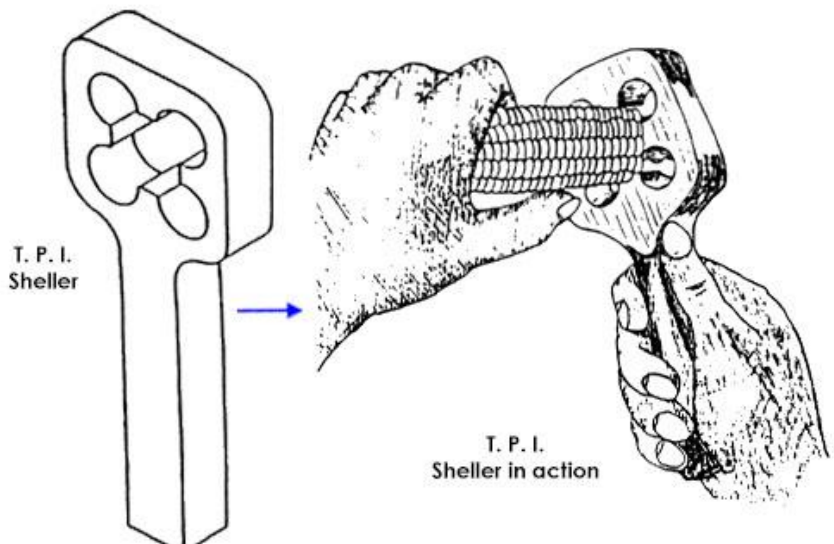
(b) SHELLING / THRESHING

Damage is caused by:

- Beating seed with sticks in sacks
- Interaction with machine parts

Performance of Tubular Maize Sheller as compared to traditional practices

Particulars	Tubular Maize Sheller	Beating maize with stick
Shelling efficiency (%)	98	90
Labor requirement (Man-hour/q)	4	4.30
Field Capacity (Kg/hour)	25	22.22
Damage/Broken grains (%)	1	10


T. P. I.
Sheller
T. P. I.
Sheller in action

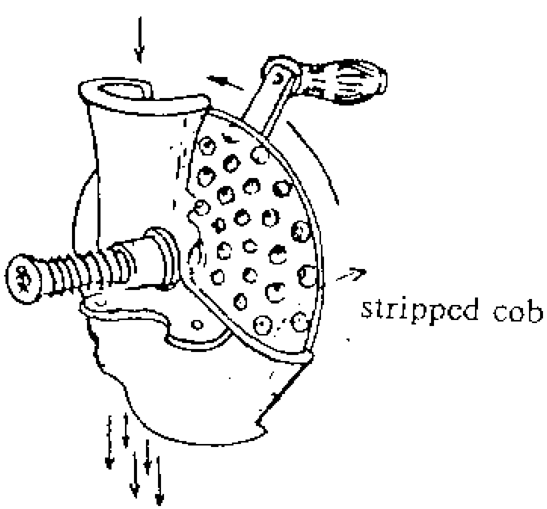
BEST PRACTICES FOR MACHINE SHELLING

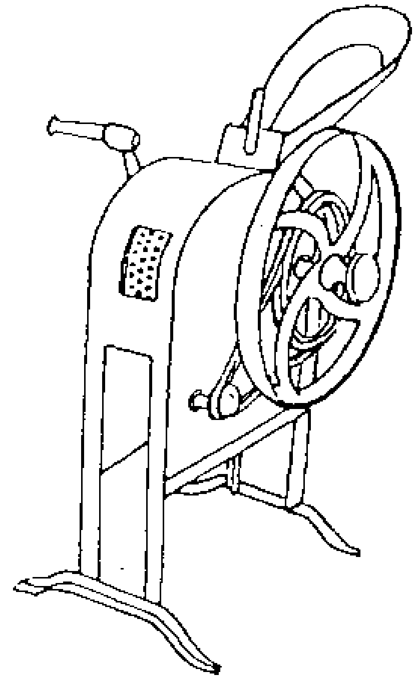
Baker *et al. (1991) found that drying,* germination of shelled maize seed were affected greatly than the unshelled seeds.

To reduce mechanical shelling damage do the following:

- For shelling, optimum level of moisture content should be 13-20%.
- For preventing, reducing mechanical damage or cracking of seeds, speed of shelling machine is needed to adjust.

After shelling, seeds can be redried to reduce seed moisture content for good storage level (lower than 11 %)

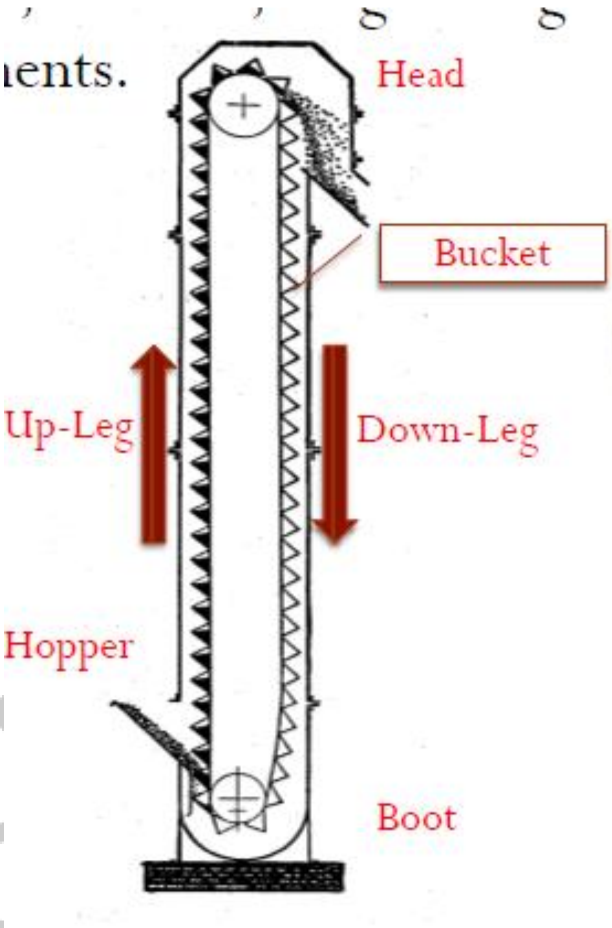




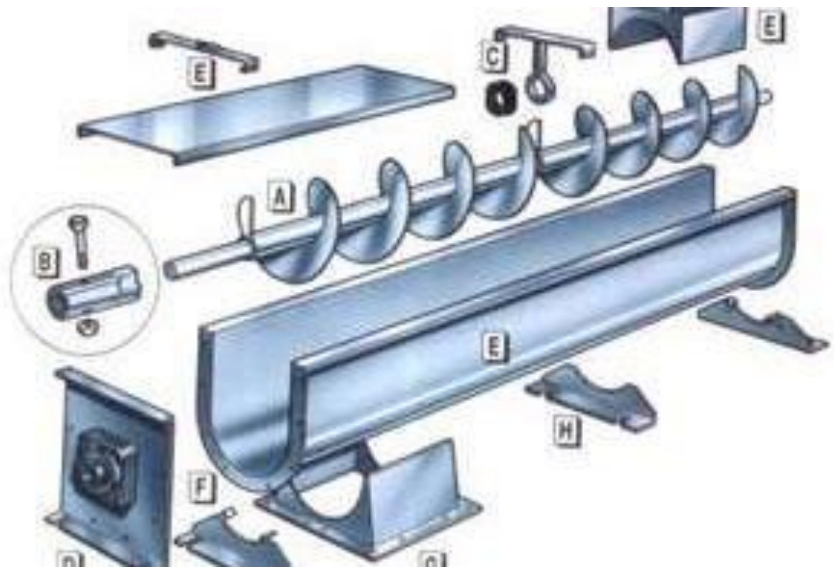
Source: CIRAD

(c) CONVEYING DEVICES

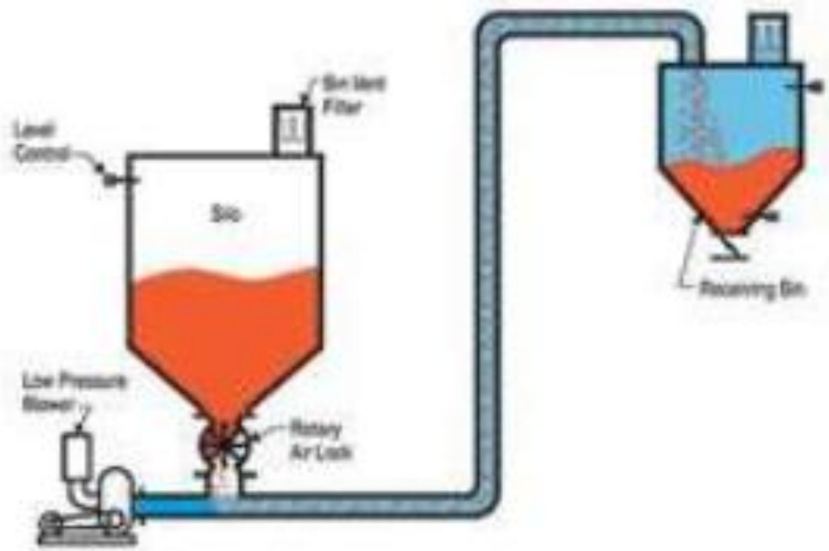
Bucket elevators may cause impact damage as seed is thrown at the head



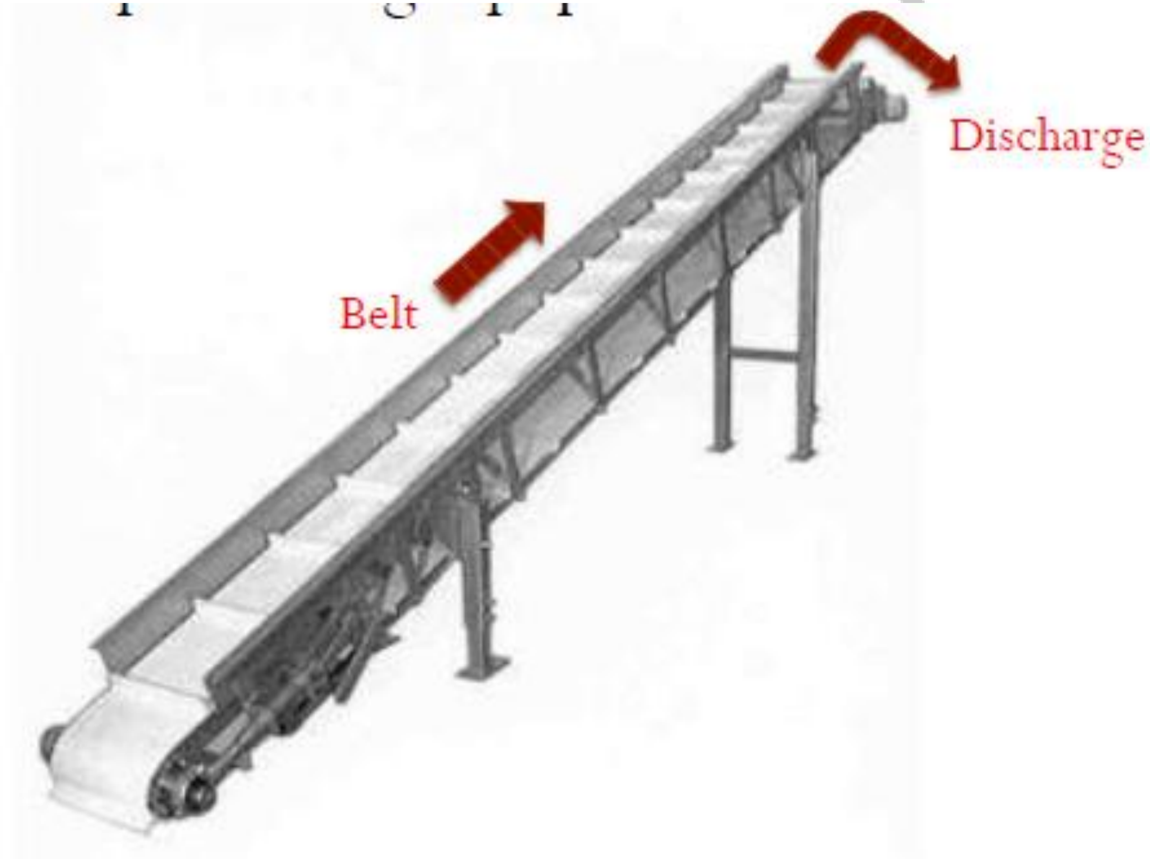
Screw feeders may compress the seed to breakage



Pneumatic conveyors may damage seed



Belt conveyors are much better

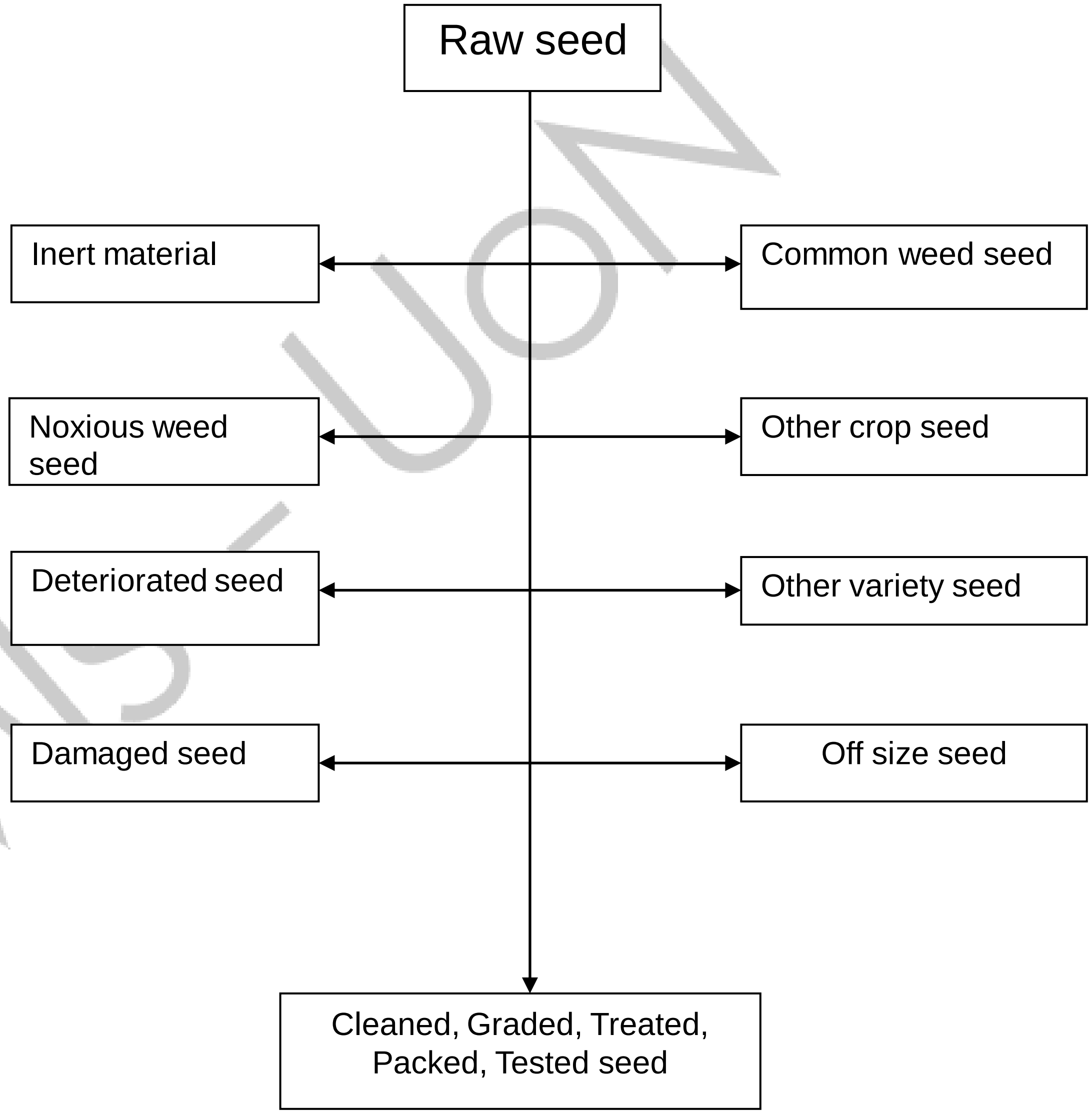


Vibrating conveyors are much better

Lift Truck

2. REJECTS FROM SEED PROCESSING

Reduces quality



3. ENVIRONMENTAL CONDITIONS

Dry cool conditions are best for seed storage.

a) SEED MOISTURE AND HUMIDITY ON SEED LONGEVITY:

The general relationship is that for each one percent increase in seed moisture, longevity decreases by half (Harrington, 1972). This rule applies to seed with moisture content between 5 and 13%.

Above 13% moisture content, seed storage fungi and increased heating due to respiration cause longevity to decline at a faster rate.

Once seed moisture reaches **18 to 20%,** increased respiration, and the activity of microorganisms cause rapid deterioration of the seed.

- **40-80%** Moisture content of developing seed. Seed not mature enough to harvest
- **18-40%** Physiologically mature seed, High respiratory rate, susceptible to field deterioration, ***heating*** occurs if seed is bulked without proper ventilation.
- **13-18 %** Respiratory rate still high, mold and insects can be damaging and seed resistant to mechanical damage
- **10-13 %** Seed store well for 6-8 months in open storage in temperate climates.
- **8-10 %** Seed sufficiently dry for 1-3 years open storage in temperate climates. Very little insect activity.
- **5-8%** Safe moisture for sealed storage
- **0-5%** Extreme desiccation. Can be damaging to seed.
- **33-60%** Seed germinates when they imbibe water to these levels.

How do you tell when your seed is dry enough for storage?

Share any simple techniques

(b) Temperature

- The general effect of temperature on longevity is that longevity increases as temperature decreases.
- The relationship between temperature and seed longevity is that for each 5.6 °C decrease in temperature, longevity doubles.
- This rule applies to seeds stored between temperatures of 0 °C and 50 °C. This rule assumes that the moisture content is a constant.
- temperature is **less than 45 °C** is favorable for seed germination and vigor.
- Drying of seed at **50 °C** causes damage of seed
- At **60 °C** causes germination loss
- At **70 °C** all seeds can be lost

(c) Illumination

- Seeds stored in glass containers should be stored out of direct sunlight because of the localized "**greenhouse heating effect**" on seeds.

- Drying seeds in the sun is a questionable practice if the air temperature is above 32 oC. The air temperature at the seed surface is higher because of the conversion of light energy into heat at the seed surface, and the heat is "**moist heat**".

- **Ultra-violet light** from the sun may have a deleterious effect on seed longevity while the seeds are drying (Harrington, 1972).

4. **SLOW COMPRESSIVE DAMAGE IN STORAGE**

Stacking too many bags of seed may result in slow mechanical damage of the seeds at the bottom of the stack

QUALITY MEASUREMENT

Normally, germination tests considered as quality
test of seed during conditioning and it is indicated by germination percentage. It can not indicate the change of seed vigor and the step of conditioning

- *Standard germination test* ***: It was done by following ISTA,(1985).***
- *Membrane deterioration test : It was done by Electrical conductivity (AOSA, 1983)*
- *Seed leachates : It was done by Tetrazolium test (ISTA,1985)*
- *Seedling growth rate (SGR) : It was determined by ISTA, (1985)*
- *Seed damage by Fast green test (0.1%)*

- By Joackim Mutua

Contents

1. Safety And Health Management - General & Kenya
2. Safety And Health Management In The Seed Processing

MANAGEMENT

BY

JOACKIM MUTUA

DEPT OF ENVIRONMENTAL AND BIOSYSTEMS ENGINEERING

QUESTIONS

- How many have a law on safety and health
- How many have safety and health mgt systems
- OSH Policy
- Safety officers
- Safety committees
- Examination of plants
- Medical exams
- Osh audits
- Fire safety audits
- Fire drills
- etc

A workplace

- A place where goods and services are produced. This a positive side of it.
- Ill health, diseases, accidents and damage to property may occur as unintended products of the work activities.

The tripartite approach

- Good OSH management requires a tripartite approach- Government, Employer, and Employee
- Each organ has specific roles in the management of OSH

GOVERNMEMT

- The government provides the national framework for management of occupational health and safety as follows.
- National policy- legislation on occupational health and safety. OCCUPATIONAL SAFETY $ HEALTH ACT 2007 and rules have been made
- A department- DOHSS established for the promotion of occupational health and safety.

Government continued

- The national advisory committee on occupational health and safety.
- Occupational health and safety officers for enforcement
- Health and safety advisers have been approved for advice to employers.
- Air quality monitors,
- Engineering Controls Examiner
- Fire safety auditor

Government- Conti--

- Authorised persons have been approved for testing and examination of plants
- Doctors –designated health practitioners
- Institutions have been approved for facilitating quality training.
- The government reviews and updates legislation
- Providing guidelines - codes of practice

Employer- Managing Safety and Health

- Development of policy on occupational health and safety to ensure compliance with the national legislation and best practices.
- set out in writing the occupational safety and health policy.
- Organization of health and safety function
- Planning and implementation of policy
- Measuring performance
- Reviewing performance

Safety and Health Policy

- The policy for the organisation should be concise, clearly written, dated and signed by the most senior accountable person
- Included a clear statement of commitment
- Should give direction and influence activities.
- Involve workers for ownership
- Be readily accessible to all workers
- Be made available to other interested parties
- Be reviewed for continuing suitability.

Organizing OSH functions- control

- Provide strong leadership and commitment to OSH by appointing a senior manager to take charge of the health and safety function.
- Assign responsibility for safety to every person so that managers, supervisors, and employees in the organisation know what performance is expected of them.
- Integrate health & safety in all company functions
- Set up a health & safety committee.
- Set targets -expected performance of every worker
- Provide resources for the health & safety activities.

Organizing OSH functions- Competence

- Recruit competent employees and contractors.
- Assess the skills to carry out all the tasks
- Ensure that the managers, supervisors and workers are adequately instructed and trained skills to carry out tasks safely
- Provide for newly employed persons to undergo adequate induction
- Arrange for a suitable induction for all visitors on site.
- Train adequately members of the Safety and Health Committee.
- Arrange for access to sound technical advise-appoint OSH adviser.

Organizing OSH functions- Cooperation

- Involve workers in OSH matters for synergy and ownership.
- Clearly spell out employee responsibility in OSH matters.
- Coordinate and cooperate with contractors at your workplace
- Chair meetings
- Motivate workers through incentives
- Encourage employee involvement in safety matters even at individual level

Organizing OSH functions-Communication

- Provide information on hazards and preventive measures to employees and contractors
- Discuss openly health and safety regularly
- Make health and safety visible– posters, signs

Planning and implementation

- Setting objectives- what you want to achieve-agreeing on OSH targets with managers
- Identifying hazards and assessing risks – deciding how to eliminate them.
- Complying with the legislation and best practices
- Developing Safe work procedures
- Setting standards against which performance will be measured
- Implementing the standards of performance

Measuring your performance

- What did you plan to achieve? Expected performance.
- Where are you now?-Actual performance. Establish whether targets and standards have been achieved. Whether the solutions in place are effective?
- What is the difference- (performance gap-deficiency) and why?

Monitoring systems- proactive

- Active monitoring – looking at things before things go wrong. Do not Condone Murphy's law.the following tools should be used;

  - Regular workplace inspection of the organisation itself (self inspection)
  - Annual health and safety audits by external agency
  - Medical examinations of workers
  - Thorough examination of plants by approved persons.

Monitoring systems-reactive

- After things go wrong. Investigating injuries, cases of illness, property damage, near misses
- In each case determining why performance was not to standard
- What improvement to undertake?

Reviewing effectiveness of your policy

- Degree of compliance with health and safety compliance standards
- Areas where standards are non existent or inadequate
- Achievement within set time scales
- Accident, illness data –analyses –trends and common features
- Lessons learned from your mistakes and success.

EMPLOYEE ROLE

- To cooperate with their employer to ensure success of the policy
- Be interested in learning and developing skills on OSH
- Comply with all safe work procedures and practices
- Make use of the protective appliances provided for use
- Report all unsafe conditions, acts and practices noted

Way forward

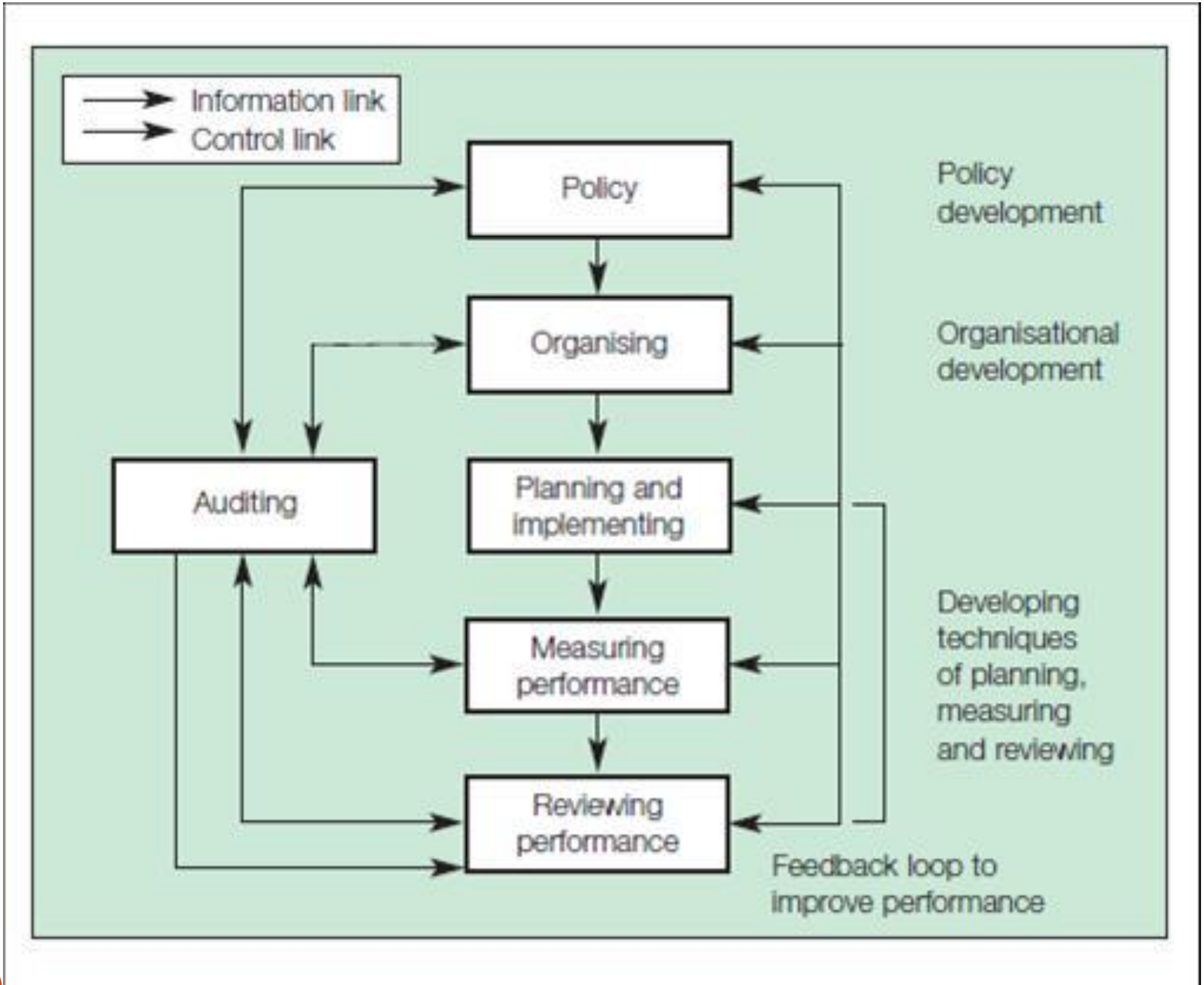
- Manage health and safety just as you manage other functions of the Organization to Protect people and control loss.
- Act today - Do not wait to react to an accident tomorrow.

PREFERRED HIERARCHY OF RISK CONTROL PRINCIPLES

- The following is a summary of the preferred hierarchy of risk control principles:
- **Eliminate risks** by substituting the dangerous by the inherently less dangerous, eg:
- use less hazardous substances;
- substitute a type of machine which is better guarded to make the same product;
- avoid the use of certain processes, eg by buying from subcontractors.

- **Combat risks** at source by **engineering controls** and giving collective protective measures priority, eg:
- separate the operator from the risk of exposure to a known hazardous substance by enclosing the process;
- protect the dangerous parts of a machine by guarding;
- design process machinery and work activities to minimise the release, or to suppress or contain airborne hazards;
- design machinery which is remotely operated and to which materials are fed automatically, thus separating the operator from danger areas.

- **Minimise risk by:**
- designing suitable safe systems of working;
- using personal protective clothing and equipment; this should only be used as a last resort.
- The hierarchy reflects the fact that eliminating and controlling risk by using physical engineering controls and safeguards is more reliable than relying solely on people.


Information link
Control link
Policy
Organising
Planning and implementing
Measuring performance
Reviewing performance
Auditing
Policy development
Organisational development
Developing techniques of planning, measuring and reviewing
Feedback loop to improve performance

SAFETY AND HEALTH MANAGEMENT IN KENYA

Occupational Safety and Health in Kenya

- The law to regulate health and safety in Kenya has been in existence since 1951; as "The Factories and Others places of work act, cap 514.
- The Directorate of Occupational Safety and Health Services(DOHSS) – Ministry of labour Is charged with the implementation of the Health and Safety legislation
- Current act: Occupational Safety and Health Act, 2007 (OSHA, 2007)
- Came in to effect in 2007 and repealed The Factories and Other Places of work act, Cap 514.

- AN ACT of Parliament to provide for the safety, health and welfare of workers and all persons lawfully present at workplaces, to provide for the establishment of the National Council for Occupational Safety and Health and for connected purposes

- DOHSS is responsible for ensuring that necessary and adequate provisions are made at all work places for the prevention of occupational diseases and accidents; promotion of workers' health, safety and welfare as specified under the relevant ILO Conventions and national safety and health laws and regulations.
- The department's services in this area are beneficial not only to the workers but also the employers that benefit from high productivity and safety for their equipment and other facilities.

- The directorate has officers in National, provincial and district levels. Their work is to inspect all workplaces and ensure the workers safety is fully addressed.
- The officers have powers to issue a stop or an improvement order. They can also take you to court if you are not complying with the law.
- Apart from the Occupational Safety and Health Officers who are GOK employees, DOHSS approves competent people to undertake safety and health audits, Medical exams, first aid training, plant examination, health and safety training, fire safety audits and training, etc.
- These approved persons are categorized as follows:

Categories of approved persons / Institutions

- Approved Plant Inspectors /Examiners
- Approved Training Institutions
- Approved OSH Advisers
- Approved Fire Safety Auditors
- Approved DHPs

SUBSIDIARY LEGISLATION

- Woodworking machinery rules-L.N 431/1959
- Docks rules L.N 306/1962
- First aid rules- L.N 160/1977
- Eyes protection rules L.N 44/1978
- Electric power special rules L.N 340/1979
- Cellulose solutions rules L.N 231/1957 revised,
- Building operations and works of engineering construction rules L.N 40/1984
- Health and safety committee rules-L.N 31/2004
- Medical examination Rules L.N24/2005
- Noise prevention and control Rules, L.N25/2005
- Hazardous Substances Rules, L.N.59/2007
- Fire Risk Reduction Rules L.N.60/2006

- The health and safety committee rules requires all employees which employ 20 workers and above to form safety and health committees which should comprise representation from both workers and management.
- The committee oversees the health and safety issues at the workplace.
- The rules also require the members to undergo a basic training in health and safety

- The directorate has come up with a syllabus which covers such topics as Machinery safety, electrical safety, chemical safety, fire safety, construction safety, HIV/AIDs awareness, Personal protective equipment/clothing, Occupational hygiene, first aid at work etc. The training takes 4 days and is conducted by approved training institutions.

Health & Safety Training Timetable

TIME / DATE	8:30-10:00	10:00-11:00	11:00 - 11:30	11:30-1:00	1:00 - 2:00	2:00-3:30	3:30 - 4:00	4:00-5:00
Day One	Course opening Health & Safety Management	Health & Safety Management	**B**	Machinery Safety	**L**	Plant safety	**B**	Electrical safety
Day Two	Health & Safety committees (composition, duties and operations)	Health & Safety committees (composition, duties and operations)	**R**	Chemical Safety	**U**	Fire Safety	**R**	Machine and manual Handling of Goods and materials
Day Three	Occupational health overview of causes of occupational disease & their management	Stress Management/ Drug & Alcohol abuse	**E**	Occupational hygiene (dust, fumes and noise hazards)	**N**	First aid management at workplaces	**E**	HIV / AIDS An Overview
Day Four	Occupational Accidents	Personal Protective Equipment (P.P.E.)	**A** **K**	Workplace inspection techniques	**C** **H**	Workplace inspection techniques (Practical)	**A** **K**	Official Closing

Safety and Health Audits

- The act requires all employers to conduct safety and health audit once in every period of 12 months
- They are supposed to hire the services approved OSH advisers to do the audit
- The audits should be done by approved OSH advisers who prepares a report and submits a copy of the report to DOHSS for follow-up.
- The directorate has come up with a code of practice for health and safety auditing to ensure nothing is left out.

Contents of safety audits

- Workplace Information
- Management of Occupational Safety and Health Policies
    - Safety and Health Policy
    - Assignment of Responsibilities
    - Organization for Safety and Health in the Company
    - Implementation of Safety Policy
    - Performance Monitoring
    - Occupational Safety and Health Training Programmes
    - Occupational Health Service Programmes,
    - List of Common ailment or complaints in the workplace
    - Medical Insurance Scheme
    - Employee Medical Examination,
    - Accident Information,
    - Information Systems,
    - Permits-to-Work,
    - Contractors & Suppliers,
    - Emergency Response Plan.

Contents contd

- Workplace Safety, Health and Welfare Conditions
    - Safety
    - Machinery Safety,
    - Chemical Safety,
    - Plant Safety,
    - Electrical Safety,
    - Fire Safety and
    - Construction Safety;
    - Transport Safety
  - Occupational Hygiene Conditions
    - Personal Protective Equipments,
    - Ventilation,
    - Overcrowding,
    - Lighting,
    - Noise,
    - Vibration,
    - Radiation,
    - Thermal Conditions,
    - Pressures
  - General Conditions
    - Ergonomics
    - Storage and Handling of Materials
    - House keeping
    - Welfare Facilities

- The act also requires workplaces to carry out risk assessment for all their activities to establish the risk levels and put control measures to minimize the risk.
- The act also classifies some machines and equipment as plants.
- These are things like steam boilers, lifting equipment, air receivers, steam receivers, etc. The reason is for safety.
- The act also requires all plants to undergo periodic examinations by an approved person and a report is submitted to DOHSS for follow-up.

- The act also requires all work places conduct a fire safety audit once in every period of 12 months.
- This is done by approved fire safety auditors.
- The act also specifies dangerous processes and work.
- It requires workers who are exposed to dangerous work processes to undergo various types of medical exams to establish the levels of damage.
- If one is found to be affected, he should be redeployed to another area. This is done by approved DHPs

- Workplaces include: Industries/Factories, hospitals, hotels, construction sites, agriculture based processing establishments like tea factories, coffee estates etc. All sectors are covered.
- Finally the act requires all workplaces to obtain annual registration as workplace from DOHSS

Some popular Safety Slogans

- Safety starts with you
- Don't learn safety through an accident
- Protect your hands, you need them to pick up your pay check
- Safety - A small investment for a rich future
- Let's all keep our heads, and other body parts, together
- Safety is no accident
- Don't watch her behind, Keep safety in mind!
- Arms work best when attached to the body

- THE END
- THANKYOU

- SAFETY AT WORKPLACES IN MOST CASES INVOLVES USE OF COMMON SENSE BUT COMMON SENSE IS NOT ALWAYS COMMOM

Why manage safety and health?

- Every working day in Great Britain at least one person is killed and over 6000 are injured at work.
- Every year ¾ of a million (750,000), people take time off work because of what they regard as work related illness
- About 30 million work days are lost as a result.
- Accidents and ill health are costly to workers and their families, employers and country's economy
- they may lead to damage to property or equipment, and lost production.
- Compensations, litigation, lost production time, stoppages etc

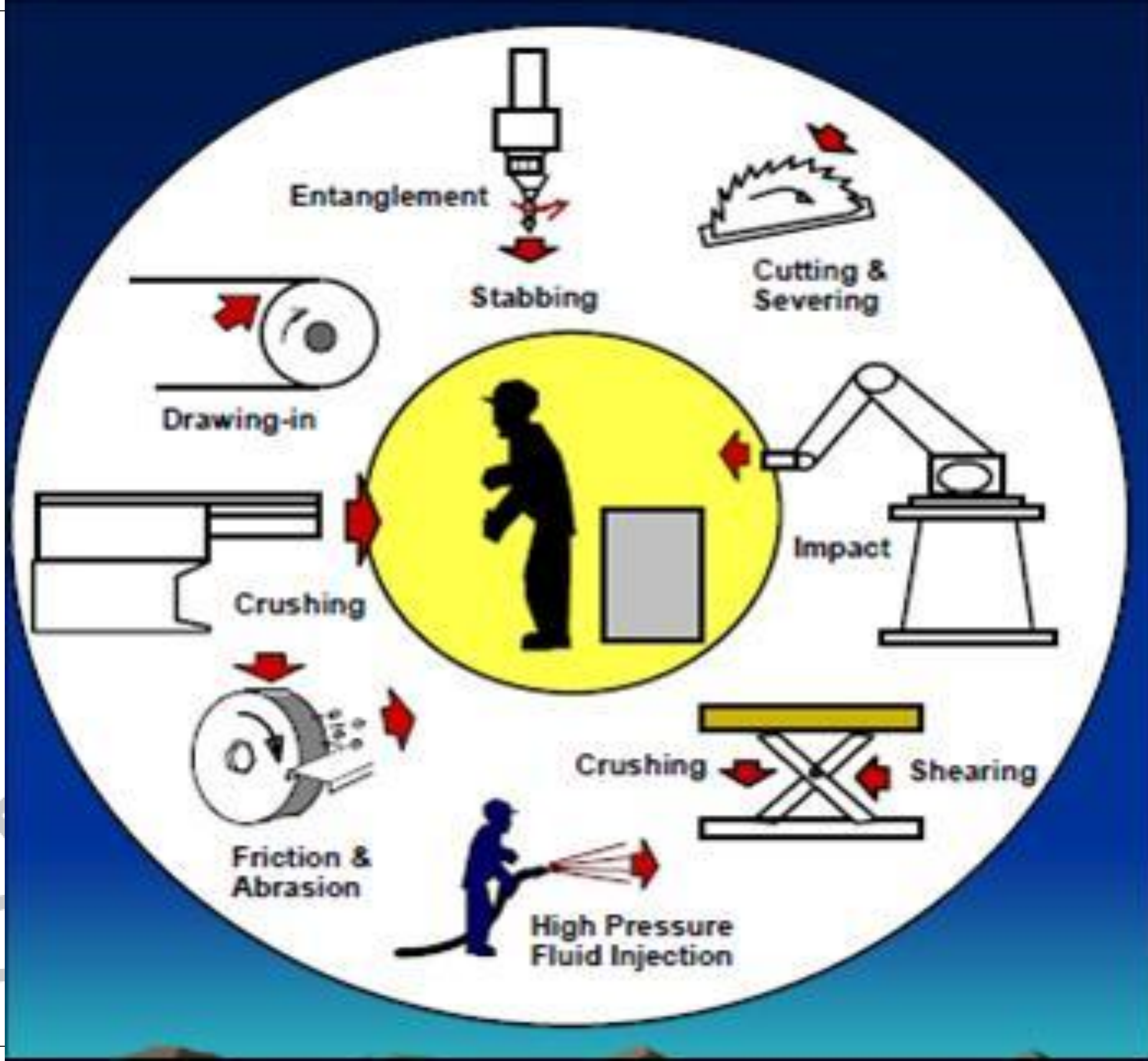
COMMON WORK HAZARDS

- MACHINERY
- ELECTRICITY
- FIRE
- CHEMICAL
- CONSTRUCTION
- PLANT
- TRANSPORT

MACHINERY SAFETY

Common Sources of Machinery Risk

- contact or entanglement
- crushing
- being struck by ejected parts
- being struck by material ejected


Entanglement
Stabbing
Cutting &
Severing
Drawing-in
Impact
Crushing
Crushing
Shearing
Friction &
Abrasion
High Pressure
Fluid Injection

Machinery Safety

- Other non- mechanical hazards associated with the use of machinery:
- Electricity;
- Heat;
- Noise;
- Vibration;
- Radiation;
- Hazardous materials and substances; and
- Ergonomic hazards.

Control Options
Engineering controls

- The most effective risk control measures are those implemented at the machine/work equipment design stage;
- In order to achieve this, manufacturers and suppliers need to carry out a risk assessment and demonstrate that all risks associated with the machine are adequately controlled by design, rather than by procedural controls.

Physical controls

- Safeguards and safety devices
- The main types of safeguards and safety devices can be classified as follow:
- fixed guards;
- fixed guards with adjustable elements;
- automatic guards;
- interlocked guards; and
- Safety devices including trip devices, such as photoelectric light curtains, pressure sensitive devices and two-hand control devices.

Human Factor Controls

- An important risk control measure for preventing machinery and work equipment accidents is a ***well-trained, well-disciplined and effectively supervised workforce.***
- The workforce must receive regular training in order to operate machinery and equipment safely

- The training should enable trainees to reach the desired levels of competence, to gain a clear understanding of the safety systems, procedures and the hazards and the emergency procedures
- Employees should only operate machinery and equipment for which they have received training and have been authorized to use.

Electricity Safety

- Risks from Electricity Include
  - Electric shock;
  - electric burn;
  - fire;
  - arcing; and
  - Explosion.

Electric burn:

- The passage of an electric current through the body may result in body tissue burns, which tend to be deep seated and therefore difficult to heal.
- Contact with high voltage is often characterized by body burn marks at the current entry and exit points, such as the hand palms and soles of the feet in the case of a hand-to-feet shock path.

Fire:

- Fire may be the result of heat generation due to the overheating of cables or electrical equipment.
- Arcing, which arises from short-circuit flashovers or sparks that are generated within electrical equipment such as motors or switching devices, may provide an ignition source for adjacent flammable materials, such as solids, gases, vapours and dusts.

Explosion:

- Some work processes can generate static electricity, which acts as an ignition source, as well as creating a potentially explosive atmosphere.
- Examples include processes that involve the movement of particulates or the dispersion of liquids through nozzles.
- lightning represents the creation and dissipation, through lightning flashes, of extremely large static electricity charges.
- Lightning strikes have the capacity to cause fatal accidents to people and severe damage to buildings.

Controls Options

- **Connections**
- Electrical joints and connections should be mechanically and electrically suitable for use.

Excess Current Protection

- Protection should be provided in order to protect every part of a system from excess current.
- **Working Space, Access and Lighting** Adequate working space, access and lighting should be provided, which is particularly important in the case of live work.
- Electrical insulation, such as cable insulation;

Management Controls

- **Safe Systems of Work – Work on isolated equipment**
- Isolation from all points of electrical supply;
- earthing, in order to discharge any residual electrical energy and to prevent the build up of induced charges;
- Confirmation of isolation at the point of work;
- Demarcation of the safe zone of work;
- Preparation of safety documentation, such as permits to work;
- The removal of fuses; and
- The use of hazard warning signs.

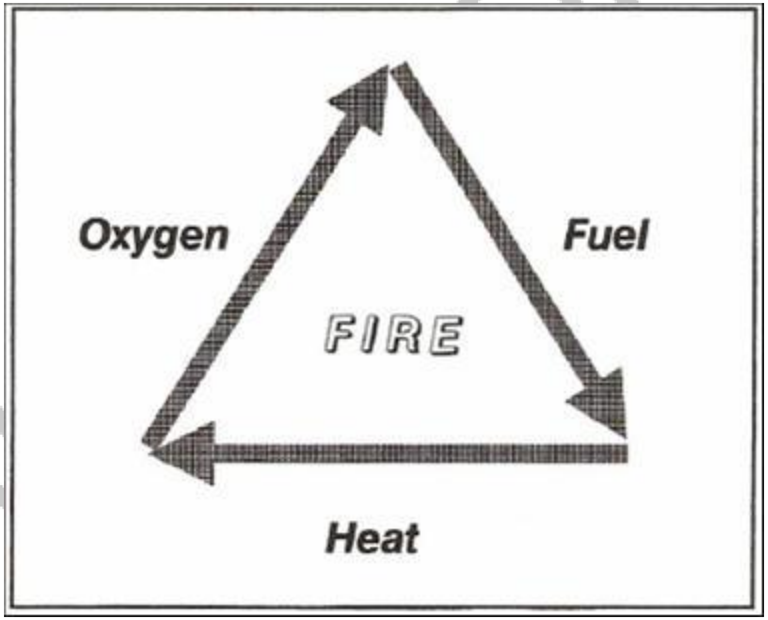
FIRE SAFETY

- Typical consequences of fire can include:
- injury or death of employees;
- loss of plant, product and/or information;
- disruption to production and supply of goods;
- management time spent investigating/reporting/carrying out rework;
- investigation/enforcement action by regulatory authorities;
- prosecution/fines and increased insurance premiums;
- damage to the environment; and
- community concerns.

Components required for a fire to start:

- a combustible substance (the fuel), such as wood, paper or plastic;
- oxygen (usually from air); and
- a source of heat (the ignition source).
- It is only if these three components are present that a fire can occur.
- These three components are often referred to as the fire triangle; see Figure 1.
- If one of the components is removed then the fire will be extinguished.

FIRE TRIANGLE



Control Options

- Control options for fire safety comprise three essential elements:
- fire prevention, in order to prevent fires from occurring;
- fire protection, in order to minimize the impact of a fire on equipment and people once the fire has started; and
- fire suppression, in order to extinguish a fire.

- **Prevention** entails eliminating or reducing the:
- sources of fuel; Sources of ignition; or
- sources of oxygen.
- **Fire protection**
- building design, such as fire resistant structures,
- fire alarms and systems;
- emergency shut-down systems

Fire Suppression

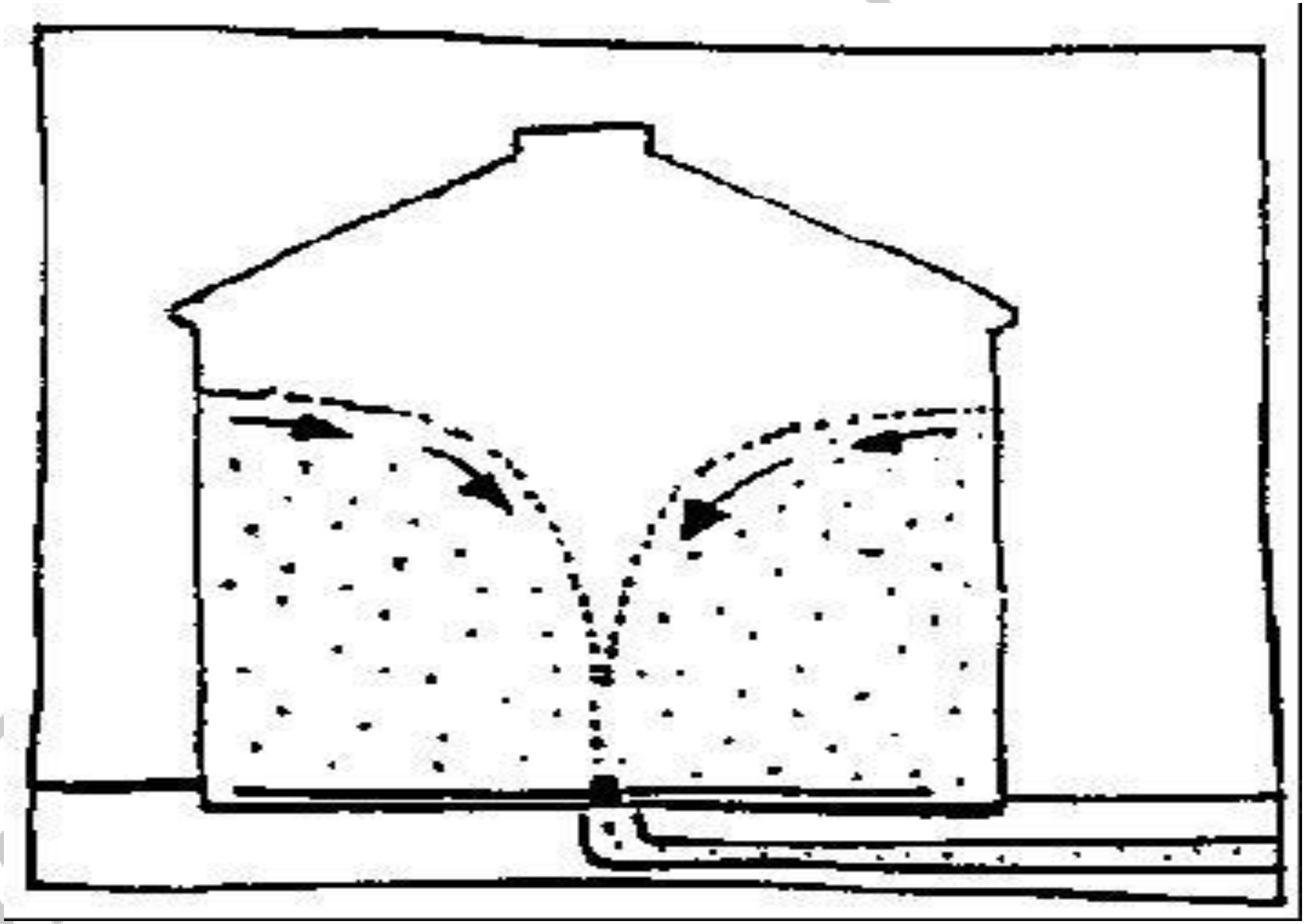
- Fire suppression requires the effective application of one or more methods of extinguishment,

COMMOM HAZARDS IN SEED PROCESING

- Seed Processing can be devided into the following sections:
- Harvesting
- Transportation
- Storage
- Conveying
- Processing

SAFETY HAZARDS IN STORAGE

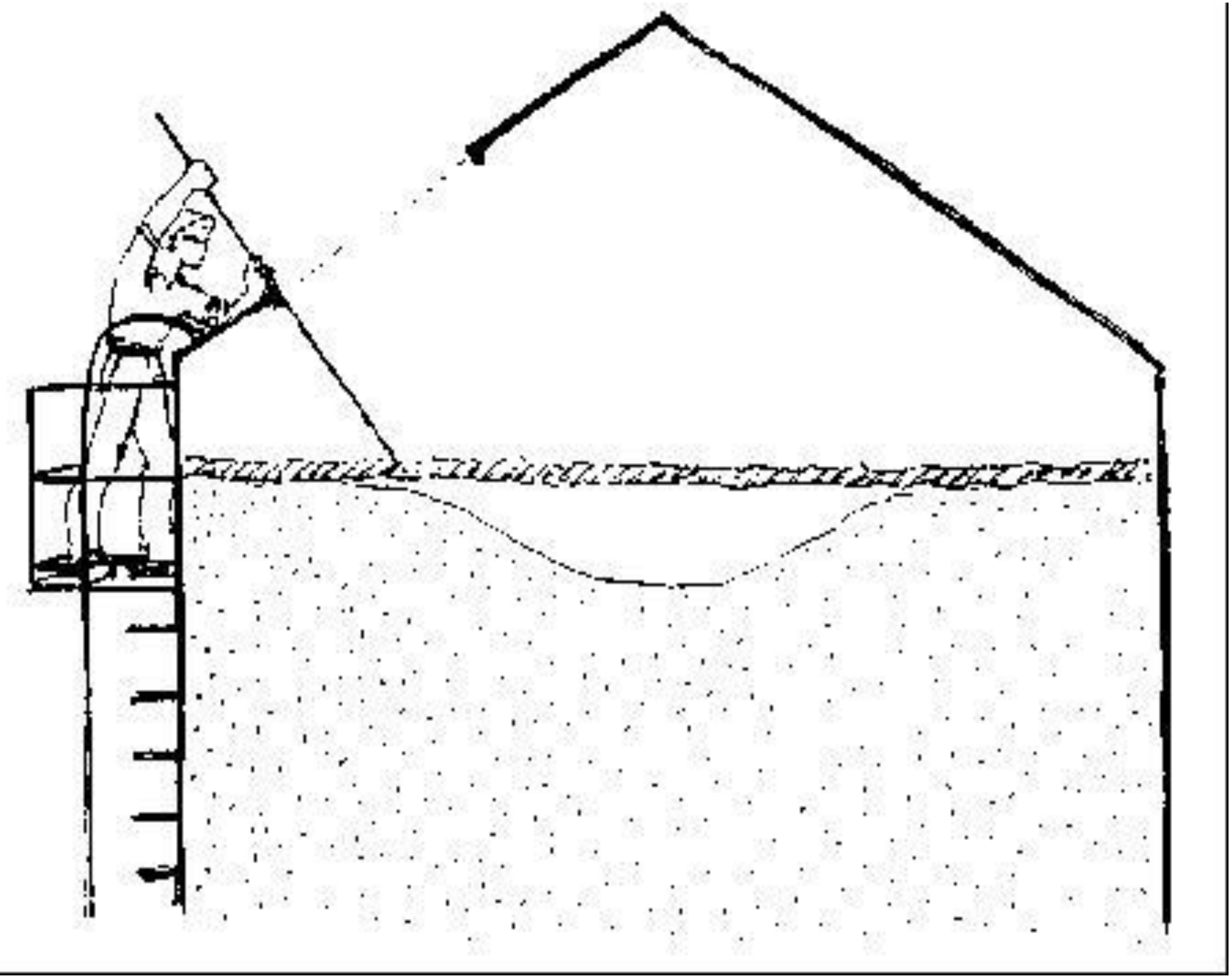
- **Suffocation**
- Suffocation in grain bins usually occurs when a person is buried while the bin is being emptied.
- Flat-bottomed grain bins emptied through the center of the bin floor
- A person entering the bin will be carried to the center and quickly drawn under in this column of grain.
- Typical unloading rates will completely bury a worker in less than a minute. In addition, some grains, such as flax and millet, cannot support a person, even when still.



- The suffocation hazard can be eliminated by never entering grain-storage structure when it is being loaded or unloaded.
- The power to all conveying equipment, automatic and manual, should be shut off, locked, and tagged to prevent unexpected operation
- Consider installing a permanent ladder on the inside of all grain bins.
- If workers **must** enter the bin and unloading starts in spite of proper shut-off, lock-out precautions, they may be able to get to the ladder and climb to safety.

- Caked or frozen grain is also a suffocation or crushing injury threat.
- If a bin has been partially emptied below a crust of grain, someone who steps on the crust while attempting to break it up can fall through and become buried.
- Workers should always assume all surfaces are bridged.
- Break up surface crusts from outside the bin with a wooden pole—not a metal one—or a weighted line thrown through the bin door

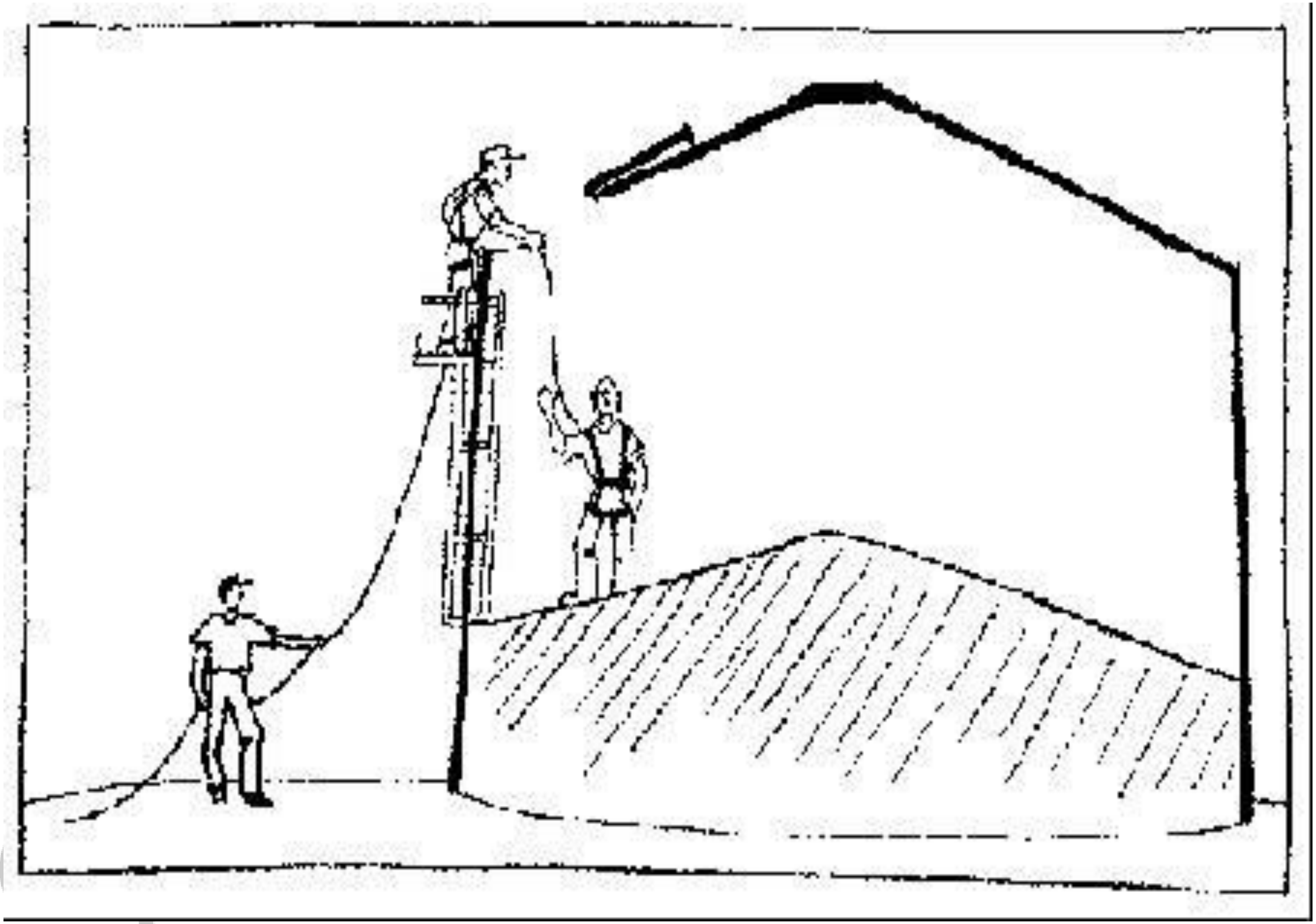
- Metal poles, pipes, or lines are electrocution hazards, since they may contact overhead power lines near the grain bin.
- You might consider mechanical agitation or vibration equipment to assist in breaking up badly crusted grain from outside the bin



- Frozen or crusted material sticking to walls can fall on someone trying to break this material loose, crushing or suffocating the worker.
- Workers should always remember that it takes very little grain to entrap and suffocate a person.
- Never enter a storage structure below material that is sticking to the sides of the structure or caked on a wall.
- Break up this material from above.

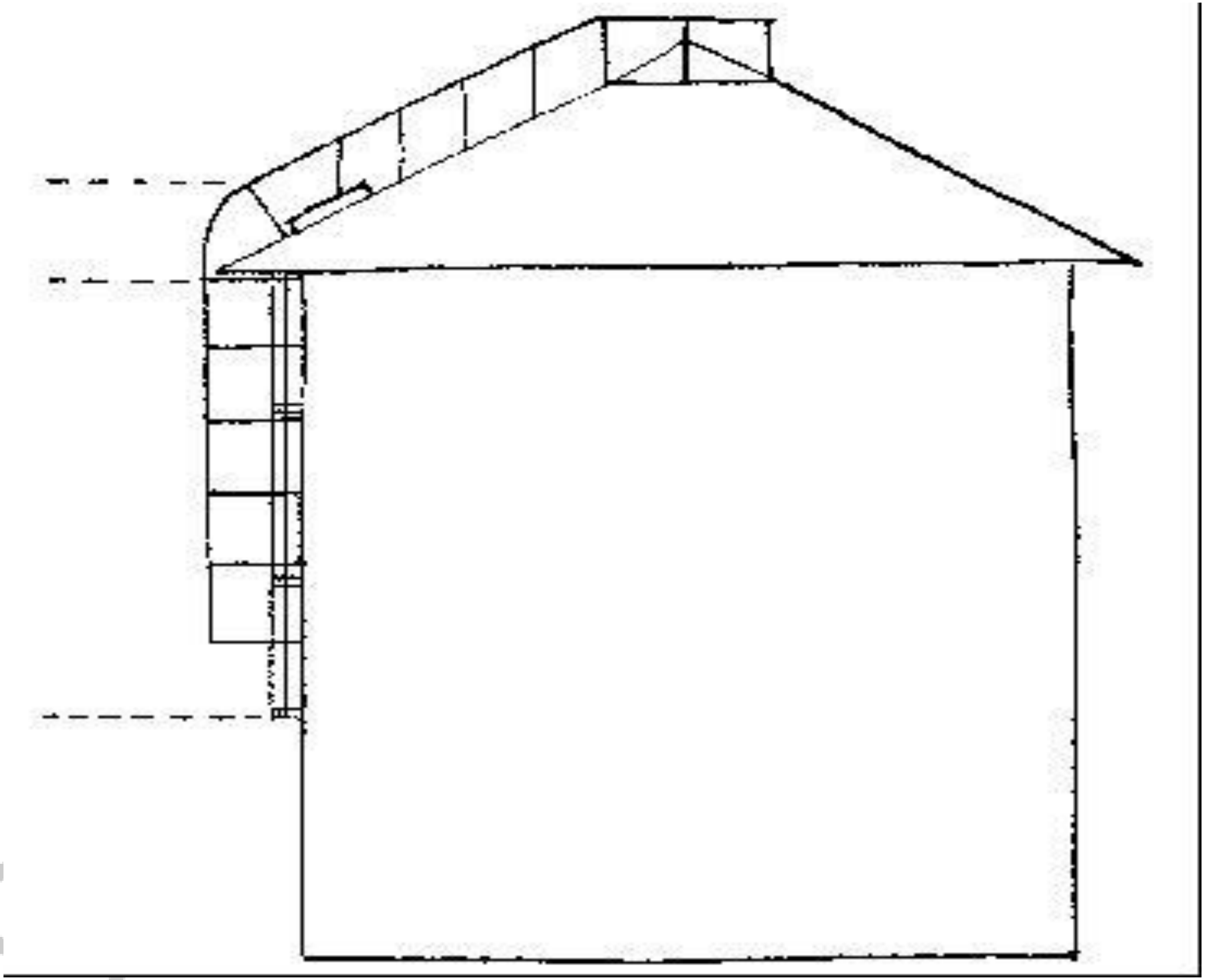
- A suffocation hazard also exists from the gases given off from spoiling grain.
- For example, the carbon dioxide (CO_2) given off is heavier than air and will collect above the grain surface.
- You cannot smell, see, or taste the CO_2.
- If enough gas has collected to decrease the oxygen concentration from the normal 21 percent to less than 19.5 percent, you will think less clearly, become drowsy, lose consciousness, or even die.
- Workers who fall through crusted grain can be killed by CO_2 that has collected under the crust, even if they are not completely buried.

- If a grain bin must be entered, three people should be used
- The person entering the structure should wear a harness attached to a lifeline.
- A second person should remain at the bin entrance to watch the person inside the bin and keep tension on the lifeline
- The third person should remain on the ground to go for help.
- All of the unloading equipment should be turned off, locked, and tagged.
- If the bin has a ventilating fan, it should be turned on to thoroughly ventilate the bin before entry and should be left on as long as a person is in the bin.



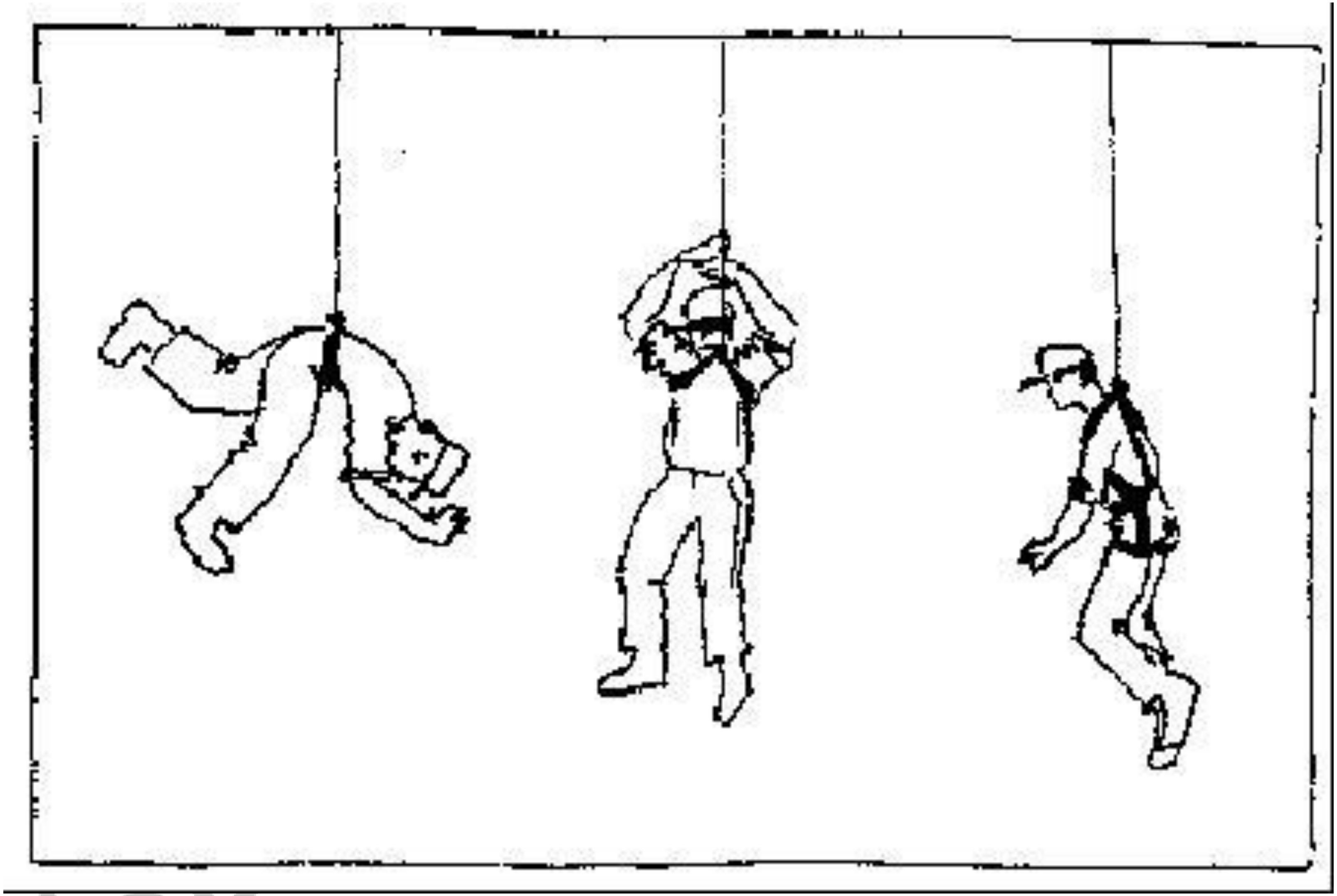
Falling hazards

- Falls from machinery and structures is another hazard.
- Research has shown that falls that seem fairly short, 12 to 20 feet for example, can kill a person.
- Some falls can be prevented by simple safety practices.
- For example, keep all ladders in good condition and avoid climbing them in wet or icy conditions.
- Permanent ladders more than 20 feet long should be surrounded by a safety cage which will support the weight of two workers.



- Falls can occur as workers move from the vertical exterior ladders on grain bins to the bin roof or through a bin entrance.
- Handrails extending 3 1/2 feet above the end of ladders will help workers get onto and off the ladders.
- To prevent falls while accessing the center roof openings on grain bins, consider installing guardrails along the roof ladder and around the center roof cover.

- Equipment is also available to prevent serious injuries in case a fall does occur.
- Most of this equipment uses a waist belt or body harness
- A body harness is better than a waist belt or a loop of rope around the waist or under the arms, since the harness spreads the force of a fall over a larger part of the body (Figure 8).



Fires, Explosions, and Electrocutions

- Fires, explosions, and electrocutions are not as common as falls, but can have equally severe results when they do occur.
- Fires and explosions in grain storage are generally due to dust or grain-drying equipment.
- The risk of a dust explosion or fire can be reduced by preventive maintenance.
- Installing dust control systems
- Regularly checking and servicing bearings, belts, and conveyors will help to prevent overheating from lack of lubrication, slippage, or rubbing.

- Thoroughly ventilating the bins with the dryer fans before igniting the dryer will reduce the risk of a fire or explosion from leaking fuel.
- Regularly cleaning grain material from the inside and outside of grain dryers will decrease the chances of a fire.
- The risk of a fire can also be reduced by keeping the air intake screens clean and in good condition so combustible material cannot be pulled in with the air.

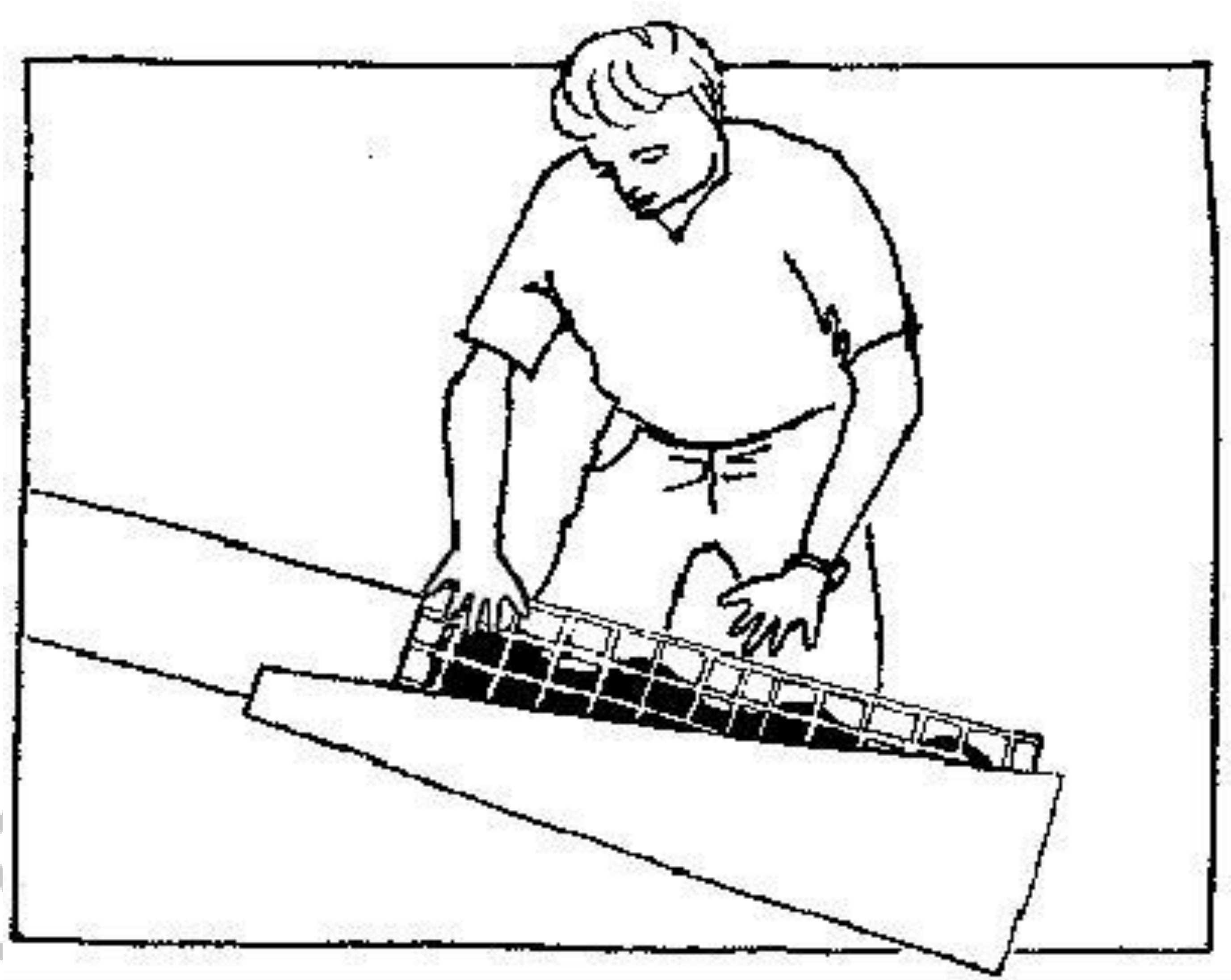
CONVEYING

- Entanglements involving equipment, such as augers, combines, and grain wagons, are a major source accidents.
- To prevent contact with grain-conveying equipment, try to work on a stable, level surface.
- For example, place portable conveyors on dry, level ground.
- Consider placing gravel on the unloading areas to provide better footing.
- Grain spills should be cleaned up between each load,
- only after all of the equipment has been shut
- so workers are not standing on loose grain.
- workers will not slip and become entangled if they work with a secure footing.

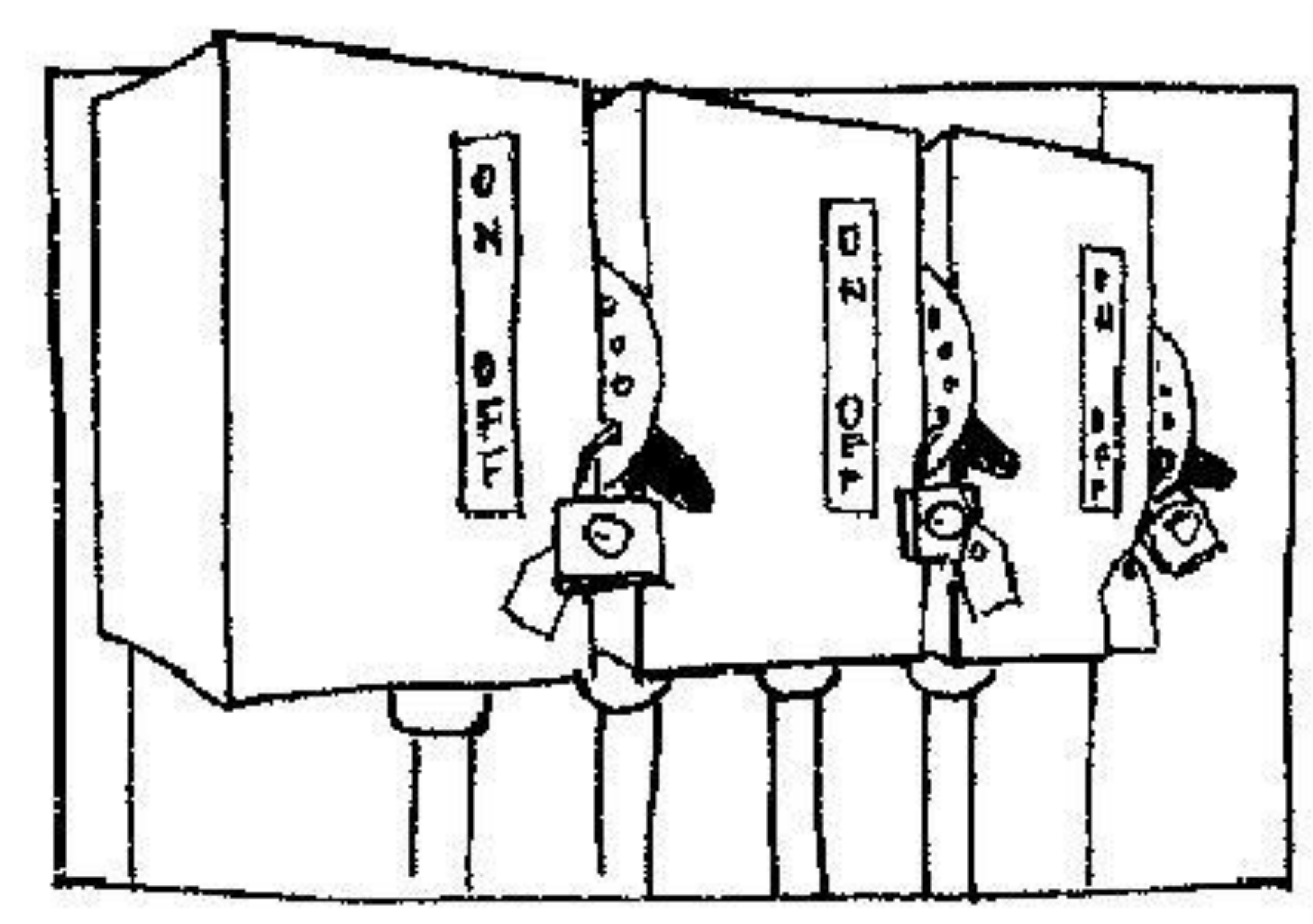
- Keep your hands and feet from the intake areas of augers and elevators.
- For example, don't level or redirect the flow of grain into the auger or elevator with your hands or feet.

Guarding

- Guarding can help protect you from injury in case you do slip and contact the machinery.
- Belts, chains, intake areas, and drive shafts of conveying equipment should be guarded.
- Guards should be used on the intake areas of portable grain augers and augers that are part of other machines (Figure 9).



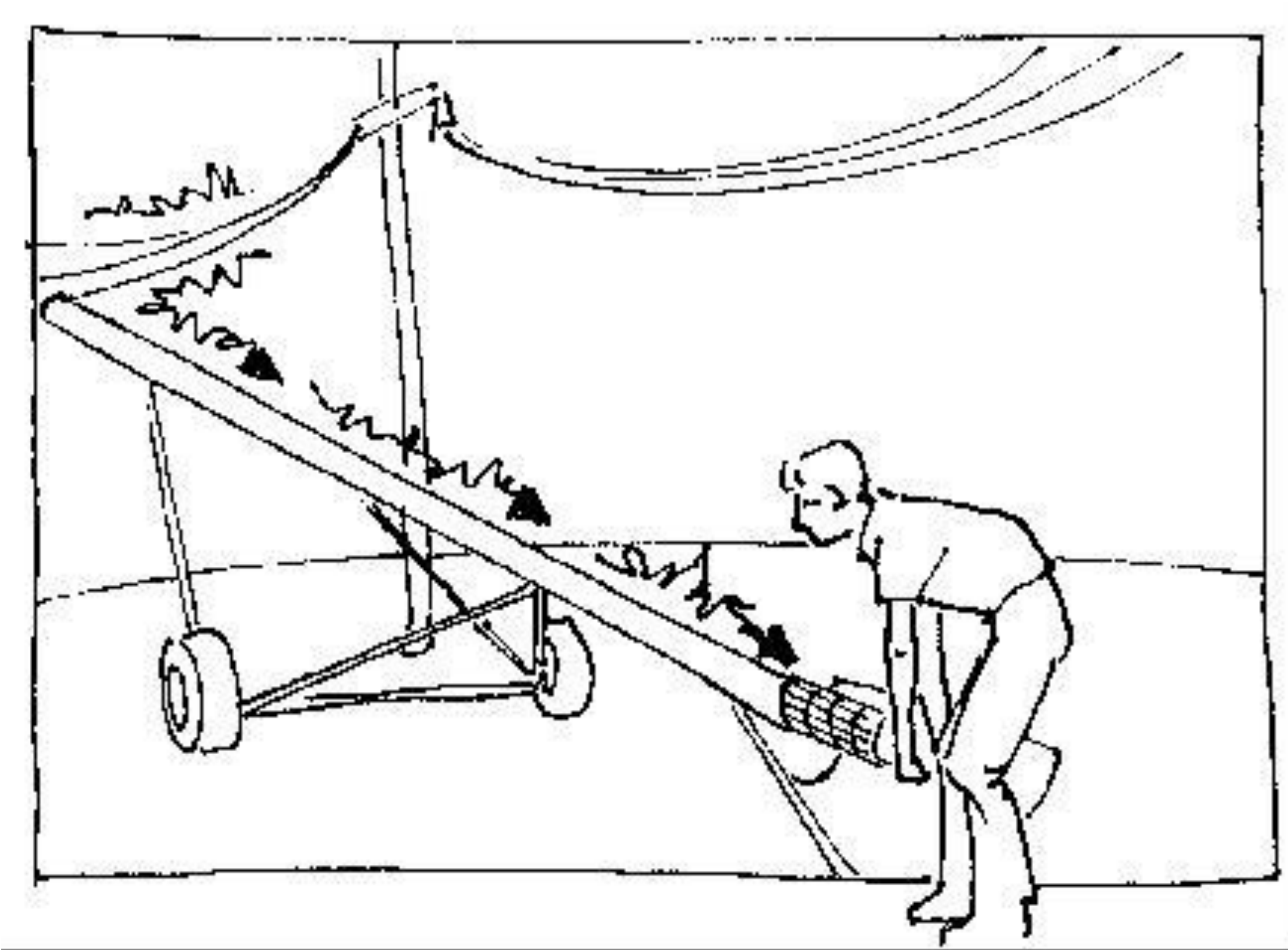
- Always shut off and lock the power to conveying equipment before servicing or unclogging it (Figure 10).
- If the equipment is driven by a power take-off (PTO), shut off the tractor and take the key;
- if it is electrically driven, turn off and lock the power.
- Don't take the chance that the equipment may start or be started while you are working on it.


ON
OFF

Moving Augers and Elevators

- Portable augers, elevators, and blowers also have hazards associated with their transport and placement.
- Augers and elevators can contact overhead power lines or collapse if not handled properly.
- Before moving an auger or elevator, plan your path.
- Leave a minimum overhead clearance of 10 feet between a power line and the equipment.
- Keep the conveyor in its lowered position any time it is being moved.

- If cables are used to raise and lower the auger, check them for broken strands or frayed sections.
- A broken cable can lead to an elevator collapse and possibly a death.
- Make sure that workers not absolutely necessary to raise the conveyor are a safe distance away.




OUR MOTTO:
THINK SAFETY
WORK SAFELY
STAY SAFE


SAFETY VIOLATION MEASURES
First Violation — Verbal Warning and Re-training
Second Violation — First Written Warning
Third Violation — Second Written Warning
Fourth Violation — Termination
(Disregarding Safety)
FACTORY UNIT MANAGER

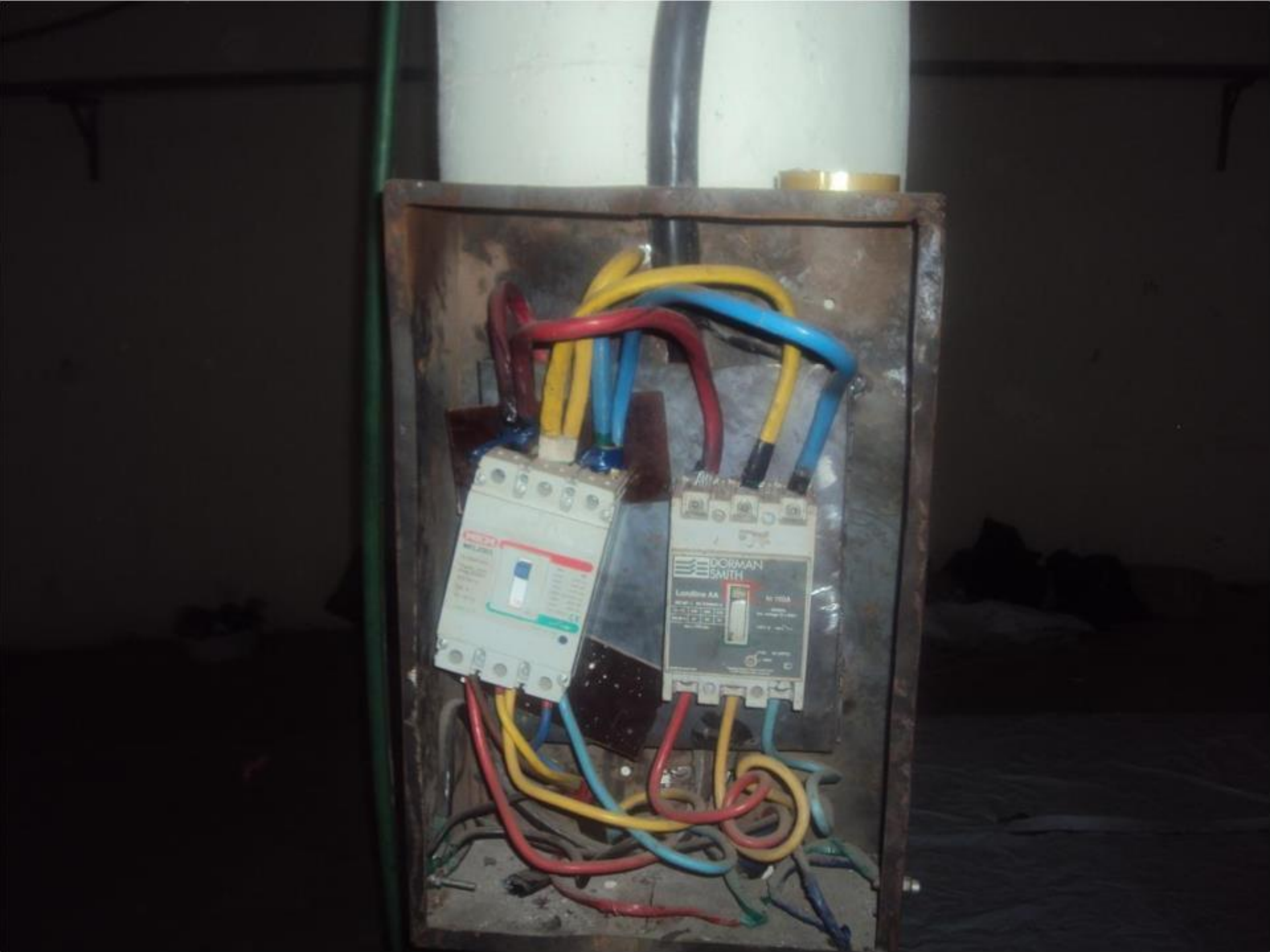

FIRE
EXIT


intel
DELL


BREAK GLASS
FOR
KEY TO DOOR

0792
9X5/8
18694


Fire point
Fire point


DORMAN SMITH

- By James Muthee

contents

1. Seed Processing, Plant-level Sampling, Testing For Quality Control And Process Management

KENYA PLANT HEALTH INSPECTORATE SERVICE (KEPHIS)

SEED PROCESSING, PLANT-LEVEL SAMPLING, TESTING FOR QUALITY CONTROL AND PROCESS MANAGEMENT

Presented to SEMIs Training

BY: James Muthee

E-mail:jmuthee@kephis.org
Website: www.kephis.org

1.What is Good Quality Seed?

Good quality seed has the following properties:

- ✓ a high germination rate;
- ✓ well dried;
- ✓ pure: all seeds are of the same variety and of the same size;
- ✓ clean: is not mixed with foreign matter such as stones or dirt, or other seeds;
- ✓ not damaged, broken, shriveled, mouldy, or insect damaged;
- ✓ not rotten (may be diseased);
- ✓ not discoloured or faded (may be diseased).

1. SEED PROCESSING

- Seed Processing is that activity of the seed industry responsible for upgrading seed, improving planting condition of seed and applying chemical protectant to the seed

2. ADVANTAGES OF SEED PROCESSING

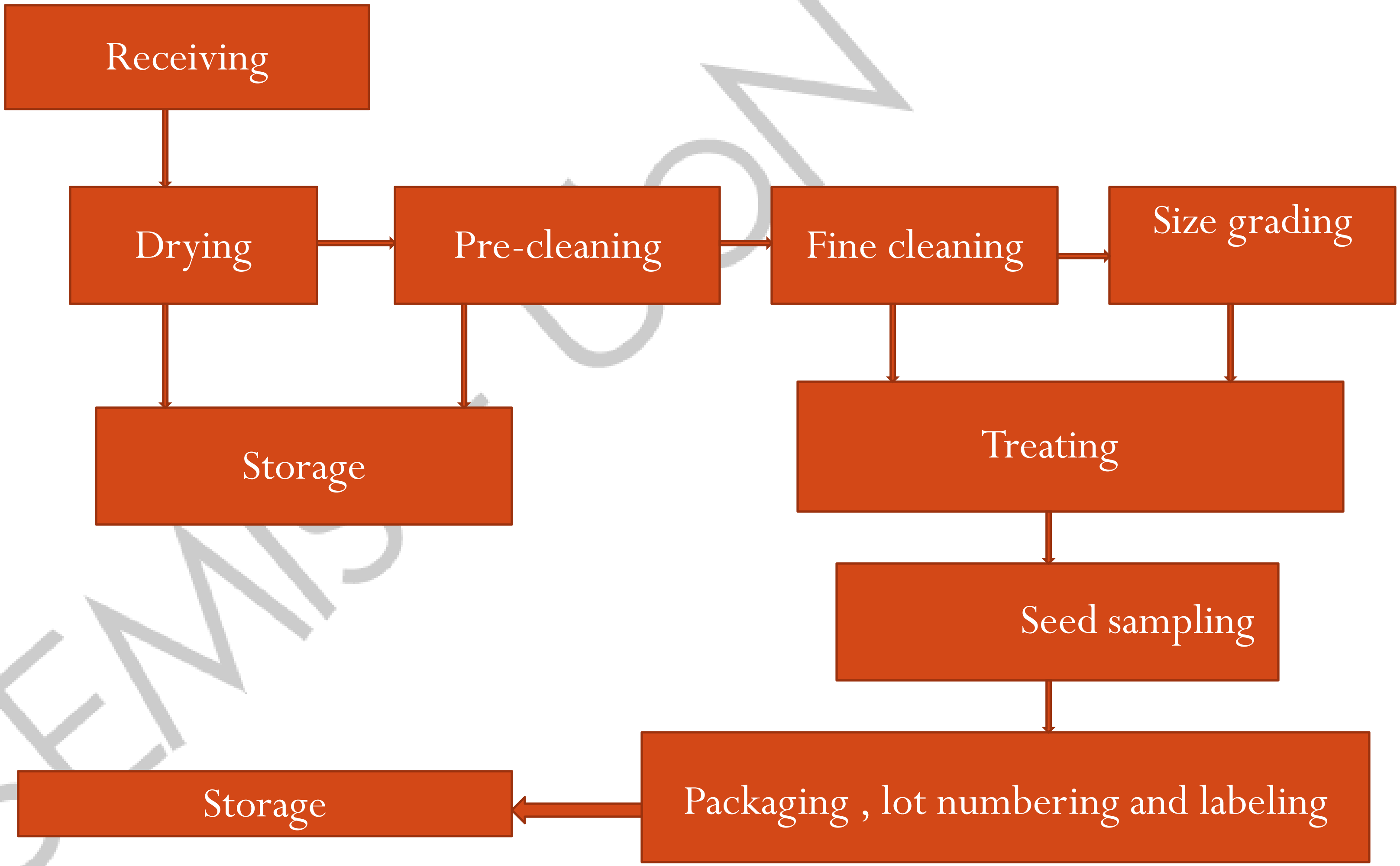
- Better uniformity in planting rate by proper sizing
- Prevents spread of weed seed
- Prevents crops from diseases
- Reduce seed losses by drying to proper moisture content

3. SEED PROCESSING

It involves upgrading of seed quality by:

- Removing Contaminants eg broken ,diseased, and insect damaged seed, straw, weed seeds and other rops seed.
- Drying seed to safe moisture levels for storage
- Uniform size grading of seed
- Applying chemical protectants to the seed

4.AN OUTLINE OF THE STAGES OF SEED PROCESSING



5. HARVESTING

- Pre-harvest inspection-Ensure that male and male plants are separated
- Post harvest inspection-Ensure that rejected fields are left out while approved fields are harvested
- harvest at physiological maturity
- -black layer forms at point of attachment between the cob and the kernels(maize seed)
- -moisture content 20-30% (maize seed)
- Rejected seed fields-Used for other purpose but not seed

Seed inspectors ensures that:

- All containers are clearly **marked** to ensure that the correct identity of a seed lot can be ascertained
- Delivered Seed is from approved fields(Records)
- For imported seed the ISTA certificate, phytosanitary certificate and plant import permit
- Sampling for post control is done

Machine inspection is done by an inspector including Elevators to ensure that they are clean before processing start.

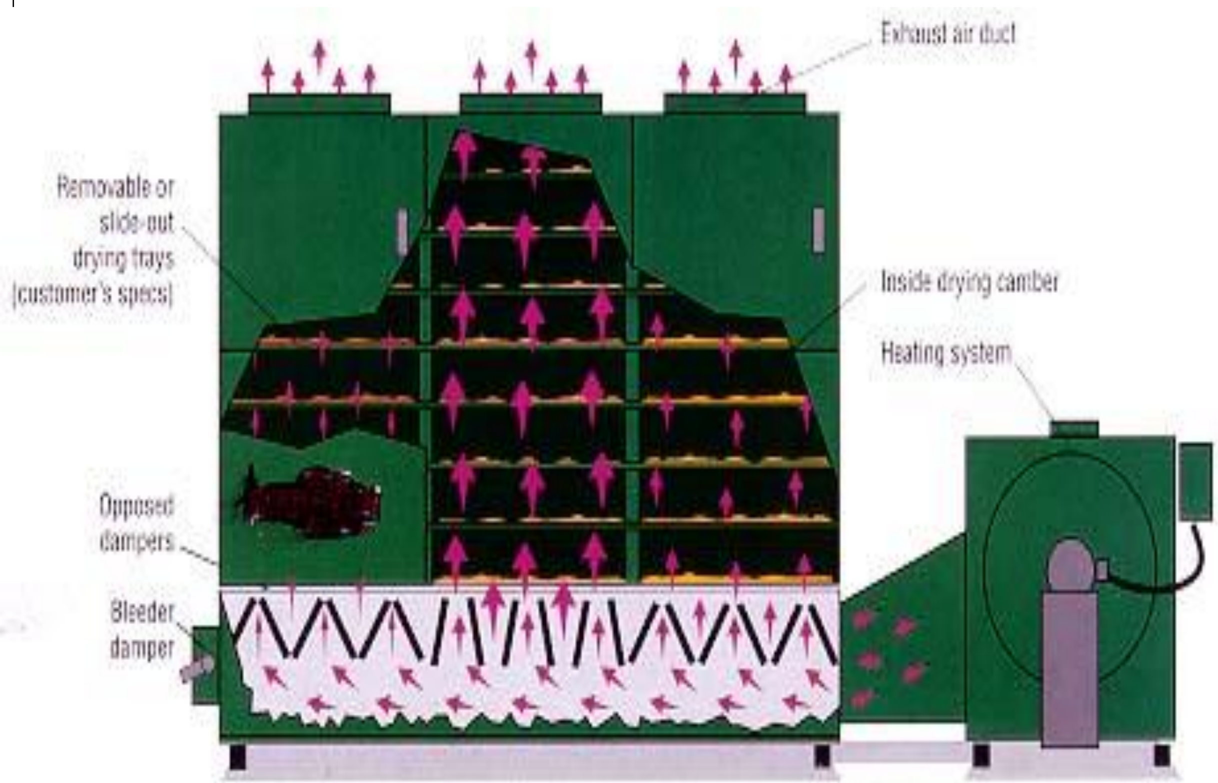
7.COB SELECTION

Seed Inspector check for:Trueness to variety;

Maize: Selection is done against off-types, diseased cobs, rotten cobs, wet cobs, insect damaged cobs, sprouted cobs, coloured grains and doubtful cobs

Seed inspector –allows shelling if selection is satisfactorily done and issue a work order(SR 8)

8. DRYING



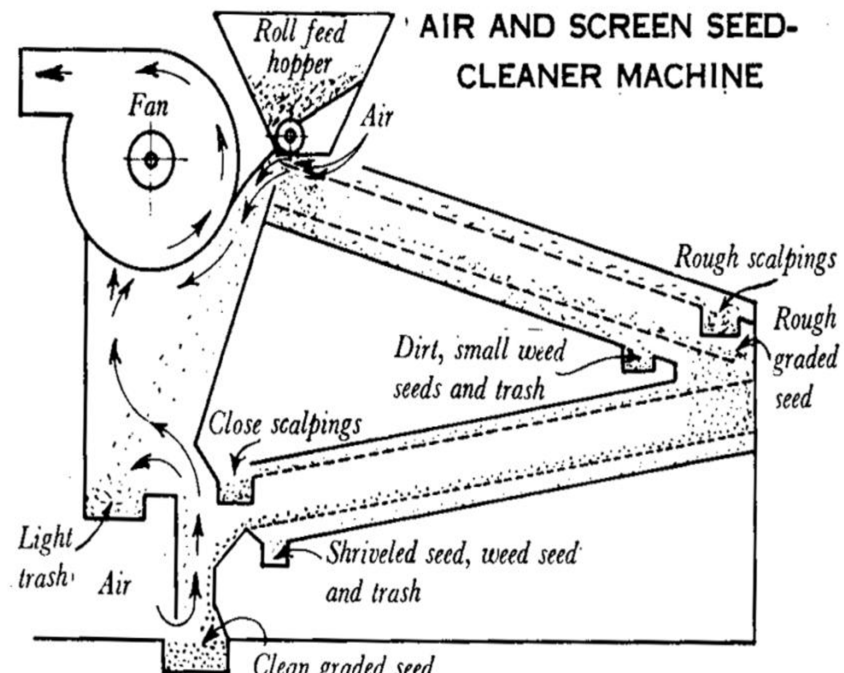
- Seeds which are dry will retain their viability for longer periods in storage.
- Drying Tem. Seed Maize-40-45^{0}C
- Moisture content should be reduced to less than 12%
- Seed inspector- Carries out dryer inspection

This is the reduction of seed moisture content (mc)to the recommended levels for seed storage
The drying process should begin as soon as possible after the receipt of the seeds

9.Precleaning

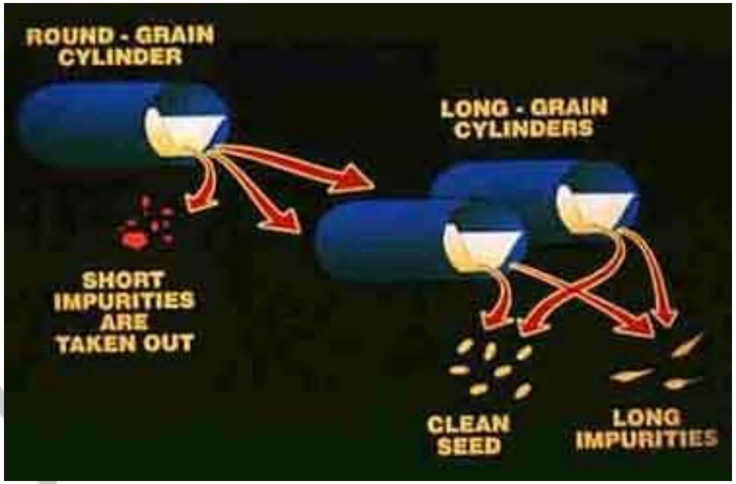
- Basic machine in almost

  all seed processing plants.
- uses two air blasts and two screens.
- removes dust and light chaff,shriveled, immature, small, damaged and diseased seeds; as well as weed seed and seed of other crop species
- good seed to drop onto the second screen.
- foreign material rides over the first screen and is discarded.
- Cleaning improves seed quality by improving physical purity and germination.
- Cleaning can be done because seeds differ in length, width, thickness, density, shape, surface texture and color



Specific gravity separator

- Seed of same size and general shape can be separated because they differ in specific gravity by using gravity separator. It removes light immature seed or heavy sand and rocks to improve the purity and germination of seed.



Indented cylinder:

Seed of the same width and thickness can be separated by taking advantages of difference of length. Indented cylinder can do very precise separation by using length difference.

The indented cylinder separator is a rotating almost horizontal cylinder with a movable horizontal separating trough mounted inside it. Thousand of half round indents line the inside surface of cylinder.

FINE CLEANING

- Seed can be sorted by colour .
- wrong coloured or damaged seed are removed. Eg wheat out of barley

11. SIZE GRADING

Involves separation of seed into different sizes eg

Maize-

- HP-hand plant-Mixed grade- For small scale farmers

  -2 kgs,5 kgs,10kgs

- MF-Medium flat,LF-Large flat,MR-Medium round
- LR-Large round
  - For large scale farmers-25 kgs

Potatoes-

Size 1-28-45 mm

Size 2-46-60mm

12. LOT EXAMINATION

- Lot examination is carried out to ensure that the seed lots meet processing standards.
- -obtain seed free of noxious seeds
- -determine trueness to types
- -check diseased seeds
- -check mixtures with other species
- -removal of rejects
- -Graded seed lots

13. TREATING

Seed treatment refers to the application of fungicide, insecticide, or a combination of both, to seeds.

Benefits of Seed Treatment:

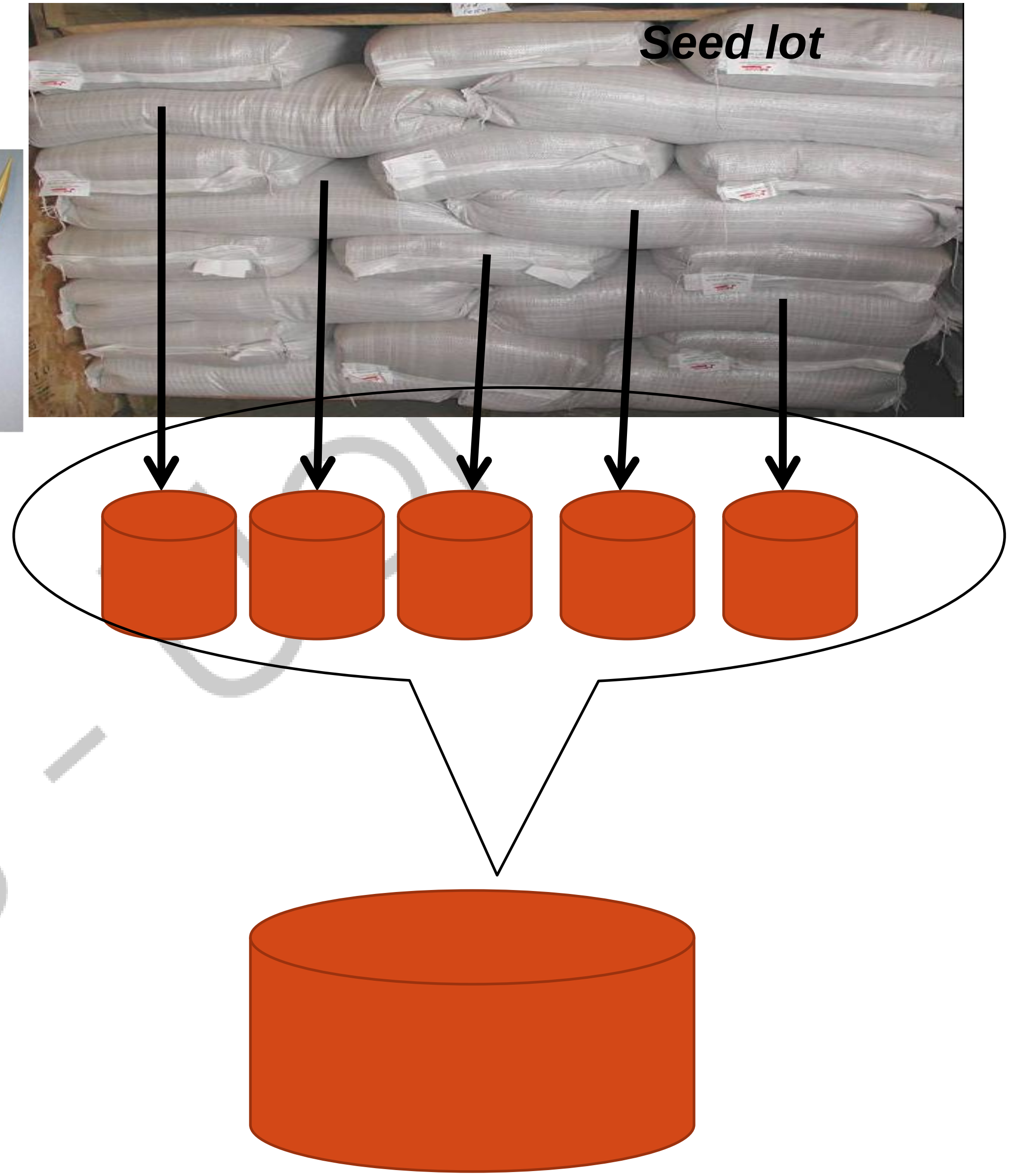
1. Prevents spread of seed borne diseases
2. Provides protection from storage insects
3. Controls soil insects

14.SAMPLING SEED FOR ANALYSIS

- The objective of seed sampling is to obtain a representative sample of each lot of seed under inspection.
- No matter how accurate the technical work is done, the result will be no better than the sample submitted for testing.
- Therefore, drawing, mixing, dividing and preparation of samples
- should be so done as to ensure that the sample is representative of the entire *seed lot**.
- KEPHIS uses **ISTA** Rules in all seed sampling and testing operations
- **A seed lot is a specified quantity of seed , physically idenfiable, in which an international seed lot certificate may be issued*

SAMPLING PROCEDURE

1. The use of
a dynamic for free
flowing seed



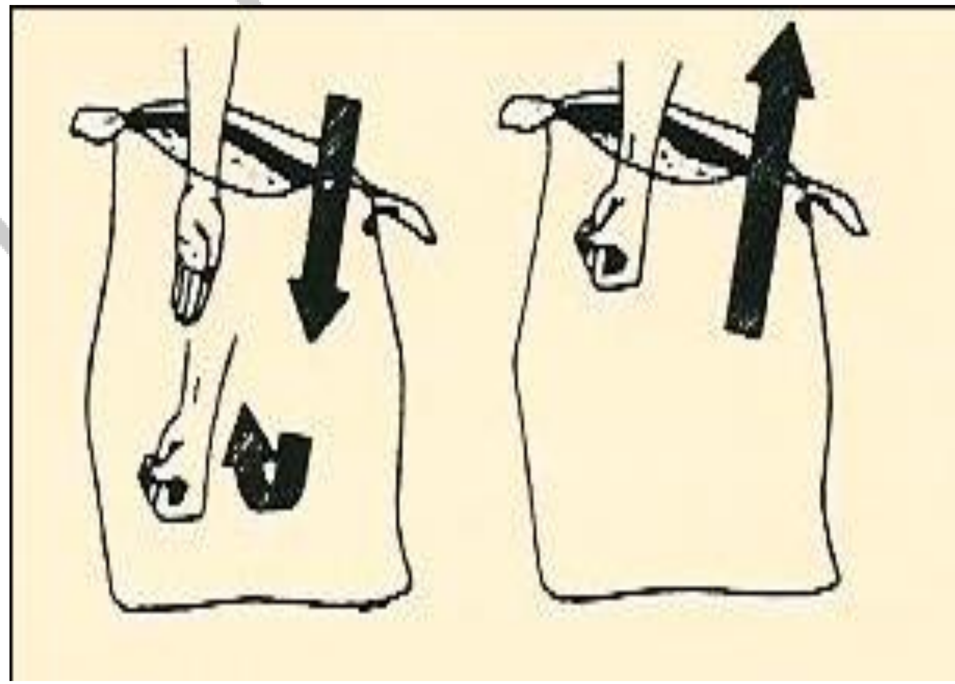
Primary samples:
A small portion taken from one location in the lot.

Composite sample:
A mix of all the primary samples from the lot.

Submitted sample*: The sample submitted to the testing station,* comprising the composite sample after mixing and dividing

Hand sampling for non-free flowing seed

- *The hand* sampling method is used on seed that would clog up triers. The bags are sampled at the top, middle and bottom. The sample is grabbed by pushing a hand into the bag until it
- reaches the depth required. The hand is closed after grabbing a sample, withdrawn and the
- sample placed in a container.



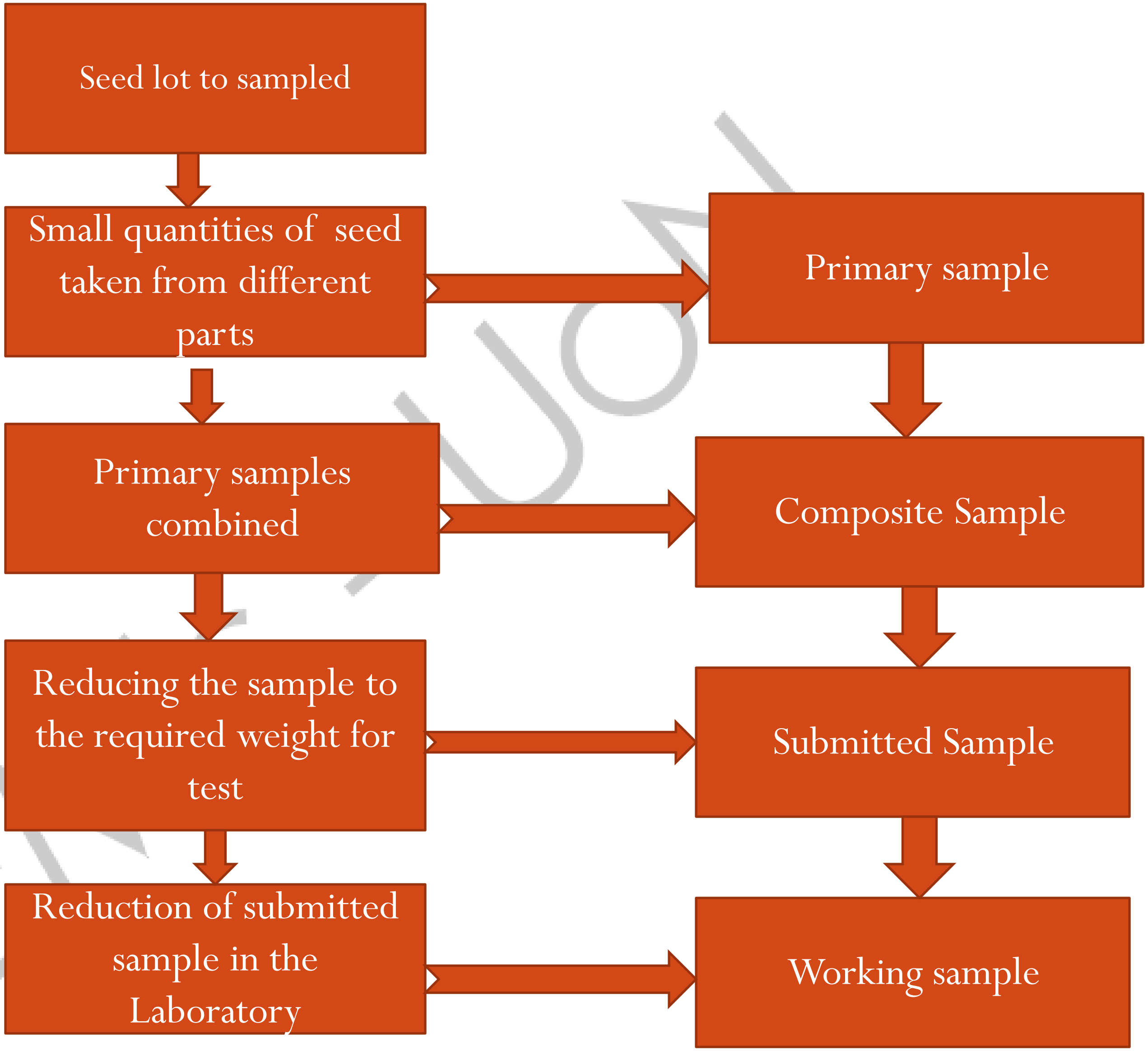
SAMPLING BY AUTOMATIC SEED SAMPLERS

- Primary samples are drawn from a seed stream automatically, using an apparatus regulated by a timing device.
- The seed sampler is involved only in handling the composite sample
- Automatic samplers utilize systematic sampling instead of random sampling
- They can be used in a closed processing system

Sampling from small containers

- For containers smaller than 15kgs, containers must be combined to sampling unit not exceeding 100kg, and the sampling unit regarded as a container.

Summary of seed sampling



15 MAXIMUM SEED LOT SIZE

- ISTA rules prescribe maximum seed lot sizes for different seed types. Should the lot size be greater than the maximum, the lot would have to be split into two lines. For example, maize has a maximum lot size of 40,000 kg. If the amount is 42,000 kg. it should be split into two lots, of 21,000 kg, each. Then a sample should be taken from each lot.

16: SEED TESTING

- All processed seeds must be sampled for laboratory analysis.
- Seeds are tested for: -
- ❖ Purity
- ❖ Germination
- ❖ Moisture content
- ❖ Health status

KEPHIS issues certificate (local/ISTA) for each seed lot that meets the <u>minimum standards</u>

17: PACKAGING AND LOT NUMBERING AND LABELLING

- After the seeds are tested and found to meet the minimum standards they are packaged, labeled and lot numbers printed on the packets
- Packets designed to hold convenient quantity for handling and transportation
- Seed inspector ensures the seed meet the germination and purity standards before Marketing.

18. Seed Storage

- Seed of each variety should be stacked separately
- The bags should be laid on pallets
- There should be sufficient space between the stacks to allow easy access
- Rodent and bird proof
- Label all containers
- Proper ventilation
- Keep record of all seed lots and their history

Properly stacked bags

THANKYOU

For more information contact

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Mobile: 0722-516221 / 0723-786779

0733-874174 / 0734-874141

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- By Peter K. Mulwa

Contents

Institute (SEMIS)

Managing Seed Plan Spreadsheet Using Microsoft Excel 2010

By: Peter K. Mulwa – University of Nairobi, peter.kyalo@uonbi.ac.ke

Definition of Terms

- **Spreadsheet:** A spreadsheet manual or electronic is a ledger sheet that enables the user to enter, edit and manipulate numeric data. An electronic spreadsheet is an automated version of the accountant's ledger. It eliminates the paper, pencil and eraser. Usually, data is organized into rows and columns.
- **Workbook –** The work file created using a spreadsheet program. Normally contains one or more worksheets
- **Worksheet** – Work area in a spreadsheet made up of columns and rows. It is like a single page in a workbook
- **Column** – the vertical divisions of a worksheet

Definition of Terms

- **Column** – the vertical divisions of a worksheet
- **Row** – The horizontal divisions of a worksheet
- **Cell** – The smallest unit that holds data in worksheet and its made by the intersection between a column and a row
- **Formula** – User define expression for performing calculations
- **Function** – Spreadsheets in-built formula used for performing simple to complex calculations. The user does not have to construct the expression when using a formula but only supplies the function arguments – data references to be acted on.

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Examples of Electronic Spreadsheet Applications

- Microsoft Excel, Quattro Pro, Lotus 1-2-3, VisiCalc

Advantages of Electronic spreadsheets

- Advantages of electronic spreadsheets over the manual spreadsheets are;
- Spreadsheet final results are neat
- Numeric data can be edited and manipulated easily
- A large virtual worksheet for data entry and manipulation
- Enhanced formatting capabilities

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Advantages of Electronic spreadsheets

- Enhanced formatting capabilities
- Built-in functions which enable the user to create powerful mathematical formulae
- Automatic recalculation – The result of a given formula auto-adjusts when a value used in formula is changed
- Advanced data manipulation tools like sorting, filtering, data validation, Sub-Total, etc.
- Data presentations tools like charts

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- Advanced data manipulation tools like sorting, filtering, data validation, Sub-Total, etc.
- Data presentations tools like charts

Class Activity

- *What are the disadvantages of using electronic spreadsheets?*

Introduction to Microsoft Excel 2010

- Microsoft Excel 2010 is one of the products in the Microsoft office 2010 suit. The previous versions of Microsoft Excel include; Microsoft Excel 97, 2000, XP, 2003 and 2007

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Starting Microsoft Excel 2010

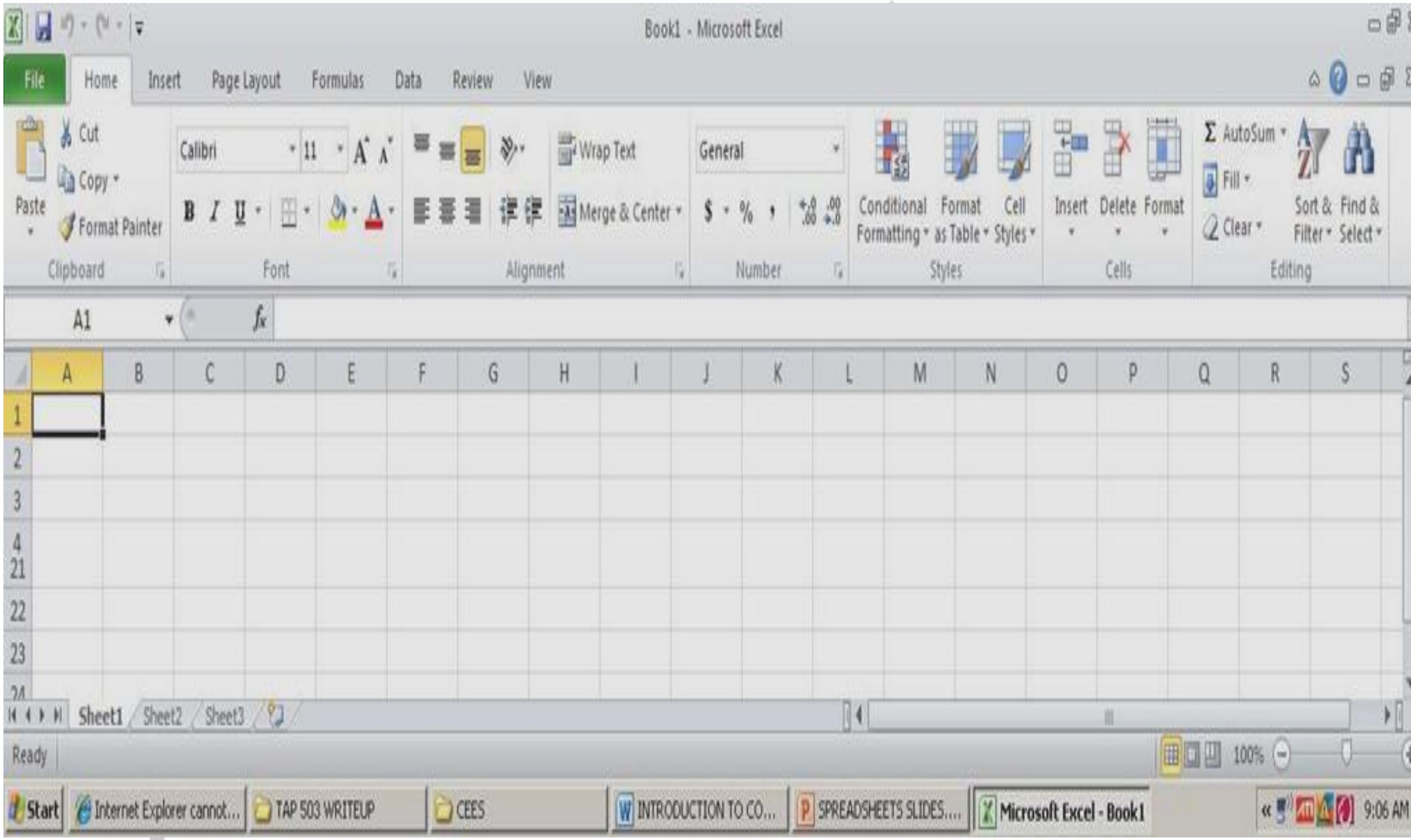
- Double click the Microsoft Excel 2010 shortcut icon from the desktop

Or

- Click on start button from the task bar on the desktop
- Point at All Programs from the pull up menu
- Point at Microsoft office from the sidekick menu, then click on Microsoft Excel 2010 from the sidekick menu.

Microsoft Screen Features

Microsoft Excel 2010 Window Screen Shot



Microsoft Screen Features

- **Formula bar:** Displays the contents of the active cell including formulas and functions. Also used to enter data into a cell.
- **Name box:** Displays the active cell, i.e. cell with a dark outline that indicates where data in the formula bar will be inserted. Used to name/label cells.
- **Workbook:** refers to the user file that holds related information organized in a good manner.
- **Worksheet**: Blank area made up of rows and columns. Several worksheets form a workbook. A worksheet consists of:

Microsoft Screen Features

- Columns are the vertical division of the worksheet. Are labeled using letters of alphabet from A to XFD
- Rows are the horizontal divisions of the worksheet. Are labeled using numbers from 1 – 1048576.
- Cell which is the intersection between a column and a row. Are referenced using column letter and the row number e.g. A1, B2 etc.

- **Worksheet tabs** – used to select the worksheets. Labeled as sheet1, sheet2, sheet3, sheet4 etc. there are 3 worksheets at default.
- **Worksheet browsers** – used for navigating through worksheets

Creating a Workbook and Entering data in a worksheet

- A cell can hold any of the following:
  - **Label:** Alphanumeric data that has no numeric significance and can only provide descriptive information e.g. name of a place, person etc.
  - **Value:** A numeric value (number) that may be used to perform numeric computations
  - **Formula and Functions:** A formula is user defined mathematical expression that evaluates into a value while a function is an in-built formula.

Take note of the following when entering data:

- Type numbers as you press enter or tab or an arrow key to move to the next cell
- Precede a negative number with a minus sign
- To type a fraction, type the whole number followed by space then the fraction, otherwise, type zero(0), space and then the fraction.
- A cell filled with #### means that the number is too large to fit in the cell. Adjusting the column width or row height fits the number in the cell.
- To type text, click the cell where to type the text, type the text from the keyboard and press enter or tab or an arrow key
- To type number as text, precede the number with an apostrophe(‘)

Take note of the following when entering data:

- To enter a new line within a cell, press ALT + ENTER.
- To type date and time, type using any of the format valid date and time format.
- To enter data in series e.g. 1, 2, 3…… type the first two data in the series in two adjacent cells; select the data, point at the handle at the right bottom end of the cell selector and drag outward to fill the series or inwards to clear. This uses the auto fill feature.
- Long text data appear truncated meaning it cannot fit within the cell, hence need to increase the size of the cell/column

Activity

- Enter the data below in to Microsoft Excel worksheet and save it as Blue-Chip on the desktop of your computer. Adjust the column width and row heights to fit all the data. Merger and Center the cells in the first and second rows to appear as in table 2.6.1 below. To save a workbook, refer to Microsoft Word notes.

Blue-chip Communication Ltd					
Summary of Year 2006 Sales Report					
Month	**Nairobi**	**Kisumu**	**Mombasa**	**Total Sales**	**Average Sales**
January	87350.00	65800.00	87000.00		
February	78000.00	23000.00	67000.00		
March	90000.00	28000.00	56000.00		
April	67000.00	45000.00	56000.00		
May	67000.00	28000.00	45000.00		
June	89000.00	31000.00	45000.00		
July	50000.00	45000.00	78000.00		
August	45000.00	42000.00	54000.00		
September	67500.00	43000.00	56700.00		
October	79000.00	28000.00	65000.00		
November	78000.00	56000.00	45000.00		
December	120000.00	87000.00	97000.00		
Yearly Sales					
Minimum Sale					
Average Sales					

Saving a Workbook

- Click on the file tab
- Click on the Save as submenu from the pull down menu
- On the dialog box that appears, choose the location/folder to save in e.g. desktop
- Type the name of the workbook. The default name is Book1 that can be replaced350
- Choose the save as type e.g. Excel Workbook (*.xlsx) for Ms Excel 2010 and 2007 compatibility o Excel 97-2003 workbook (*.xls) for Ms Excel 2003 and lower versions compatibility
- Click save to save and close the dialog box

Editing a Workbook/Worksheet

To edit the contents of a cell,

- Either click the cell
- click on the formula bar to type new cell contents or double click the cell and type in the new cell contents

To adjust column width;

- Point at the row border. The mouse pointer changes to a cross.
- Hold down the left mouse button and drag downwards to increase the height or upwards to decrease the height or double click the border to auto fit contents in the column width

Editing a Workbook/Worksheet

To insert a column;

- Click on the column left of which to insert a new column
- Click on the drop down arrow below the Insert option in the Cells group
- Click on Insert Sheets Columns from the drop down list

Editing a Workbook/Worksheet

To delete a column or row or a sheet;

- Click on the column or row or sheet to delete
- Click on the drop down arrow below the Delete option in the Cells group
- Click on what you want to delete.

- NB: Use Undo and redo icons to reverse the changes

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Formatting a Workbook/Worksheet

- You can format a worksheet to improve its appearance just as in Microsoft word.

To change font of data in a worksheet;

- Highlight the data to format
- Click on the home tab
- Click on the format options to apply from the Font group.
- For more Font options, click on the arrow next to the Font.

Formatting a Workbook/Worksheet

To change alignment of data in a cell,

- Highlight the data to format
- Click on the home tab
- Click on the alignment format options to apply from the Alignment group. For more alignment options, click on the arrow next to the Number group to display the format cells dialog box.

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Formatting a Workbook/Worksheet

To apply number formats in a cell,

- Different numeric data can be formatted to show different quantities in a worksheet;
  - Highlight the data to format
  - Click on the home tab
  - Click on the number format options to apply from the Number group.
  - For more number formatting options, click on the arrow next to the Number group to display the format cells dialog box.

Formatting a Workbook/Worksheet

- **To format border formatting:**

The grids in a worksheet are non-printable until one formats the borders.

To format the borders;

- Select the cell range to format the borders
- Click on Home tab then click on the drop down arrow below the Format option in the Cells group
- Click on Format Cells from the drop down list. The Format cells dialog box below appears;
- Click on border tab
- Select the line style, color and border type to apply then click ok

Cell Referencing

This is the process of addressing or identifying cells in a worksheet

Different methods used include.

- **Single cell reference** – in this the identity of a cell is done by using the column letter and the row number e.g. A1, B78

Cell Referencing

- **Relative cell referencing** – in this, a cell reference changes relative to the position of the formula. E.g. Consider the formula =A1+B1 entered in C1. What happens when it is copied into B2 through B10?

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Cell Referencing

- **Absolute cell referencing** - when a formula is copied to other cells, the cell references remain unchanged. A dollar sign is placed before the column letter and the row number by either typing it or pressing F4 e.g. B20.
- **Mixed cell referencing** - either the column or the row is absolutely referenced but not both e.g. $B20, B$20

Performing Calculations using formulae and functions

a) **Using a Formulae**

- When constructing a formula, it is important to note that;
- The formula is typed after clicking on the cell where the result is to appear
- Every formula starts with an equal sign (=)
- Cell references are used in the formula other than the actual values

Performing Calculations using formulae and functions

- Math's operators are used depending on the operation being carried out e.g. **+** (addition), **-** (subtraction), **/** (division, ***** (multiplication), **^** (exponentiation)
- Parenthesis (brackets) can be used to supersede the order of evaluation of the operators
- Example of a formula: **= B3 * B5**

Performing Calculations using formulae and functions

b) Using Functions

- Functions are in-built formulas and therefore they are inserted using the function wizard that guides one through the process.
- There are different categories of functions that include;
- Math and trigonometry e.g. sum() etc.
- Statistical e.g. average(), count(), rank() etc.

Performing Calculations using formulae and functions

- Statistical e.g. average(), count(), rank() etc.
- Logical e.g. the IF function
- Financial e.g. pmt(), ppmt() etc.
- Date and time e.g. now(), today() etc.
- To insert a function;
- Click on the cell where the result should appear
- Click on Formulas tab. The different categories of Microsoft Excel functions are displayed in the Function Library group

Performing Calculations using formulae and functions

- Choose the function to use by clicking on the drop down triangle below the function category
- Specify the function arguments from the function argument dialog box e.g. the range containing values to be summed like **A2:B2** as shown below then click OK.

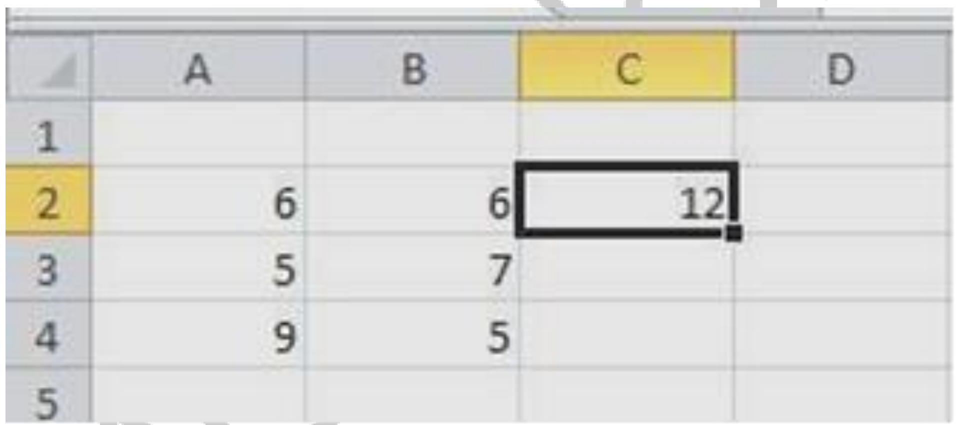
Performing Calculations using formulae and functions

Copying a formula

- You do not have to type formula in all cells containing calculated values that use the same formula. You need just to do type one correct formula and copy it to all other cells. To do so, you can use the Copy and Paste commands as used to copy data or you can use the drag and fill method.
- To use the drag and fill method;
- Click on the cell containing the formula to copy

Performing Calculations using formulae and functions

- Point and click on the handle on the bottom right of a the cell selector as shown below;



- Drag outwards to fill the formula or inwards to clear. The cell references change as you copy the formula – remember Relative cell referencing covered in 2.6.2.4 above.

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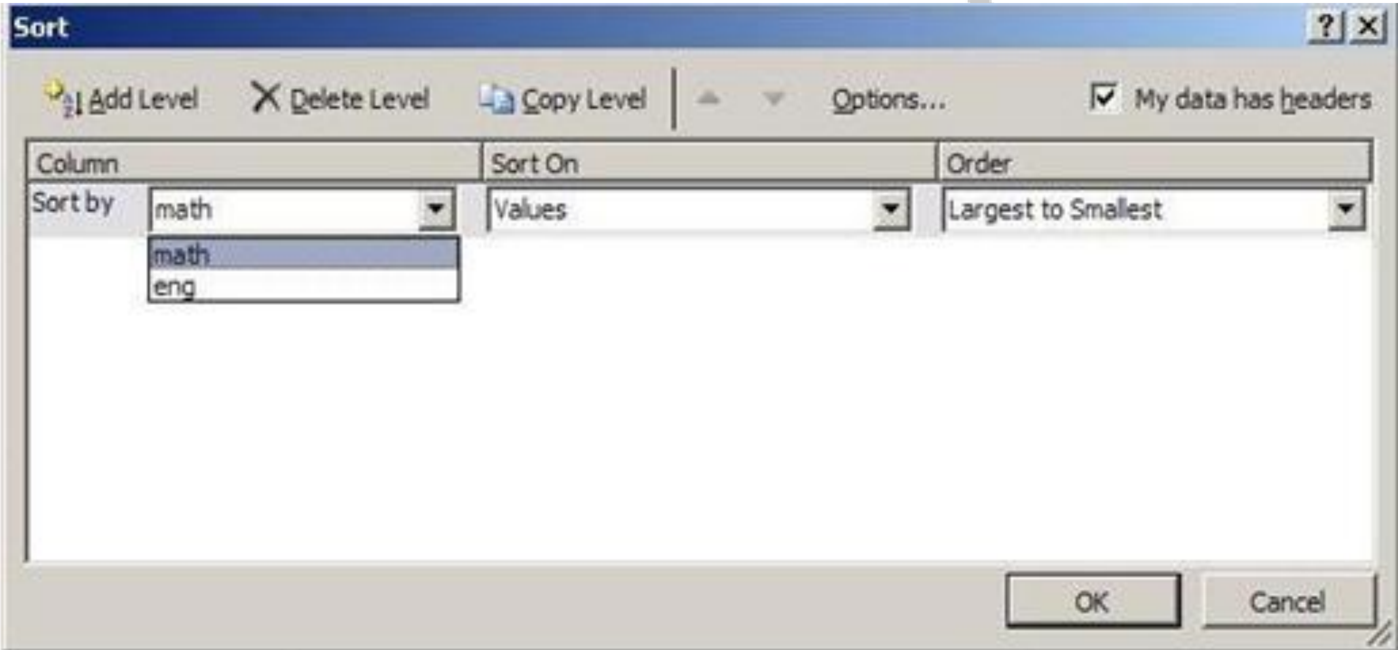
Data Management

a) Sorting

- This means to arrange data in a particular order which could be in either ascending or descending order e.g. sorting a list of names of students alphabetically or marks in descending order from the highest to the lowest. To sort data in Microsoft Excel 2011;
- Highlight or click on the data to sort
- Click on the Data tab then click on Sort option from the Sort & Filter group
- Click on the checkbox labeled *My Data Has Headers* as shown below;

Data Management



- Select column or header name by which to sort the data by in the sort by box
- Specify the sort order then click OK.

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b) Filter

Used to display data that meet a user defined criteria. Can be auto filter or advanced filter.

Follow the following steps for auto filter:

- Click on data tab
- Click on the filter icon under sort and filter group
- Click on the drop down arrows added on the fields and choose the criteria to be met

NB: Click on the same arrow show all to display all data after a filter action

c) Pivot Tables

- PivotTable reports can help to analyze numerical data
- With PivotTable reports, you can look at the same information in different ways with just a few mouse clicks. Data swings into place, answering questions, telling you what the data means.
- Select the data to analyze
  - >Ribbon
  - >Insert
  - >Pivot Table
    - Create in New sheet
    - Add filters (country)
    - Quarters (Group and show data)
    - Sort Data

d) What If Analysis

- What-if analysis is the process of changing the values in cells to see how those changes will affect the outcome of formulas on the worksheet.
- Three kinds of what-if analysis tools come with Excel:
  - scenarios,
  - data tables,
  - goal seek

i. Scenarios

- A scenario is a set of values that Excel saves and can substitute automatically in cells on a worksheet.
- You can create and save different groups of values on a worksheet and then switch to any of these new scenarios to view different results.
- Ribbon
  - >Data
  - >What if Analysis
  - >Scenario Manager
    - Add
    - Name the scenario
    - Select cell(s) to change
    - Save
    - Put in the new values
    - Save
    - Show

ii. Data Tables

- Data Table is a way to see different results by altering an input cell in your formula
- Put in values to be used in data table, then highlight the values and the formula for the input
- Ribbon
  - >Data
  - >What if Analysis
  - >Data Table
    - Select the row or column cell

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iii. Goal Seek

- A method to find a specific value for a cell by adjusting the value of one other cell.
- When goal seeking, Excel varies the value in a cell that you specify until a formula that's dependent on that cell returns the result you want.
- Ribbon
  - >Data
  - >What if Analysis
  - >Goal Seek
    - Set the target cell
    - Set the target value
    - Select the cell to be changed
    - View the results

Charts

A chart is a graphical representation of the worksheet data to shows the relationships between values. The choice of the chart depends very much on the kind of data you are trying to chart and how you want to present the data. E.g. Line, pie, column etc.

- To insert a chart in Microsoft Excel 2010;
- Click/Select the data to present in a chart
- Click on Insert Tab then click on the drop down triangle below the type of chart to insert from the Charts group

Charts

- Take note that two chart Tools tab appears at the top of the ribbon when the chart is inserted or when the chart is selected. You can use these chart tools to manipulate the inserted chart for example by changing the chart type, the location of the chart, add more data etc. For more options on chart type and subtypes, click on the arrow next to the Charts group.

Protecting a workbook and a worksheet using passwords

- Click on the File button
- Point at Info from the pull down menu
- Click on Protect Workbook drop down triangle.
- Choose the type of protection to apply e.g. Encrypt with Password, Protect Workbook Structure etc.
- Enter the password and click OK then reenter the password and click OK again

Workbook and Worksheet Printing

- To produce hardcopies of data created in Microsoft Excel, you need to print it following the steps below;
- Open the Workbook/worksheet to print its data
- Click on the File button then click on Print from the pull down menu
- Set the print options as desired e.g. printer, print range, number of copies and other options from the side list.
- Click on the Print button on the top of the side list.

Application of Electronic Spreadsheets in Education

- Electronic Spreadsheets can be used in Educational Institutions to replace the paper-based ledger sheets used in various aspects of managing educational data. Some of the practical applications of electronic spreadsheets include;
  - Time tabling and event scheduling
  - Analysis and presentation of examination results
  - Financial management e.g. maintaining electronic ledger books, balance sheets etc.
  - As a subject to be taught and examined.

References

- French, T 2010, Basic Excel 2010 Spreadsheet Tutorial, http://www.about.com/, accessed on 10/10/2011
- Excel 2010 Essential Training, http://www.lynda.com/Excel-2010-tutorials/essential-training/61219-2.html, accessed on 10/10/2011
- Excel 2010 Quick Notes, http://msdn.microsoft.com/en-us/library/gg607247.aspx accessed on 10/10/2011
- Microsoft Excel 2010, http://www.excel-2010.com, accessed on 10/10/2011
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- By Prof. Ayub N. Gitau

Content

1. Seed Drying Principles, Moisture Management and Storage
2. Seed Treatment, Packaging And Palletizing Processes and Equipment

Seed Drying Principles, Moisture Management and Storage

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3/11/2016

Components of a seed processing plant

- Reception
- Seed laboratory
- Pre-drying
- Storage and Drying
- Processing
- Packaging
- Warehousing

Definitions:

- **Drying:** Removal of moisture to moisture content in equilibrium with normal atmospheric air or to such moisture content that decrease in quality from moulds, enzymes action or insect will be negligible. Normally to 12 to 14% m.c. for most materials/products
- **Dehydration:** Removal of moisture to a very low moisture content, nearly bone-dry condition (all moisture removed)
- **Equilibrium Moisture Content (EMC):** Moisture content of the material after it has been exposed to a particular environment for an infinitely long period of time or the m.c. that exist when the material is at vapour pressure equilibrium with its surrounding. EMC depends on; humidity, temperature, species, variety, maturity of grains etc.

Merits of seed drying

- Early harvest (at high m.c.) minimizes field damage and shatter losses and facilitates tillage operations for products.
- Long storage period is possible without product deterioration
- Viability of seeds is maintained over long periods
- Products with greater economic value are produced
- Waste products can be converted to useful products
- Production operations are facilitated for products.

Part I
DRYING MECHANISMS

Knowledge of the effect of grain moisture content, other grain properties (surface shape factors, kernel size, grain depth, quality, nature of contamination), the temperature, humidity and flow rate of the air upon fully exposed kernels is essential to an understanding of how drying would proceed within a bed.

- Air Properties:
- Physical properties (mc, BD)
- LHV
- Drying time
- Drying efficiency

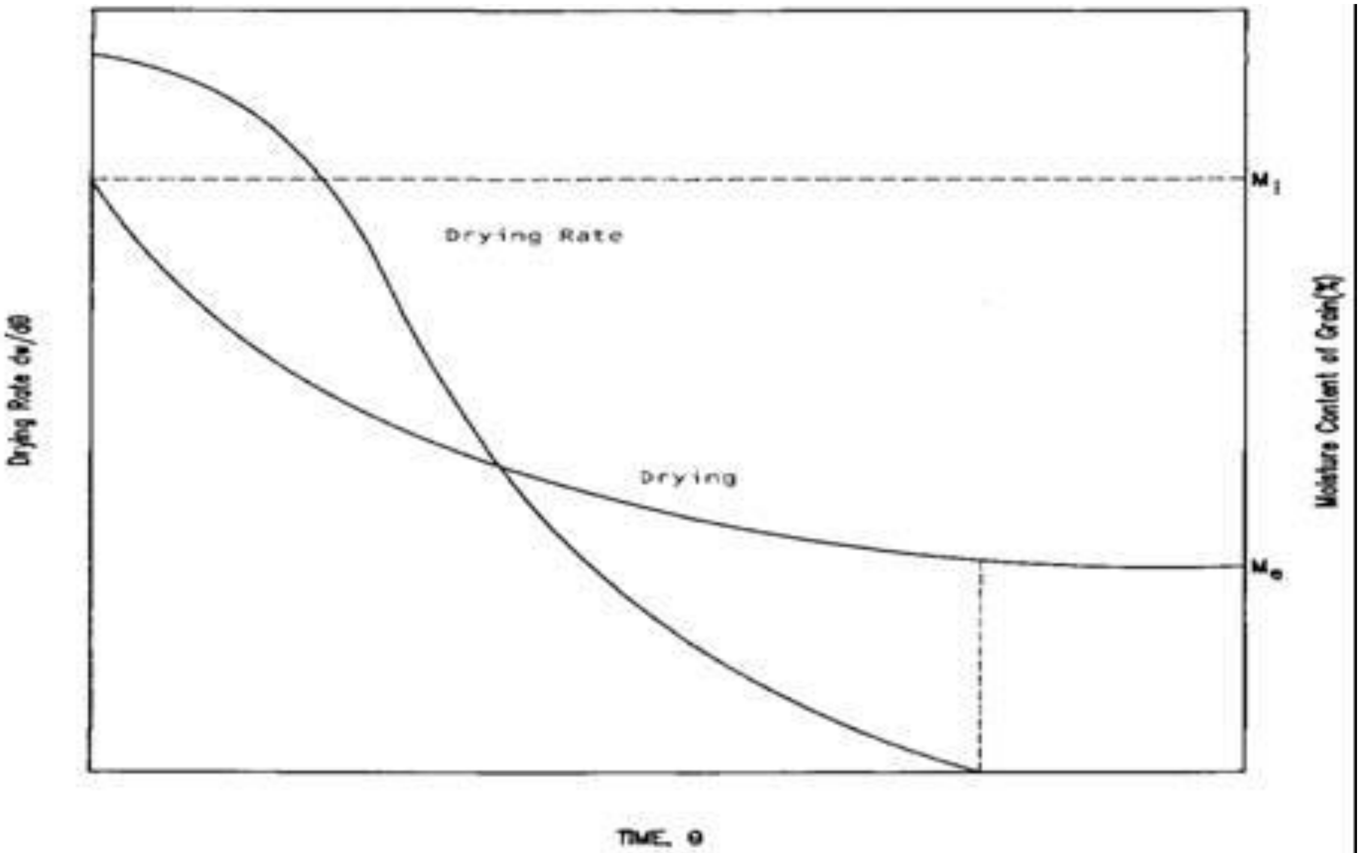
DRYING MECHANISMS

- In the process of drying heat is necessary to evaporate moisture from the grain and a flow of air is needed to carry away the evaporated moisture.
- There are two basic mechanisms involved in the drying process; the migration of moisture from the interior of an individual grain to the surface, and the evaporation of moisture from the surface to the surrounding air.
- The rate of drying is determined by the moisture content and the temperature of the grain and the temperature, the (relative) humidity and the velocity of the air in contact with the grain.

- The drying of grains in thin layers where each and every kernel is fully exposed to the drying air can be represented in the form:
- MR = f (T, h, t)

- Where:
- MR is the moisture ratio;
- MC is the moisture content of th $MR = \frac{MC - MC_e}{MC_o - MC_e}$ evel and at any time, % dry basis (%db);
- MCe is the equilibrium moisture);
- MCo is the initial moisture content of the wet grain (%db);
- T is the air temperature (°C);
- h is the air relative humidity; and
- t is the drying time.

Drying and drying Rate curves



M_i = Initial Moisture content, and M_e = Equilibrium Moisture content

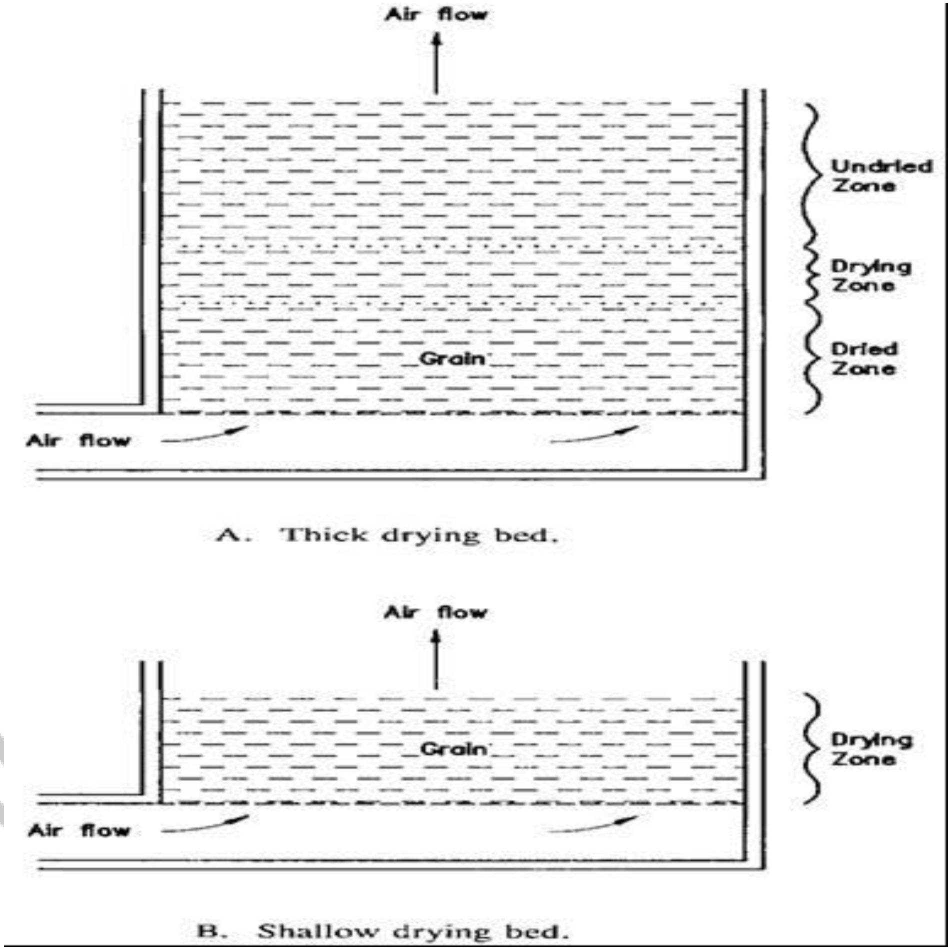
Grain Equilibrium Moisture Contents

Grain	Relative Humidity (%) 30	40	50	60	70	80	90	100
	Equilibrium Moisture Content (%wb*) at 25°C							
Barley	8.5	9.7	10.8	12.1	13.5	15.8	19.5	26.8
Shelled Maize	8.3	9.8	11.2	12.9	14.0	15.6	19.6	23.8
Paddy	7.9	9.4	10.8	12.2	13.4	14.8	16.7	-
Milled Rice	9.0	10.3	11.5	12.6	12.8	15.4	18.1	23.6
Sorghum	8.6	9.8	11.0	12.0	13.8	15.8	18.8	21.9
Wheat	8.6	9.7	10.9	11.9	13.6	15.7	19.7	25.6

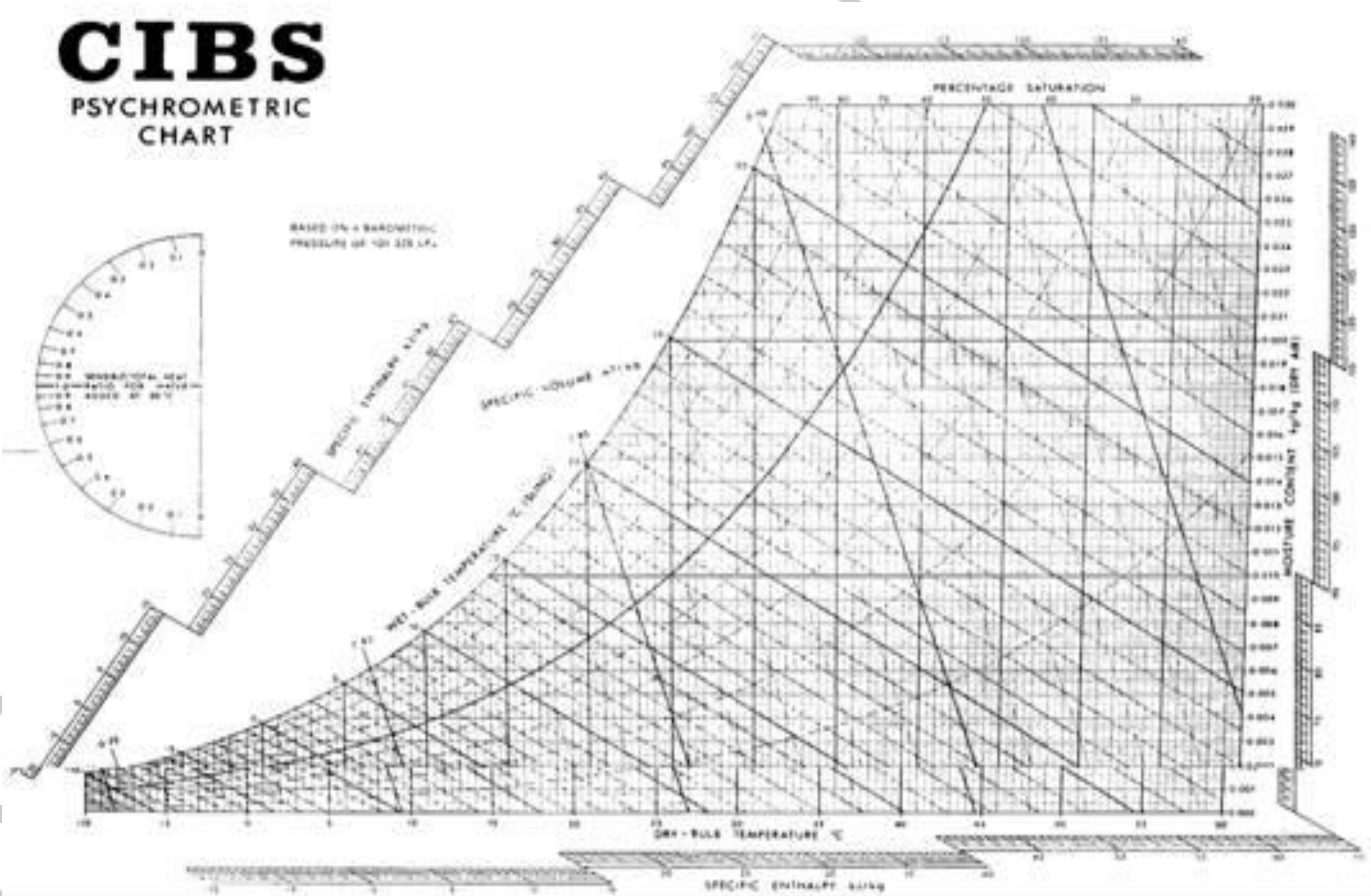
* wet basis

Source: Brooker *et al.* (1974)

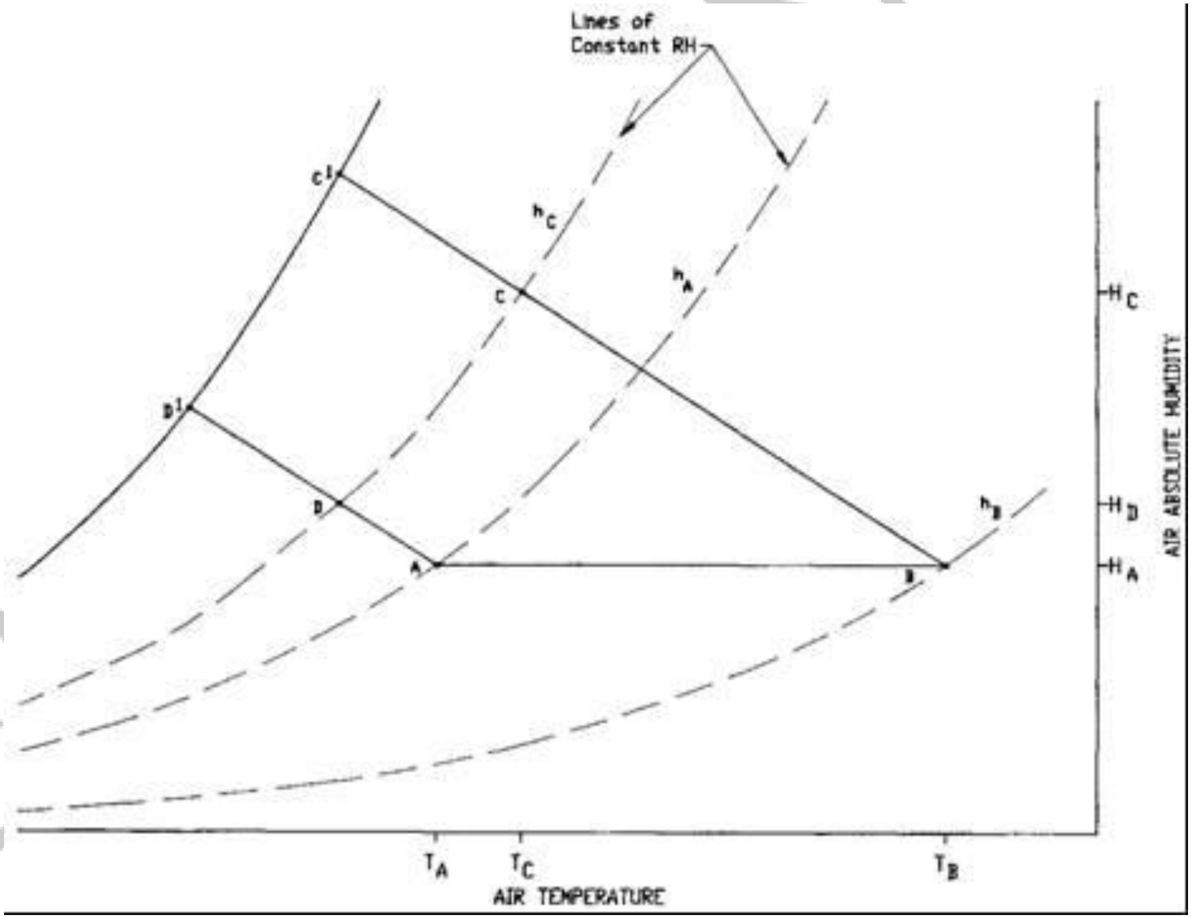
Drying Zone in Fixed-bed Drying



CIBS Psychrometric Chart



Representation of the Drying Process



$$MC_{db} = \frac{100MC_{wb}}{100 - MC_{wb}} \quad \textbf{(3)}$$

Table 2. Conversion of Moisture Contents.

Wet Basis %	**Dry Basis %**
10.0	11.0
11.0	12.3
12.0	13.6
13.0	15.0
14.0	16.3
15.0	17.6
16.0	19.0
17.0	20.5
18.0	21.9
19.0	23.5
20.0	25.0

Moisture Loss during Drying

Initial Moisture Content % (wb)	Final Moisture Content % (wb)								
	19	18	17	16	15	14	13	12	11
	Moisture Loss (kg/tonne)								
30	136	146	157	167	176	186	195	205	213
29	125	134	145	155	165	174	184	193	202
28	111	122	133	143	153	163	172	182	191
27	99	110	120	131	141	151	161	170	180
26	86	98	108	119	129	140	149	159	169
25	74	85	96	107	118	128	138	148	157
24	62	73	84	95	106	116	126	136	146
23	49	61	72	83	94	105	115	125	135
22	37	49	60	71	82	93	103	114	124
21	25	37	48	60	71	81	92	102	112
20	12	24	36	48	59	70	80	91	101
19		12	24	36	47	58	69	80	90
18			12	24	35	47	57	68	79
17				12	24	35	46	57	67
16					12	23	35	45	56
15						12	23	34	45

Latent heat of Vaporization

Temperature °C	Latent Heat of Vaporization (kJ/kg)					
	Free Water	Moisture Content %(wb) 14	16	18	20	22
25	2,443	2,605	2,518	2,483	2,464	2,453
30	2,431	2,593	2,506	2,471	2,452	2,441
35	2,419	2,580	2,493	2,458	2,440	2,429
40	2,407	2,567	2,482	2,447	2,428	2,417
45	2,395	2,555	2,469	2,434	2,416	2,405
50	2,383	2,542	2,456	2,422	2,404	2,393
55	2,371	2,529	2,444	2,410	2,391	2,381
60	2,359	2,516	2,432	2,398	2,379	2,369

Dimensionless Drying Rate Curves

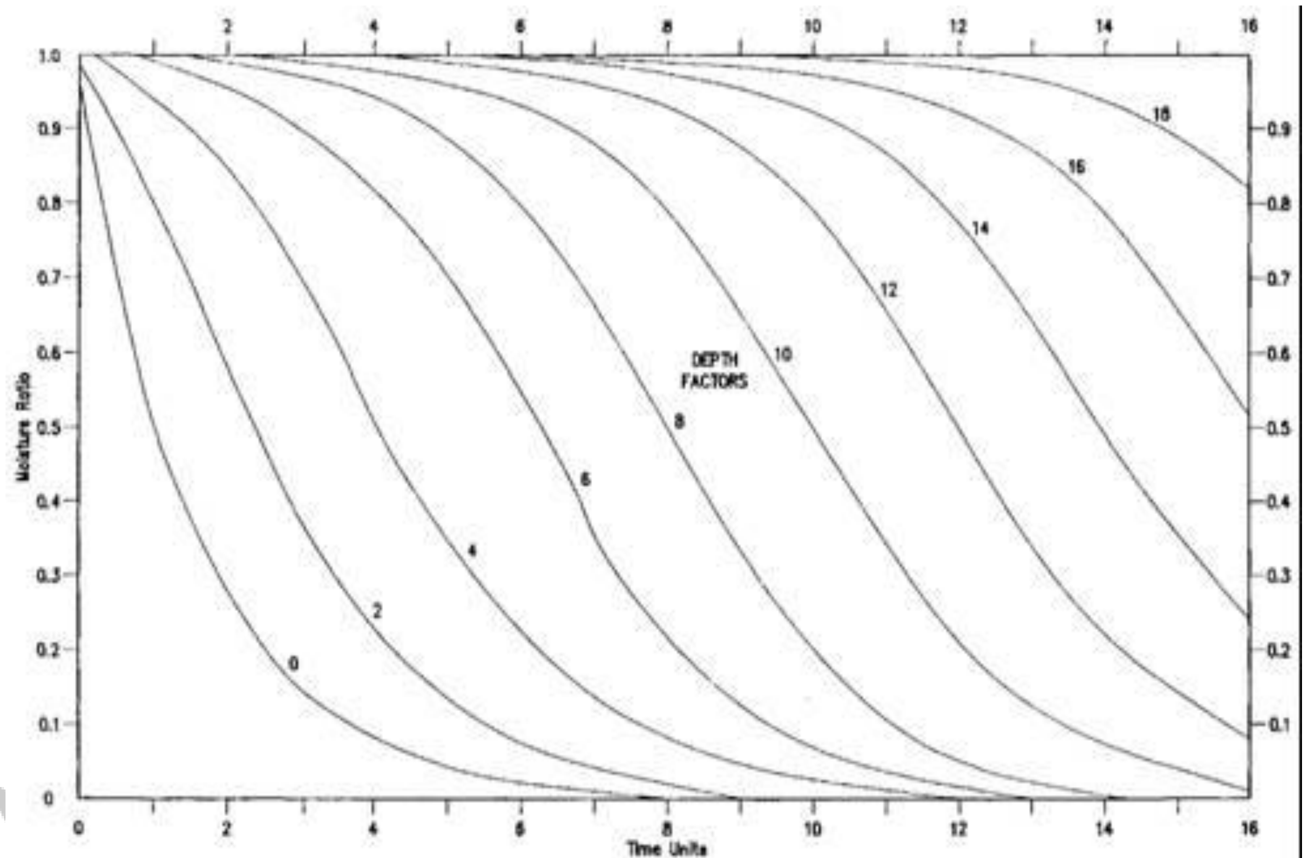


FIGURE 6: DIMENSIONLESS DRYING RATE CURVES

Drying Efficiency

- **Sensible Heat Utilization Efficiency (SHUE) = (Heat utilized for moisture removal)/ (Total sensible heat in the drying air)**
- **Fuel efficiency = (Heat utilized for moisture removal)/ (Heat supplied from fuel)**
- **Drying efficiency = (Heat utilized for moisture removal)/ (Heat available for moisture removal)**

Effect of Drying on Seed Quality

The drying operation must not be considered as merely the removal of moisture since there are many quality factors that can be adversely affected by incorrect selection of drying conditions and equipment.

The desirable properties of high-quality seeds include:

- low and uniform moisture content;
- minimal proportion of broken and damaged seeds;
- low susceptibility to subsequent breakage;
- high viability;
- low mould counts;
- high nutritive value;
- consumer acceptability of appearance and organoleptic properties.

Part II
Seed Drying Methods and Equipment

- **Sun Drying**

- The traditional practice of grain drying is to spread crop on the ground, thus exposing it to the effects of sun, wind and rain.
- The logic of this is inescapable; the sun supplies an appreciable and inexhaustible source of heat to evaporate moisture from the grain, and the velocity of the wind to remove the evaporated moisture is, in many locations, at least the equivalent of the airflow produced in a mechanical dryer
- Although not requiring labour or other inputs field drying may render the grain subject to insect infestation and mould growth, prevent the land being prepared for the next crop and is vulnerable to theft and damage from animals.

- **Crib Dryers**

- The maize crib in its many forms acts as both a dryer and a storage structure.
- The rate and uniformity of drying are controlled by the relative humidity of the air and the ease with which air can pass through the bed of cobs.
- The degree of movement of air through the loaded crib is largely attributable to the width of the crib

Solar Dryers

- Natural Convection dryers
- Forced Convection Dryers

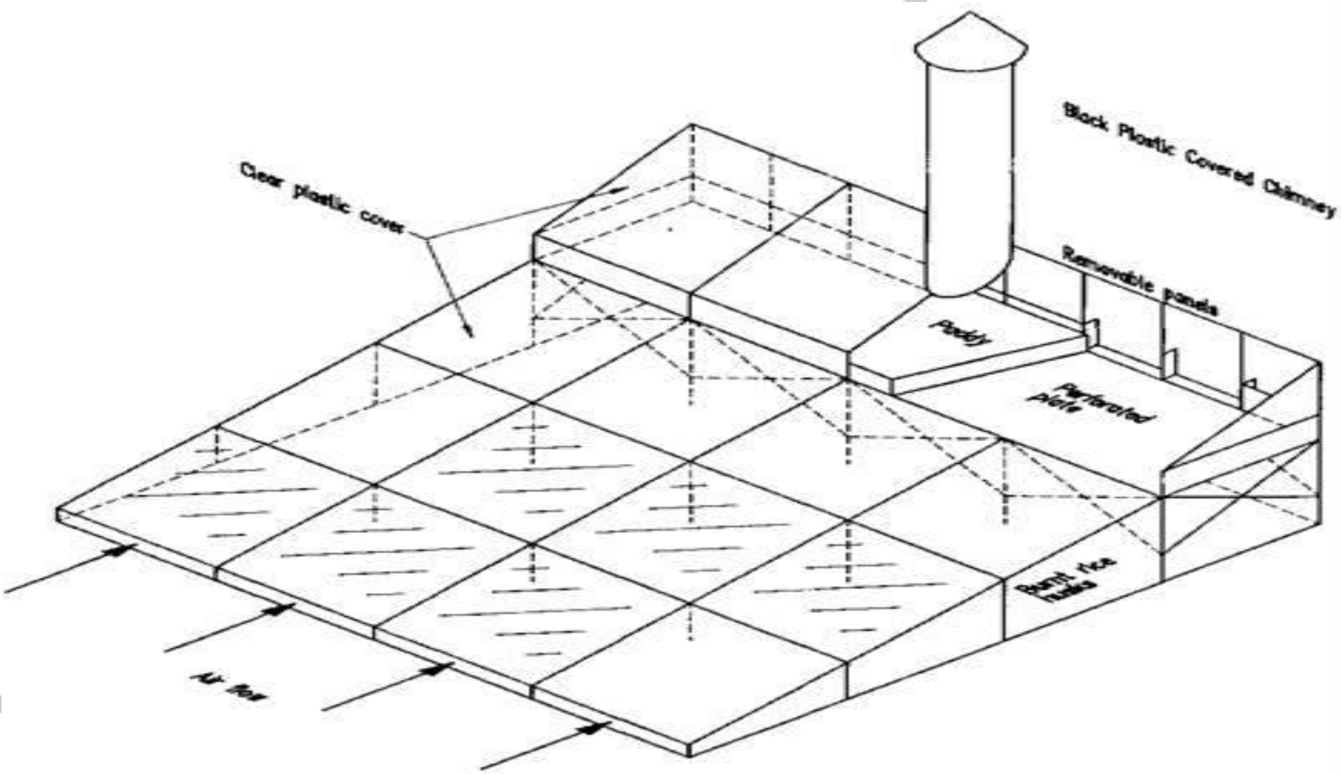
Mechanical Dryers

- Flat Bed dryers
- Re-circulating Dryers
- Continuous Flow Dryers (Cross-Flow, Counter flow and Concurrent-Flow)

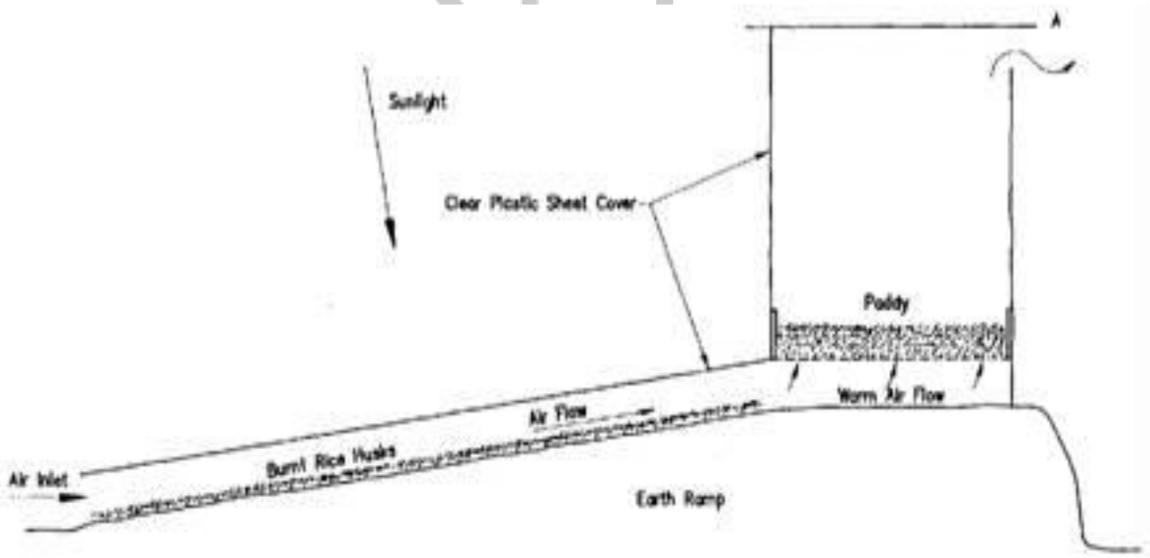
Drying Process and Equipment

Drying Process and Equipment Cont.

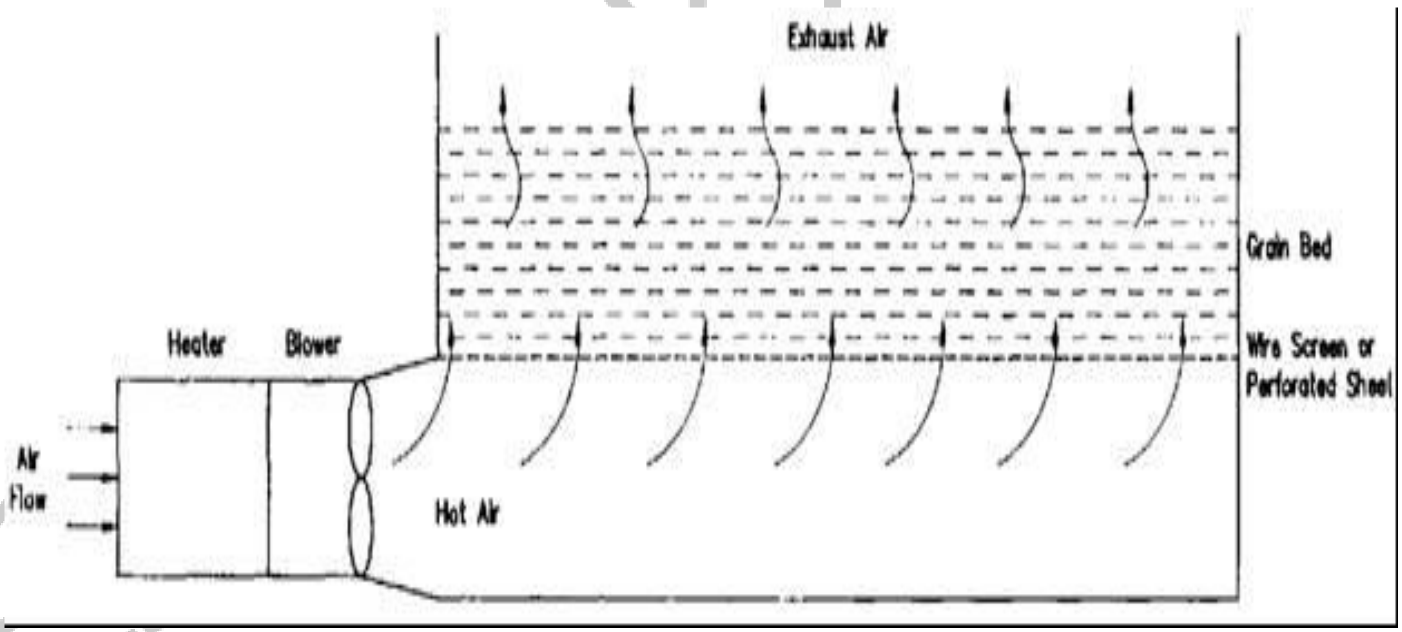
Natural Convection Solar dryer



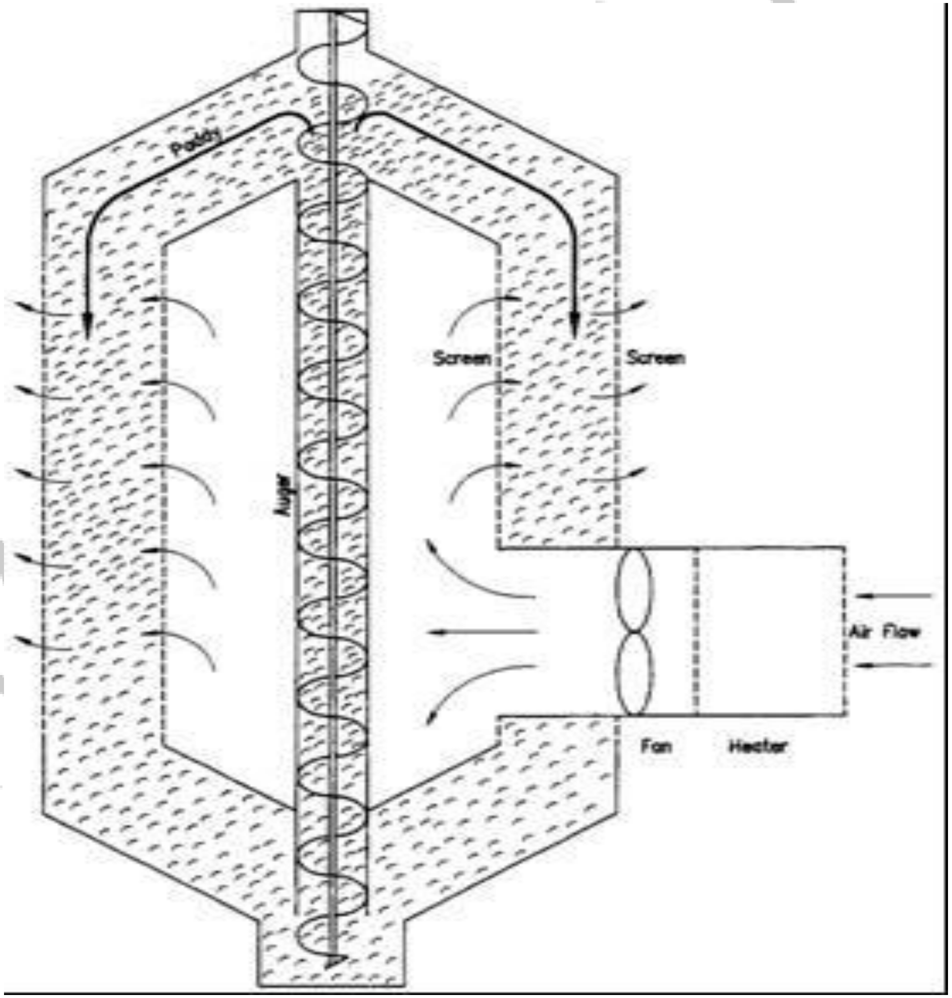
Small Scale Solar Dryer



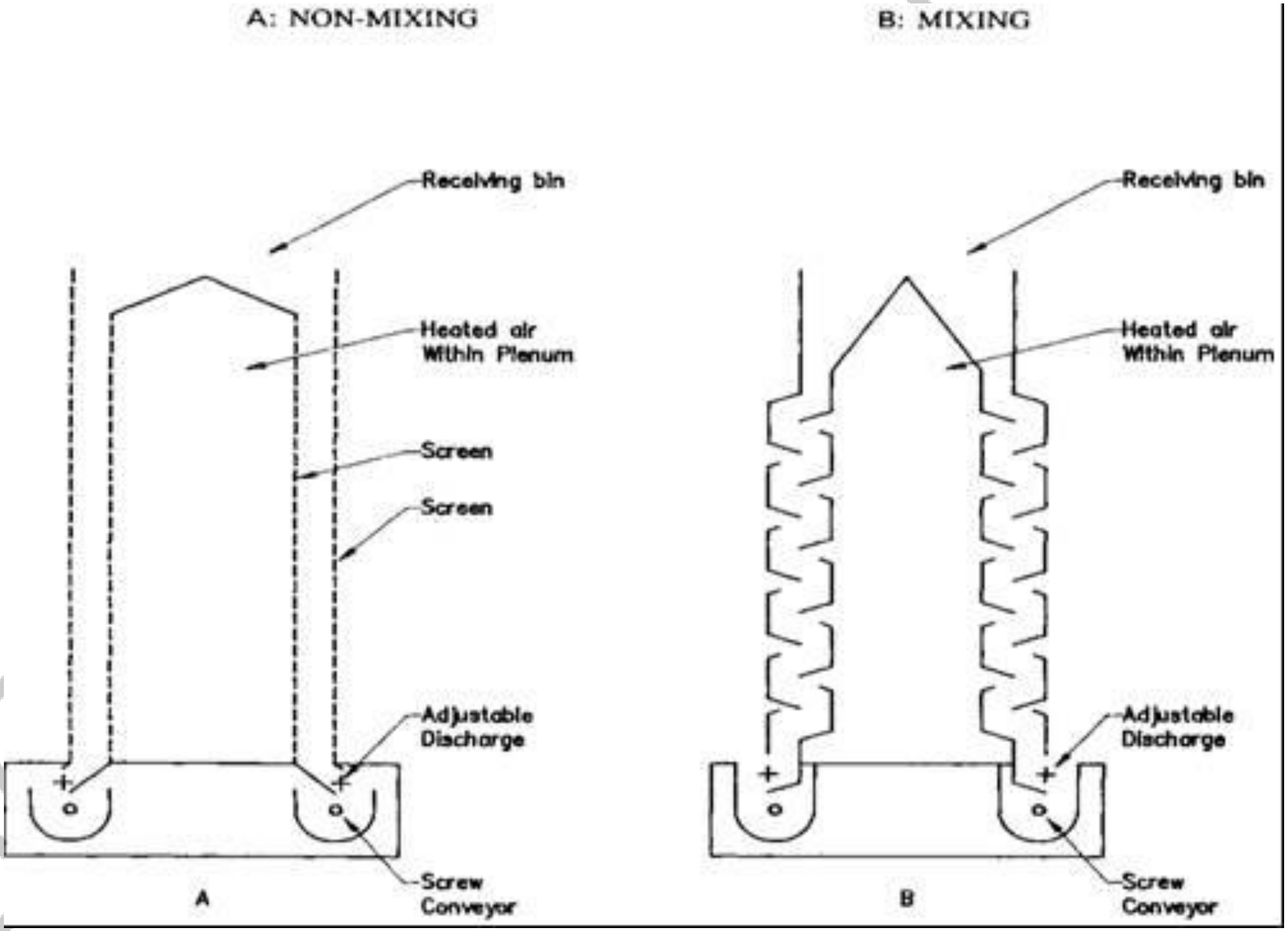
Flat Bed Dryer



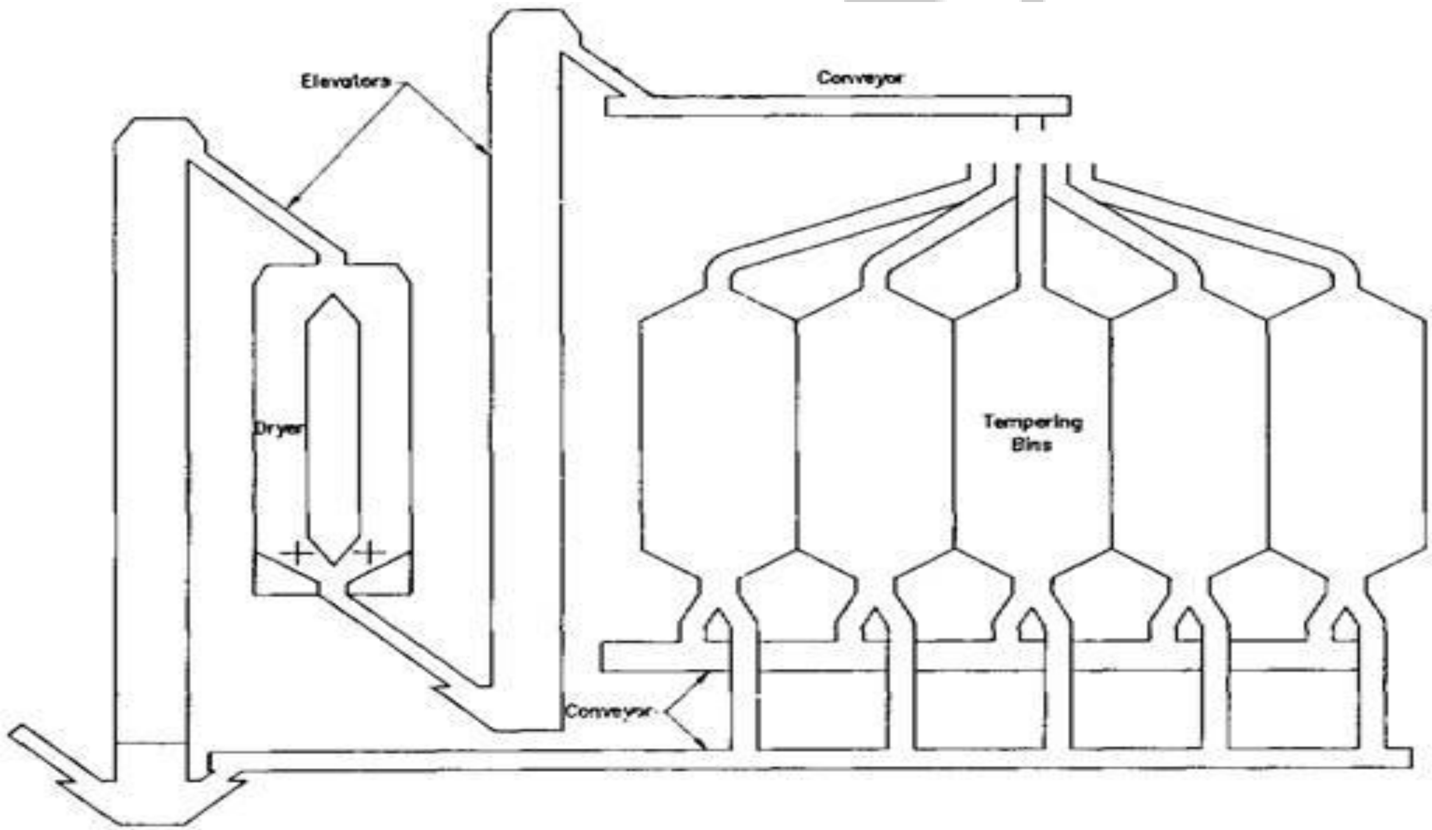
Re-circulating Batch Dryer



Continuous Flow Dryer



Large Drying System using Continuous Flow Dryer



Drying of Seed Grain

- If grain is destined for use as seed then it must be dried in a manner that preserves the viability of the seed. Seed embryos are killed by temperatures greater than 40-42°C and therefore low temperature drying regimes must be used.
- It is essential that batches of grain of different varieties are not mixed in any way and therefore the dryers and associated equipment used must be designed for easy cleaning.
- In this respect simple flat-bed dryers are more suitable than continuous-flow dryers.
- Cross-mixing between batches of different varieties can be avoided by drying in sacks in a flat-bed dryer although care must be taken in packing the loaded sacks in the dryer to ensure reasonably even distribution of airflow.

Seed Storage

According to Harrington's rule of thumb for storage,

- For every one percent increase in moisture content, the seed life is halved for seeds of moisture content of 5 - 14%.
- For temperature, every 5° C rise in temperature, between 0 - 50° C, the seed life is halved.
- Moisture content of seeds is the most important determinant of the life span of seeds. In addition, low moisture content will not favour the growth of fungi nor insect pests.
- Hence it is of vital importance to dry seeds to low moisture level of 6 - 8% and to store them at low temperature ie. at 20° C for short term storage and 5° C or -20° C far very long term storage.

Types of Storage for Seed

1. ***Ordinary storage for short periods***

- For short term storage in crops for the next season, an air-conditioned room at 20° C will be sufficient provided the seeds are properly dried and packed in bags preferably moisture proof containers.
- During storage, if the moisture content is too high, the problem of fungal growth is inevitable and also there will be insects which can breed at a faster rate in moist seeds.
- The pests will eat up the seeds or bore invisible holes which affect the vigor and quality of seeds. Too high moisture in stored seeds will lead to heating of the seeds and high rate of respiration leading to loss of viability.

Cont.

2. *Cold Storage for Breeder Seed*

- In case of breeders seed or seeds for genetic conservation then a higher standard is required. Seeds have to be dried to 6 - 8% moisture content sealed in airtight moisture proof containers and stored in cold rooms of 5° C to -18° C and 50% relative humidity. This is the case in a seed or gene bank, where genetic materials in small samples are stored in cans or aluminium foil packets.
- The temperature is often sub-zero at -10° to -20° C. The latest form of storage is cryogenic storage mainly for genetic resources as smaller samples are involved and stored in liquid nitrogen tanks at temperature of -196 C. Cryogenic storage has certain advantages in that no electricity is required. There is no mechanical breakdown and maintenance cost is low.

3. *Storage with Drying Component*

- In some cases, the storage facility may double up as the drying facility. In this case the silo takes the form of the deep layer dryer as elaborated earlier.

Thank you

for

your Attention

SEED TREATMENT, PACKAGING AND PALLETIZING PROCESSES AND EQUIPMENT

By

Prof. A. N. Gitau, PhD, R.Eng
Department of Environmental and Biosystems Engineering
University of Nairobi

1. Seed Treatment

Seed treatments are defined as chemical or biological substances that are applied to seeds or vegetative propagation materials to control disease organisms, insects, or other pests

Merits

- Seed treatments is used on many crops to control a variety of pests. They are commonly used to ensure uniform stand establishment by protecting against soil borne pathogens and insects.
- Seed treatments have had phenomenal success in eradicating seed borne pathogens, such as smut or bunt, from wheat, barley, and oats.
- Seed treatments can be used to suppress root rots in certain crops.
- Some newer systemic seed treatments can supplement or may provide an alternative to traditional broadcast sprays of foliar fungicides or insecticides for certain early-season foliar diseases and insects.

Limitations

Although seed treatments have important benefits, they also pose certain risks.

- One risk is accidental exposure of workers who produce or apply seed treatments.
- Another risk is contamination of the food supply by accidental mixing of treated seed with food or feed grain.

Cont.

- A third risk is accidental contamination of the environment through improper handling of treated seeds or seed treatment chemicals.

Note: All of these risks can be minimized by proper training and proper use of seed treatment pesticides.

The ideal seed treatment should be:

(1) Very effective against seed-borne pathogens,

(2) Relatively nontoxic to animals and plants, even if misused,

(3) Effective for a long time during seed storage,

(4) Easy to use,

(5) Acceptable and

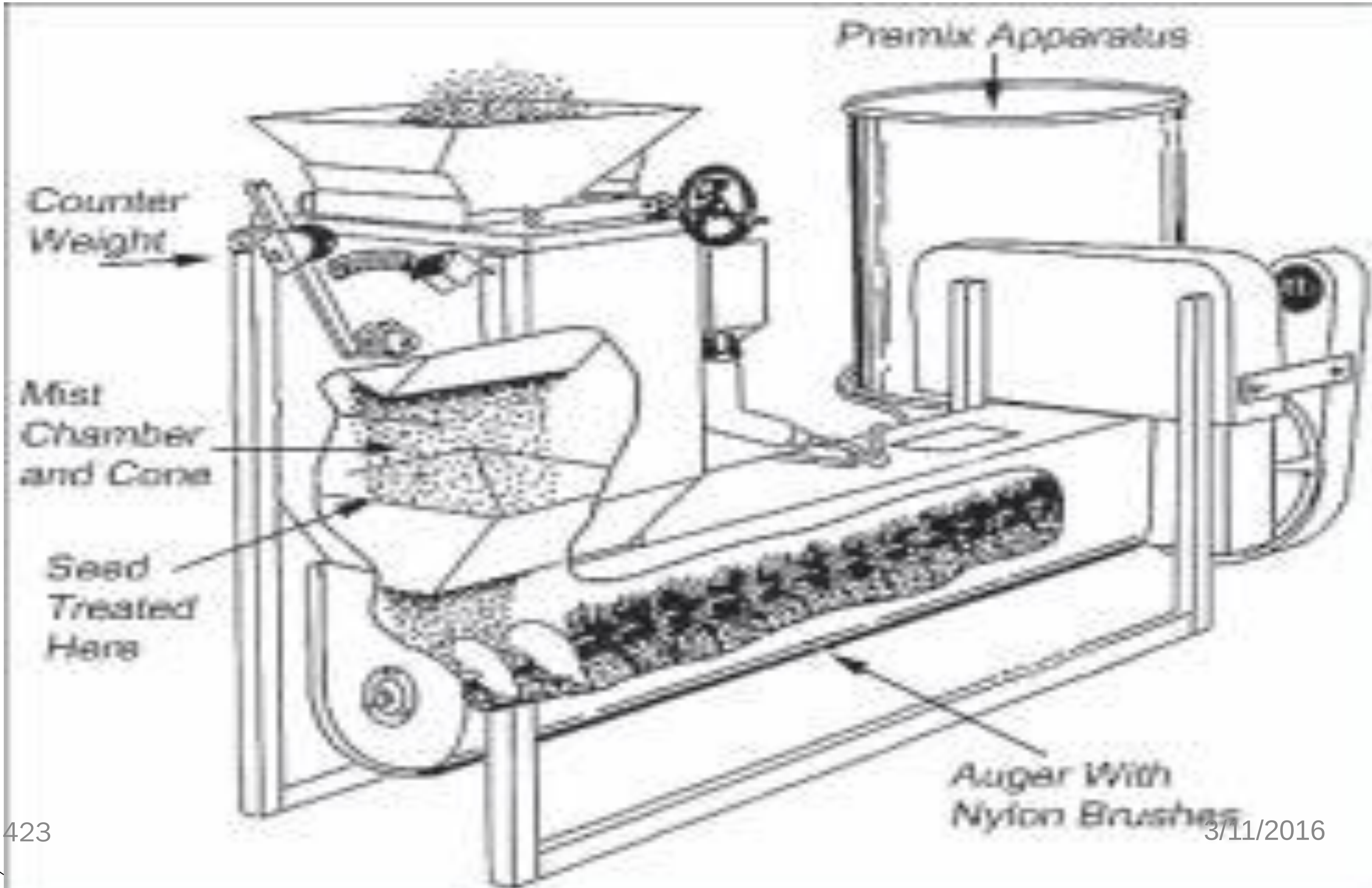
(6) Economical.

Note: The hot water treatment method meets many of these criteria. Though not as easy to use as chemical treatments, it can be more effective and is non-toxic.

Treated Seed

- Pesticide-treated seed must be stored in a dry, well ventilated location separate from untreated seed;
- It should never be stored in bulk storage bins that might also be used for edible grain storage.
- It should be stored in special multiwall (3- or 4-ply) or tightly woven bags. Some polyethylene or foil-lined bags are also good containers for treated seed.

Metered Seed treater



This Seed Treated With POISON
Treatment used: Disulfoton

Do not use for food, feed or oil purposes

2. PACKAGING

After processing and treating are completed, seeds are packaged into containers of specified net weight. Packaging or bagging is essentially the last operation in which seeds are handled in bulk flow.

The packaging consists of the following operations:

- ✓ Filling of seed bags to an exact weight.
- ✓ Placing leaflets in the seed bags regarding improved cultivation practices.
- ✓ Attaching labels, certification tags on the seed bags, and sewing of the bags.
- ✓ Storage/Shipment of seed bags.

PART I: THE PROCESS

What is meant by seed packaging?

- This is the placing of a counted or weighed sample of seeds into a container which is then hermetically (airtight) sealed ready for storage.

Why are seeds packaged?

- Seeds are packaged to prevent absorption of water from the atmosphere after drying, to keep each separate and prevent contamination of the seeds from insects and diseases.

- Other Reasons: Contain products, defining the amount the consumer will purchase; Protects products from contamination, from environmental damage and from theft; Facilitate transportation and storing of products; Carry information and colorful designs that make attractive displays.

When should seeds be packaged?

- The best time to package seeds is directly after the moisture content has been determined and found to be within the required limits for safe storage. Seeds will always show equilibrium between their moisture content and the relative humidity of the environment and therefore, if possible, seeds should be packaged into containers and hermetically sealed in the drying room or without delay on being removed from it.

How should seeds be packaged?

- Different containers and special equipment for sealing are available for the storage of seeds.
- Storage containers for base collections should be hermetically sealed and moisture-proof.
- Cans, bottles, and laminated aluminium foil containers are all acceptable for both base and active collections. The techniques used will vary with the type of container and the equipment that your gene bank is using. The general steps outlined in this section could be followed.
- Moveable racks make the best use of available space and are ideal to store containers in walk-in stores. Small containers or aluminium foil packets can be filed in boxes for ease of locating individual accessions. Coding systems by number or colour are also helpful in exactly locating accessions.

Types of Packaging

- Packaging materials are classified as rigid, semi-rigid and flexible, according to their consistency.
- Those that present some specific characteristic due to the type of product it contains or on its applications, are considered special packs.
- Rigid packs are produced in metal (steel and aluminum), glass, cardboard (flat

  and corrugated), wood, rigid plastics or ceramics, with the addition in some cases, of materials such as tinfoil, resinous or synthetic oils, paints and glues.
- Semi-rigid packs are plastic bottles and containers and mixed laminated materials.

With no reuse, discarded packs have an undesirable impact on the environment

THE PACKAGING PROCESS

- Prepare for Packing
- Package the Seeds
- Enter the data into the Data Files
- Check the Quality of the Containers

Step 1. Prepare for Packaging

- 1. Work in the drying room or, if not possible, expose the seeds to the ambient relative humidity for the shortest possible time.
- 2. Write on the outside of each container or on an adhesive waterproof label. Also prepare a label for inclusion with the seeds. Record the accession number, date of storage, genus and species if required. Use permanent markers for this.

Notes and Examples

- Adhesive labels can be used for the outside of containers, but they must be waterproof and remain adhesive for long periods at low temperatures.
- **Equipment**
- Labels
  Permanent markers
  Laminated aluminium foil containers, cans or bottles
  Machines for sealing
  Coarse balance
  Scoop/spoons

Step 2. Package the Seeds

- 1. Weigh out or count samples of seeds to fit the containers used in your gene bank.
- 2. Fill the labelled containers with the seeds. Add the label prepared for the inside.
- 3. Seal immediately, so that the moisture content of the seeds does not increase due to equilibration with ambient relative humidity.
- 4. Note the weight or number of seeds in each container.

Notes and Examples

- It is important that the containers used should be moisture-proof and sealed. The exact sealing technique will depend on the type of containers and sealing methods that are available.
- **Laminated aluminium foil bags** are easy to package, can be cut to size to save space and can be sealed again after use. However, they are difficult to stack and must be made of good quality material and have good seals or leakage may occur.

Step 2 Cont.

- **Cans** are rigid and easy to stack and usually will not break open if dropped. However, some types of cans are not resealable and therefore are expensive to use. A standard size can with only a few seeds inside wastes space in the store.
- **Glass bottles** can usually be sealed again and the amount of seed left is visible. However, a standard size will waste space and bottles are easily broken.
- Seeds can be packaged in bulk into **large containers and/or sub-samples** can be packaged separately into smaller containers. Although the initial packaging period is longer, sub-samples can then be removed quickly without having to remove the bulk of the accession from the store.

Step 3. Enter the Data into the Data Files

- 1. Enter the relevant data about each accession into the data file.

- 2. The data should include number of containers per accession, number or weight of seeds per container, type of container (if not standard) and the date of packaging.

Step 4. Check the Quality of the Containers

- 1. After sealing, make a visual examination of each container to make sure that there is no obvious damage and that the seals do not leak.
- 2. Any containers that are below standard should be replaced immediately.
- 3. At regular intervals the containers should be checked to see that they remain in good condition. It is suggested that this check should be carried out routinely once a year and that individual containers should also be checked whenever they are removed from the genebank.
- 4. If containers are found to have been leaking and the relative humidity of the store was not controlled, determine the seed moisture content.
- 5. If the moisture content has risen, dry the seeds back to the required moisture content level.
- 6. Enter the value of the new moisture content into the data files. Make a note that the seeds in that container have been held at increased moisture content for a limited period and dried again.
- 7. Check the inventory data file for the descriptor 'date of packaging' and make a list of any other accessions which were packaged in similar containers on the same day or one day before or after.

Step 4 Cont.

- 8. Check the containers on this list for leaks and poor condition and replace any that are faulty using the methods described above.
- 9. Remember that any containers removed from the cold store should be allowed to warm to room temperature before opening. This may take several hours especially with large volumes of seeds.
- **Notes and Examples**
- If any defective containers are found, it may indicate that containers made or sealed at the same time are also faulty or it may just be one faulty container or seal. Checking those packaged at the same time will show if the problem is widespread.

Summary of seed packaging in your gene bank

Fill in this table for your future reference:

Species	Type of container	Optimum number or weight of seeds/container	Sealing method

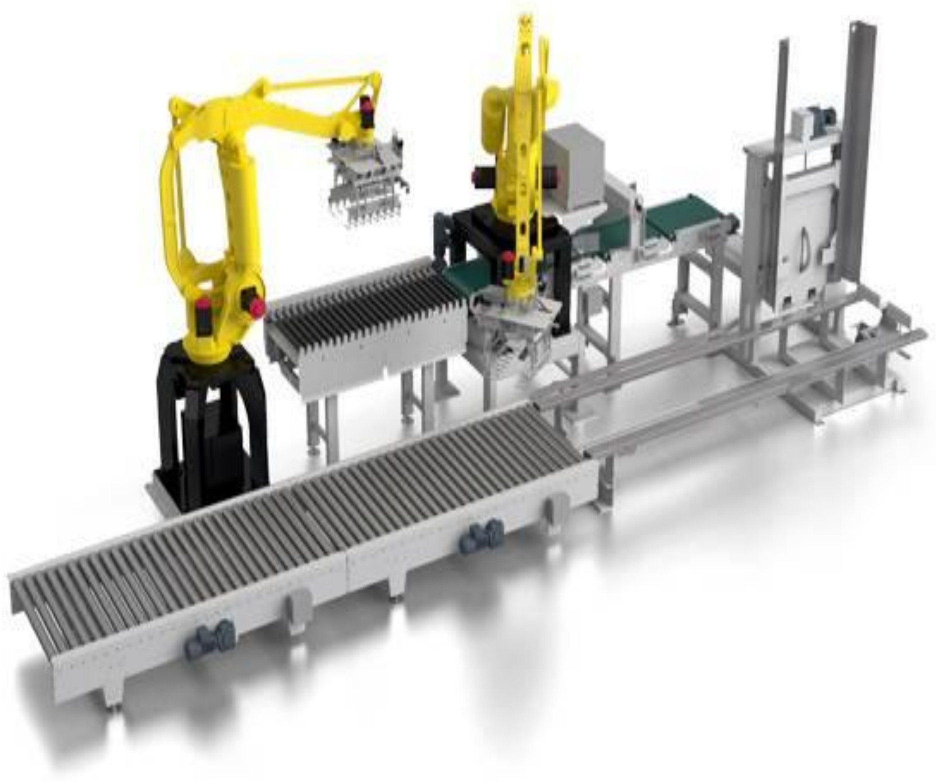
PACKAGING / BAGGING EQUIPMENT

- 1**. Bagger weigher**: These are small machines which when properly mounted beneath a bin will fill and weigh a bag accurately in a single operation. Bagger weigher and bagging scales used in seed packaging may be manual, semi-automatic or automatic.
- 2. **Bag sewing machine**: After an open-mouth bag is filled the bag top must be sewed with a bag sewing machine. Bag sewing machines are precision, high speed machines and must be operated and maintained properly to prevent frequent breakdowns and short operating life.
- 3**. Elevating and conveying equipment**: Several types of conveyors are available for moving seed into, through, or away from the processing plant in vertical, horizontal or inclined directions. Selection of conveyors that have adequate capacity, do little damage to seeds and are easy to clean and can have an important influence on processing effectiveness and efficiency.
- Conveyors used at processing plants can be classified as:
- 1. Bucket elevators 2. Belt conveyors
- 3. Vibrating conveyors 4. Pneumatic conveyors
- 5. Screw conveyors 6. Chain conveyors
- 7. Lift trucks.

Manual Bagger (by weight)

Open mouth bagger

HIGH SPEED ROBOT PALLETIZER



ATTACHING LABELS

- At the time of placing seed into bags, a label must be placed on each bag to maintain positive identity of the seed. When bags are closed with a bag sewing machine, a label or tag can be sewn to the bag.
-
- **Maximum lot size**: The maximum size of seed lot shall not exceed the limits. Each seed lot will be assigned a seed lot no. as specified in the Minimum Seed Certification Standards (MSCS).

The Steps / Parts

- ✓ Month-Year Code
- ✓ Production Location Code
- ✓ Processing Plant Code
- ✓ Seed Produce Code

FIRST PART

- This shall be called the "**Month-year code**" and will indicate the month and year in which the concerned seed crop was harvested. The month will be represented by its abbreviated form and the year will be represented by the last two digits of the calender year, such as 89 for 1989 A.D., 90 for 1990 A.D., 00 for 2000 A.D., 01 for 2001 A.D. and 10 for 2010 A.D.. The abbreviated form to be used each month is given as under:

- **Month** **Abbreviated form**
- January JAN
- February FEB
- March MAR
- April APR
- May MAY
- Etc.

SECOND AND THIRD PARTS

Second Part

- This shall be called the "**Production Location Code**" and will indicate the State, District, Sector, Territory, Province etc where the concerned seed field(s) was/were located.
- For this purpose, each State, District, Sector, Territory, Province etc is allotted a permanent numerical as shown below.

Numerical	Sector / District
01	Ngoma
02	Arusha
03	Kitale
04	Jinja
05	Mugesera

Third part

- This shall be called the "**Processing Plant Code**" and will indicate the seed processing plant where the relevant lot was processed. For this purpose, the certification department shall allot a number to each approved seed processing unit.

FOURTH PART

- This shall be called the "**Seed Produce Code**".
- It will indicate ultimate serial number of an individual lot.
- The procedure for assigning this code will be based on unit of certification.
- For this purpose, the Certification department shall allot a number commencing from 01 to each unit of certification.
- The seed produce code shall be commenced from 01 with effect from 01-04-2002 and it shall be continued for THREE financial years.

All the four parts of the lot number shall be written in series with a "dash (-)" between first, second, third and fourth parts to distinctly indicate the code number of each part.

AN EXAMPLE

Lot No: MAR11 – 22 – 10 – 01

- MAY 11 Seed harvested in May.2011
- 22-Seed crop raised in Nyanza
- 10- Seed processed in a processing plant identified as number 10 by the Nyanza District Certification Department.
- 01- Seed Produce Code that will trace to the particular unit of certification.

Note: Each seed lot under Certification shall be assigned a distinct number so as to facilitate in:

- Maintaining its identity
- Tracing back to its origin
- Handling in stores, transit etc.
- Accounting and inventory maintenance
- Referring / communicating about a certain quantity of seed.

- By Prof. Kiarie Njoroge

Contents

1. Overview Of Seed Value Chain

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Seed Enterprise Management Institute

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SEED DRYING, PROCESSING AND STORAGE COURSE

OVERVIEW OF SEED VALUE CHAIN

Prof. Kiarie Njoroge

OVER VIEW

1. Introduction
2. Steps in Seed Production
3. Definition of Value Chain
4. Players in Seed System
5. Seed Value Chain
6. Systematic Testing and Advantages
7. Conclusions

1. Introduction

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- The seed industry is backbone of all agriculture because quality seed is starting point of all good agricultural practice

- Seed has potential to address both food security and poverty through income generation because the potential of agricultural production is locked up in the seed for other inputs to exploit

- To produce adequate food, a seed supply systems that adequately responds to the farmers requirements must be in place.

...INTRODUCTION

- Seed production and supply chain logistics transforms seed from research seed into a commercial product
- From production field processing follows involving removal of impurities, treat (with coatings and inoculants), package and distribute.
- This ensures quality and other needs are met to customer satisfaction, including purity and germination, availability.
- The process involves many varied actors, who should be a team for efficiency in value addition to enhance the seed poroduct.
- Plant breeders (private or public) use seed companies to reach farmers, a process that is mediated and regulated by law, often through the NPPO agency

…INTRODUCTION

- The program is designed to promote an efficient seed industry through developing human capacity
- This program hopes to promote use of good seed to contribute into improved incomes and nutrition
- Good seed comes from good value chain seed systems.

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Steps in Seed Production

- This calls recognition of that there is need to:

  - Deploy new varieties from the researchers; research products must be delivered through the seed systems and facilitated by the agro-dealers.

  - Improve collaboration between NARS research system and the private seed sector if companies have to access good germplasm (research products) because linking private sector (private business) and public sector technical efforts is essential for success

  - In Africa, we need greater financial support and better infrastructures

Players in the Seed System

- Similarly, there is a need for streamlined seed policies and regulatory systems
- Better seed value chains are required to promote good cultivars through the agricultural system.
- Seed systems are only a component of the agricultural production system; once available, seeds require an appropriate environment of soils, rainfall, temperatures, disease and pest management protocols etc to be of use.

…PLAYERS IN SEED INDUSTRY

- To be deployed, a marketing system should also be in place to answer the demands which, if absent should be created
- A value chain is the sum of all interlinked activities that add value in the process of converting inputs into outputs which, in turn create competitive *financial* advantage to a product.

DEFINITION

Development of a seed value chain (SVC) is all about promotion of a seed system which targets delivery of high quality seed in an efficient and sustainable manner.

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Development of a seed value chain (SVC) is all about promotion of a seed system which targets delivery of high quality seed in an efficient and sustainable manner.

A SVC has nine elements:

1. Cultivar development and release, itself a complex phase
2. Establishment of seed enterprises
3. Access to foundation seed
4. Access to inputs (i.e. purchasing or procurement)
5. Production and all post harvest processing operations
6. Marketing and selling (distribution and all associated logistics e.g. after sales services)
7. Seed research
8. Human resource development
9. Corporate infrastructure.

…cont

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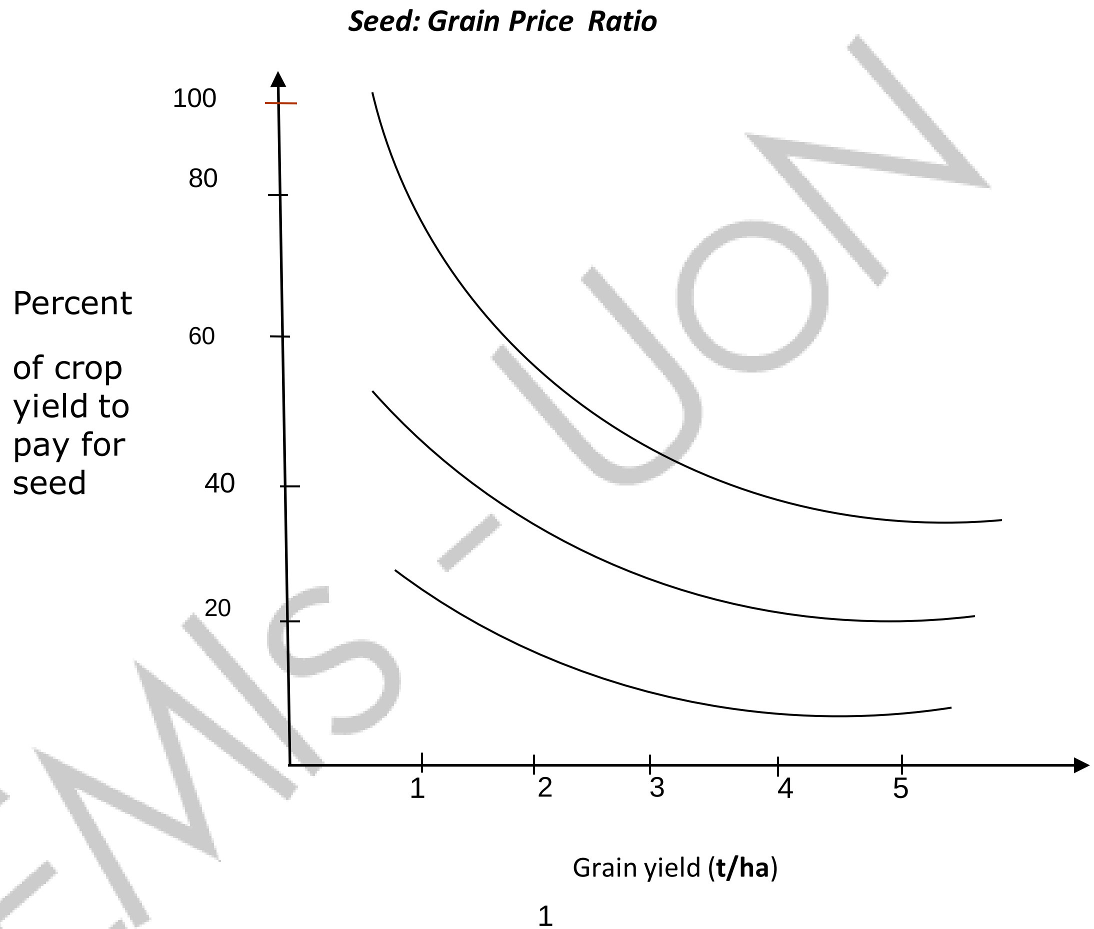

Defining a Value Chain

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- A value chain (VC) is a sequence of events from production of raw material to full transformation into a final product to be purchased by the consumer.
- Thus VC analysis characterization of each stage that a product experiences from initial product conceptualization, to provision of inputs, through primary production, to intermediate trade, to processing, retail marketing to final marketing. By implication, some value is added at each node.

….Value chain defined

Seed sector is a complex of processes that interact:

- They involve many actors all of them essential to each other's success! Supportive and influences.
- These determine how fast and how large the sector grows.
- They are at the mercy of various bottlenecks and opportunities.

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Seed Value Chain

1. Development: a costly process undertaken by N.A.R.S (NARIS & universities), C.G.I.A.R and some large seed companies.

Bottlenecks: - High staff turnover (in N.A.R.S)

-Poor research infrastructure

-Inadequate funding

-Lack of appropriate germplasm

-Ever present threat of new pests, diseases

-Climate change threat

…cont

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- *Opportunities:* -Public and private breeding linkages to make germplasm available.
  - incorporation of new breeding tools (e.g. MAS & DH technique)
- *Support:* - Government, private sector, donors & NGOs.

Variety Testing Participatory cultivar Testing

- Development varieties and research stations (controlled environment) need on farm testing; to confirm superior performance. On target environments with farmer inputs, sometimes simultaneously with cultivar development.

Advantages of Systematic Variety tests:

- Tests superiority over standard checks
- Confirms adaptability in target areas.
- Which entries meet farmer preferences.

- *Bottlenecks: -*influences regulation authorities that demand lengthy testing before registration. (This must be confronted).

Poor infrastructure, data inaccuracy.

3. Registration of Varieties

- Actors here are seen as variety development, same influences & supporters.

❑ *Bottleneck:*

- Needs to be through a known and trade system that is regulated nationally, regionally & globally.
- Have to be registered using known procedures, lack of rights & high cost & lengthy times.

4. Production and Marketing

- Requires the most attention and innovation in seed value chain.
- Production & conditioning/processing requires carefully selected farm (land resources) and staff, physical infrastructure e.g. machinery & irrigation.
- Storage also optimizes production, often small companies may only hire;
- Throughout quality assistance is partially essential.
- Production of F seed is particularly demanding on quality control.

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...Systematic testing

5. *Marketing and Distribution*

- It is a specialized area different from usual commodities. E.g. special packs required over a very short period, can die. Prices are controlled y productivity & government policy. An example rural development, farm credit, input/output pricing & market of the grain or financial production.
- Success is controlled by efficient promotion of the production; so provide information to farms & retailers and respond to their queries appropriately.
- Storage (skills & facilities) are necessary.

CONCLUSIONS

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- Success of a seed business is controlled by three factors: valuable *research products*, careful *production of the produc*ts as per regulations and *good marketing* strategies. All these are heavily interdependent on each other.

- Efficient seed production, processing and distribution under quality assurance standards may still not work as expected due to the influence of *external factors*;
- Four of these are particularly patent:

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...cont

- Restrictions from the national regulations set on seed quality standards
- Inappropriate market restrictions
- Low farm productivity that makes the enterprises unprofitable.
- Functionality of grain (and value added) markets.

Success in seed is intertwined with success in agricultural economy, and seed is only one of the key factors.

THANK YOU FOR LISTENING

- By Prof. J. Muthomi and Prof. R. D. Narla

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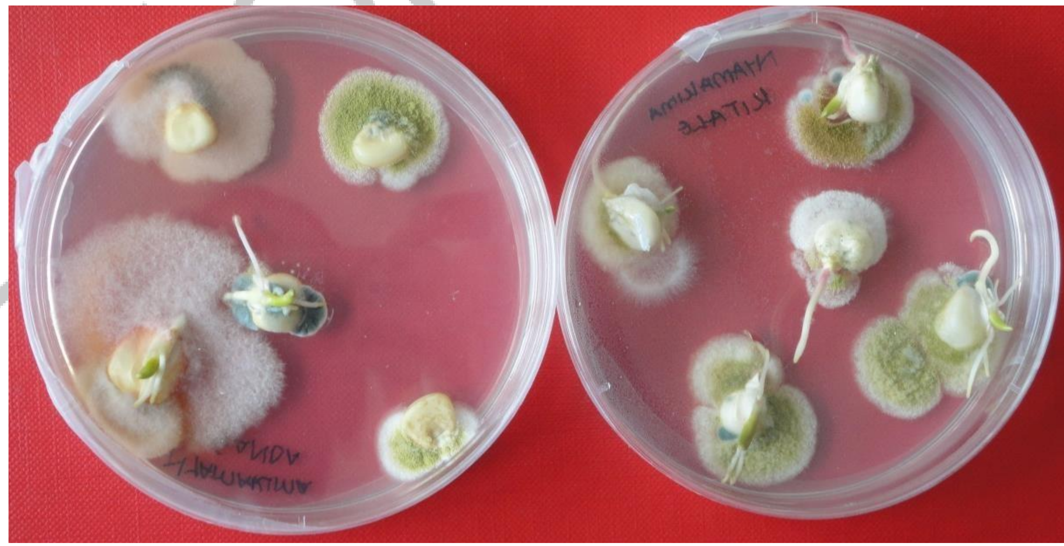
Seed Drying, Processing and Storage

Management of Storage Diseases in Seed Lots



Prof. James W. Muthomi / Prof. R. D. Narla
Department of Plant Science and Crop Protection
University of Nairobi

Management of Storage Diseases in Seed Lots

Importance of seed-borne diseases

- ✓ Healthy seed is a prerequisite for success in efficient crop production.
- ✓ Production and distribution of healthy seeds is an international issue thus affects seed trade
- ✓ Use of infected seed leads to significant crop losses
- ✓ Storage fungi reduces seed quality by causing heating and spoilage, packing or caking, & reduced germination

Management of Storage Diseases in Seed Lots

Importance ……………………..

- ✓ Movement of infected seed leads to spread of diseases across regions/countries
- ✓ Pathogens can adversely affect germination, cause seedling infection and damage mature plants
- ✓ Seed-borne diseases often strike early in the growth of a plant causing poor crop establishment and reduced plant vigour
- ✓ Diseases caused by viruses usually have higher transmission rates than those caused by fungi or bacteria

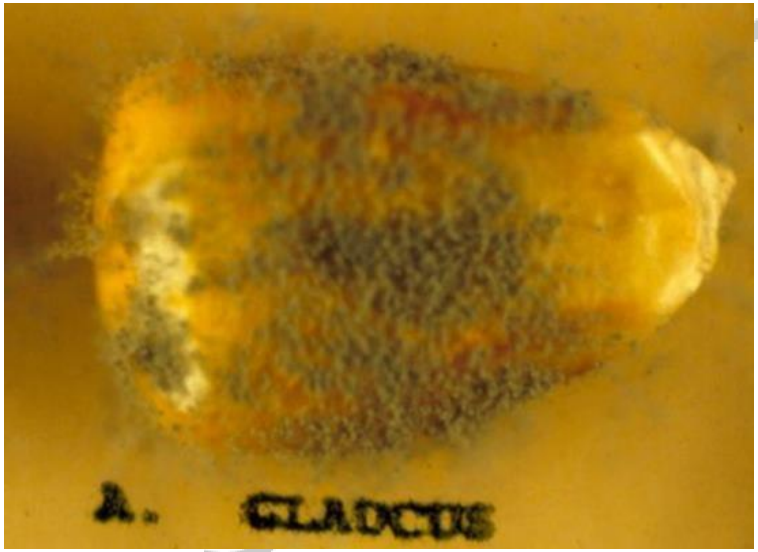
Management of Storage Diseases in Seed Lots

Infected seeds

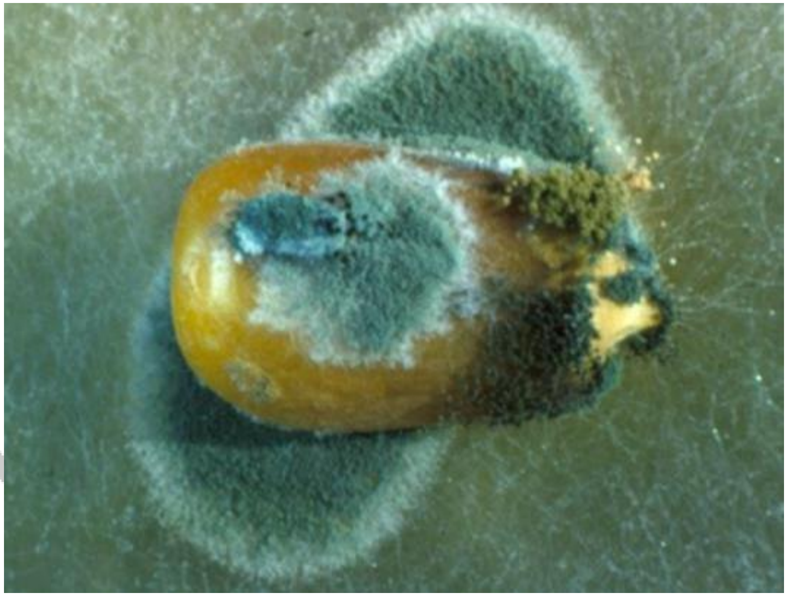




Management of Storage Diseases in Seed Lots



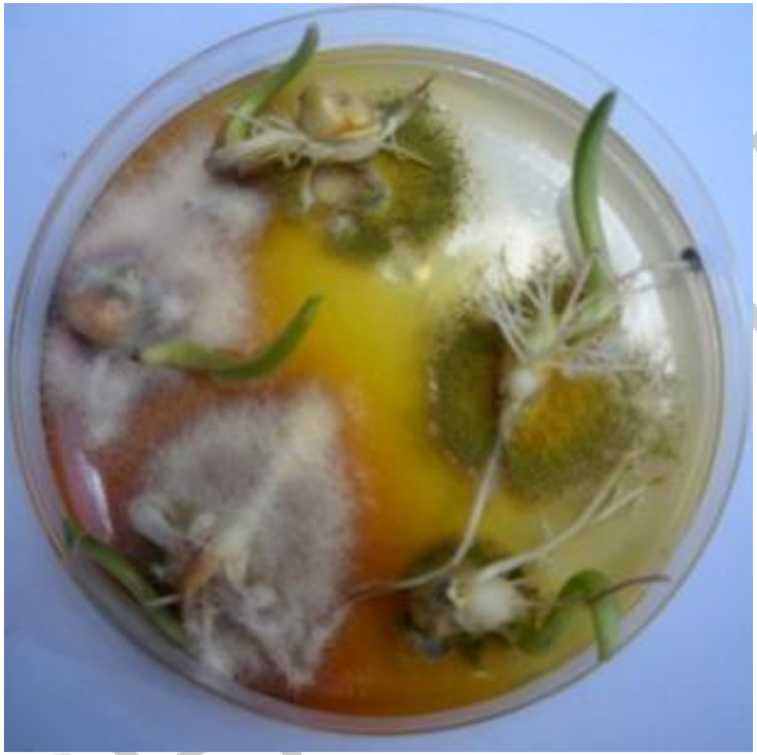
Aspergillus growing on maize seeds



Penicillium growing on maize seeds

Management of Storage Diseases in Seed Lots

Maize seeds



Wheat seeds

Fungi growing from infected seeds

Fungi growing from infected maize seeds

Conditions favouring storage diseases

Conditions favouring storage diseases

- ✓ Storage fungi (molds) invade grains or seeds during storage
- ✓ Most common storage fungi are species of *aspergillus* & *penicillium*
- ✓ Storage fungi are usually present in small quantities on grain going into storage or may be present on spilled grain present in harvest, handling and storage equipment or structures
- ✓ Improper storage conditions favours the multiplication of the disease inoculum

Conditions favouring ……………..

- ✓ Storage fungi are usually inactive at low grain-moisture levels
- ✓ Moisture content below 13.5 percent in starchy cereal seeds such as wheat, barley, rice, corn and sorghum and below 12.5 percent in soybean prevents invasion by storage fungi
- ✓ Cooling the seed grain and reducing the humidity will help prevent mould growth
- ✓ Temperature between 8 to 15 ^{o}C, storage fungi grow very slowly. At 25 to 35 ^{o}C , they grow much more rapidly

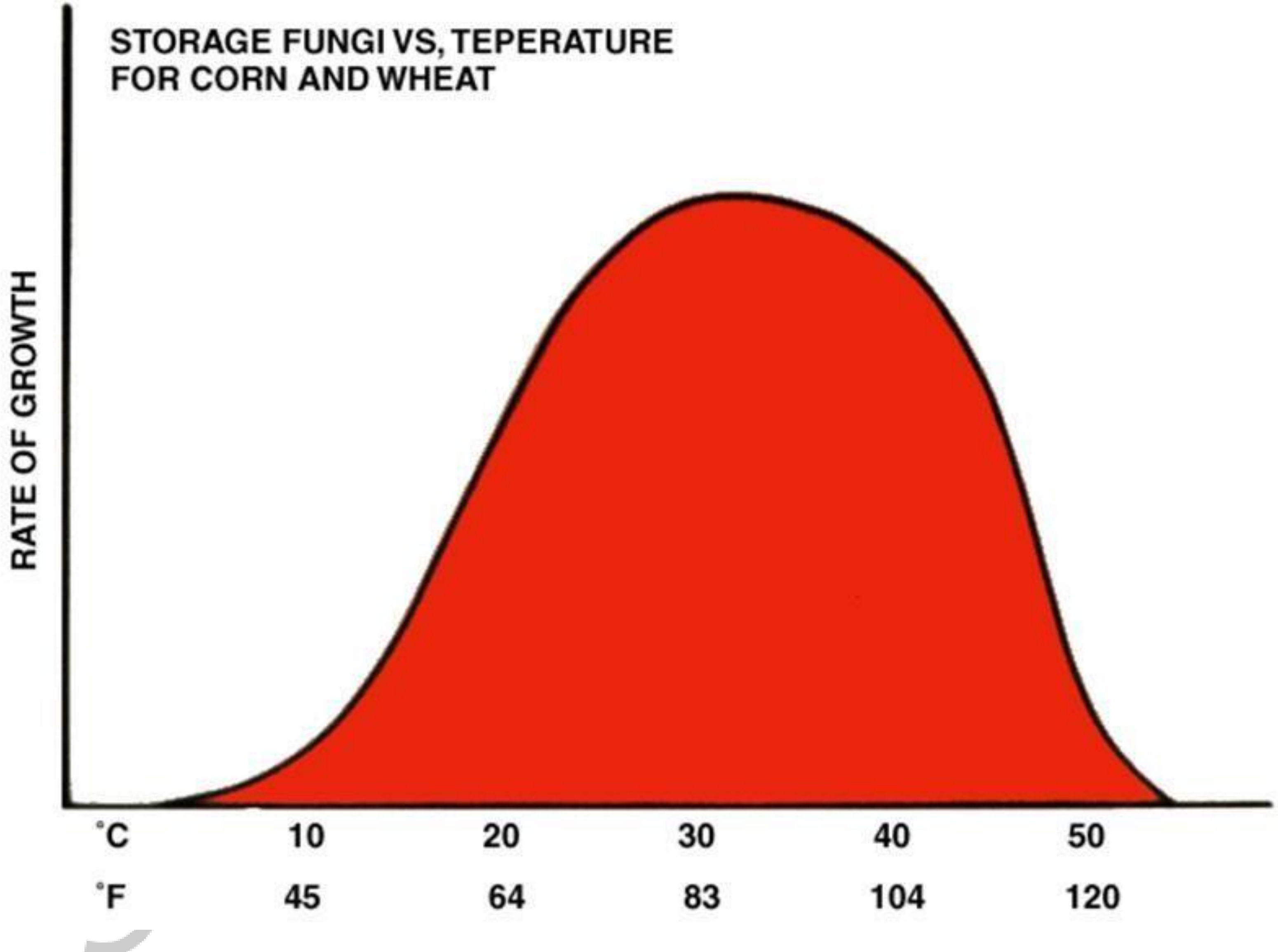
Conditions favouring ………………

- ✓ Cracked and broken kernels - Broken or cracked kernels are more likely to be contaminated with storage fungi going into storage
- ✓ Foreign material may restrict air movement through the grain mass leading to temperature and moisture problems which may favor storage mould development
- ✓ extent of infection before harvest - grain already invaded by storage fungi has a high risk of damage in favourable moisture & temperature

Conditions favouring ………………

- ✓ insect and mite activity in grain- Insects and mites may carry fungal spores thus introducing storage fungi into the grain mass.
- ✓ Insect and mite activity in a grain mass lead to increase in temperature and moisture content of the grain surrounding the insect infestation. This creates 'hot spots' with increased mould growth.

Management of Storage Diseases in Seed Lots



Damage due to storage fungi (moulds) on seed

Mould damaged maize seed

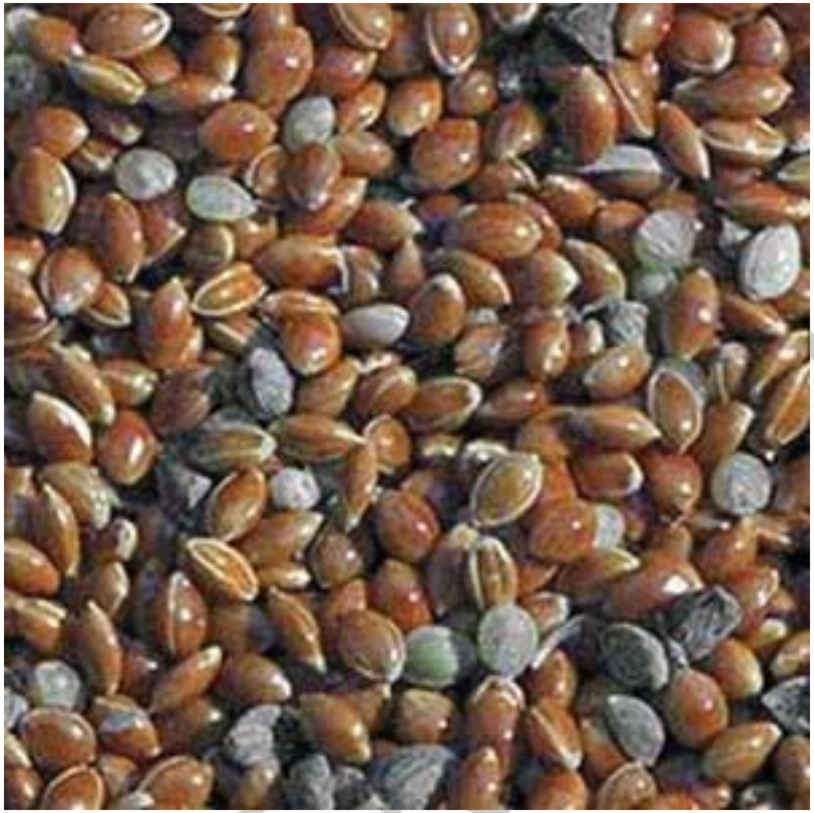
Mould damaged wheat seed

Management of Storage Diseases in Seed Lots

Mould damaged groundnut seed

Healthy groundnut seed

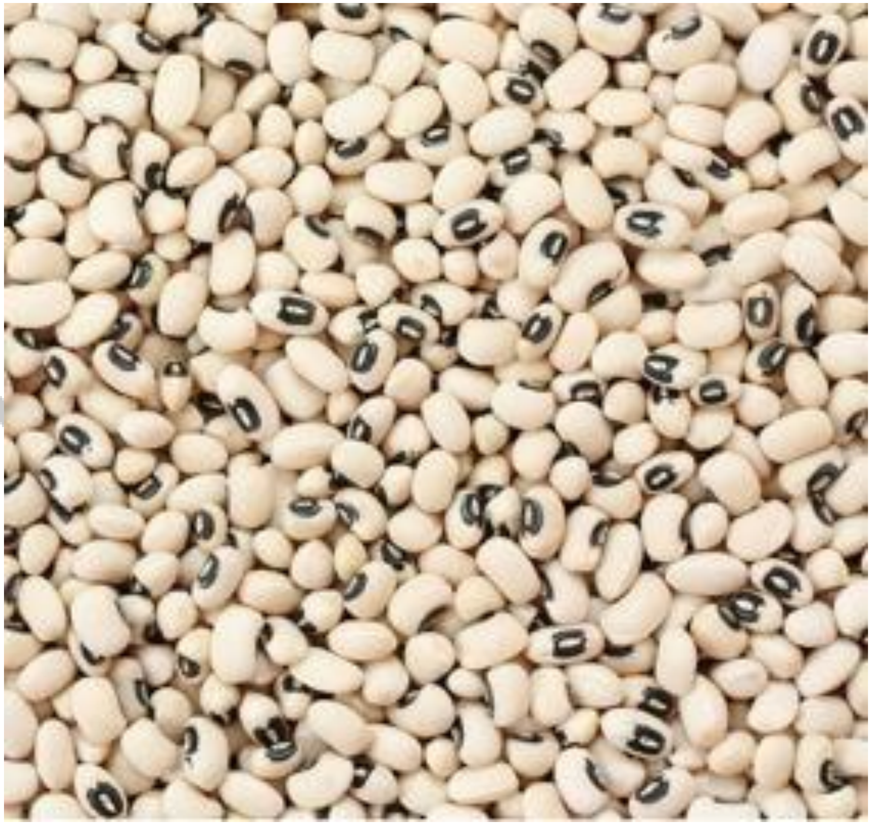
Aspergillus flavus growing on infected groundnut seed



Mould damaged sorghum seed

Management of Storage Diseases in Seed Lots

Mould damaged cowpea seed



Healthy cowpea seed

Mould damaged green gram seed

Survival of disease causing pathogens on seed

- ✓ Seed-borne pathogens can survive for several years in and on seed
- ✓ Fungi and bacteria are mostly located on the seed coat
- ✓ Viruses are not carried on the seed coat, and are only found in the seed embryo or tissues of the seed coat

Measuring the amount of seed-borne disease inoculum

- ✓ Amount of inoculum may be expressed in terms of the proportion of infected seeds
- ✓ Most seed tests measure the proportion of infected seed
- ✓ Fungi may be detected using a standard blotter test or an agar plate test
- ✓ Seed-borne bacteria can also be detected using an agar plate test
- ✓ Seed-borne viruses are usually detected using ELISA or PCR tests.

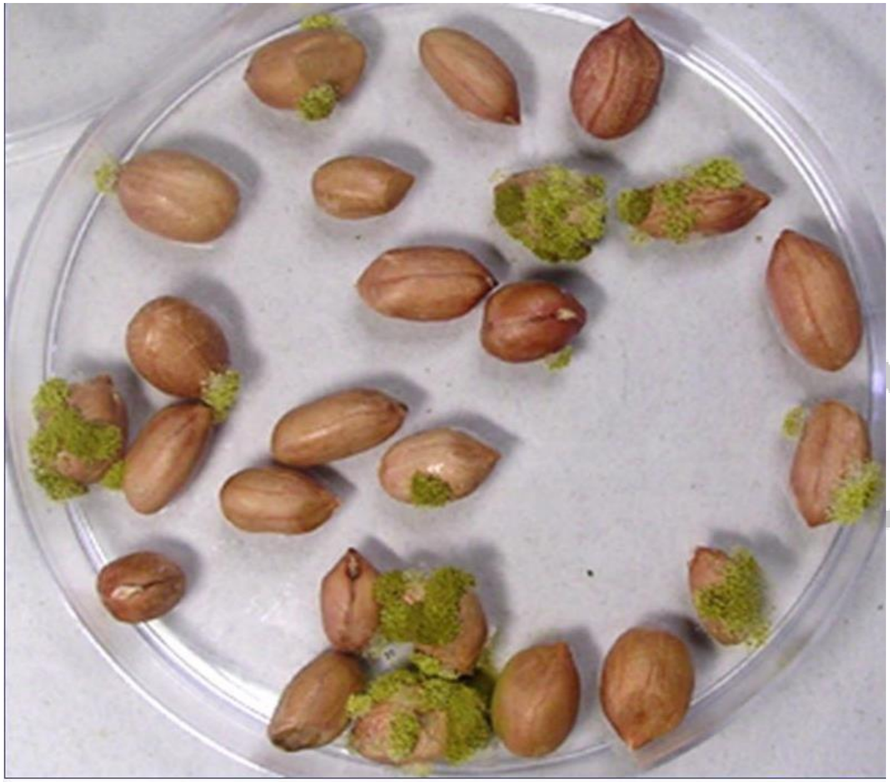
Management stored grain fungi

Management stored grain fungi

- ✓ Produce pathogen-free seed by ensuring dry weather between flowering and maturity to minimizes pod infection
- ✓ Harvest seed crop as soon as the moisture content allows for minimum grain damage.
- ✓ Adjust the harvesting equipment for minimum kernel or seed damage and maximum cleaning.
- ✓ Clean all grain harvesting and handling equipment thoroughly before beginning to harvest.
- ✓ Clean bins or storage facilities thoroughly to remove dirt, dust & other foreign material, crop debris, chaff & grain debris.

Management ………………..

- ✓ Clean grain going into storage to remove light weight and broken seeds as well as foreign material and fines.
- ✓ Seed should be dried to safe moisture contents as quickly as possible after harvest
- ✓ Aerate grain to safe and equalized temperatures through the grain mass.
- ✓ Protect grain from insect and mite damage.
- ✓ Check stored seed grain on a regular basis and aerate as needed to maintain low moisture and proper temperature.



THANK YOU

- By Prof. W. M. Okoth

Contents

AERATION AND TEMPERATURE CONTROL

By. M.W. Okoth
Department of Food Science, Nutrition and Technology
University of Nairobi

Aeration system and Technology

- Seed aeration: process of moving air at ambient temperature through stored seed in order to control the temperature to the desired level.
- An aeration system includes a fan, an air supply duct, aeration ducts (or a perforated floor), and a controller.
- Aeration ducts are less expensive than perforated floor but course uneven distribution of air through the seed.

Aeration system and Technology…

- In small storage systems, aeration can be done by natural air circulation; allowing the wind to blow through the stored seed.
- In addition to temperature control, stored seed aeration also minimizes moisture migration within the grain bulk.

Temperature of stored seed grains

- The temperature of the harvested grain establishes the initial temperatures of stored seed.
- These initial temperatures can be equal to or considerably higher than the atmospheric air temperature.
- In one case the temperature of freshly harvested seed was found to be 30°C when the atmospheric temperature averaged 23°C.
- Such high initial temperatures encourage rapid deterioration of the stored seedif cooling is not rapid. Changes in diumal temperature affect seed temperatures in bins.

- Solar radiation incident on the bin wall causes its temperature to rise to a value much higher than that of the atmospheric air.
- Cases have been cited where when the atmospheric air temperature was 28°C, the temperatures of bin surfaces in contact with the stored seed varied from 37°C to 56°C,
- This varied depending on the material of construction and colour of the bin wall.

- Seasonal changes in atmospheric temperature cause changes in the temperature of stored seed.
- Weather conditions are in fact, the most important factors affecting storage seed temperatures.
- Changes in atmospheric air temperature and solar radiation have less effect on the temperatures near the centers of large bins than of small bins.
- However, heat in freshly harvested seed and heat generated in deteriorating seed are dissipated more rapidly from small bins than from large bins,
- This is because the distance form the centre of the bin to the wall is less in small bins than in large bins.

- As a result, temperatures will rise less above atmospheric air temperature and seed deterioration will be less in small bins than in large bins.
- Insulating a bin has a similar effect on the heat transfer in and out of the bin as increasing the bin size.
- Insulation reduces the temperature gradients throughout the seed bulk and therefore may reduce moisture migration within the bin.

- The rate of heat transfer into or out of seed store d in underground bins is slow and is similar to that in large bins and insulated bins,
- This is because soil is a good thermal insulator.
- If cold seed is stored in underground bins, it will normally remain at a low temperature if the soil temperature remains low.
- But in underground bins, as in large above-ground bins, heat in freshly harvested seed and heat generated in deteriorating seed is dissipated very slowly.
- Consequently, seed deterioration can occur very rapidly if the initial temperature of the seed is high or if the temperature of the seed begins to rise.

Moisture Migration

- Moisture may migrate from one part of the stored grain to another.
- migration is caused by differences in temperature in different parts of the bulk.
- Moisture in the vapor phase moves by diffusion along the vapor-pressure gradient coursed by a temperature gradient in material of fairly uniform moisture content.
- Convection currents also contribute to moisture migration. When saturated air moves from a warm to a cooler region condensation of some water vapour occurs since the water carrying capacity of the air is reduced. The condensed water is absorbed by the grain in the cool region whose equilibrium relative humidity (water activity) thus increases. Deterioration may thus occur in stored grain even if it is stored at a safe and uniform moisture content. Diffusion is said to be the dominant mechanism of moisture transfer, assisted by convection currents.

THANKYOU

PROCESSING AND TREATMENT PLANTS

By Prof. M.W. Okoth
Department of Food Science, Nutrition and Technology

Introduction

- In a seed processing and treatment plant, the primary product is dry treated seed of the highest possible quality.
- This quality is largely determined at the farm.
- However, even within one farm there will always be defective plants that cannot produce seed of the desired quality.
- These inferior or defective seeds are often mixed with the good seed at harvest and have to be sorted out in the factory.
- They are a byproduct since they can be used for other purposes.

- It also happens that in the process of manufacturing good seed other components are separated from it.
- Some of these separated components can find use either in the same plant or elsewhere and thus form part of the byproducts form the factory.
- In this presentation we concentrate on the management of byproducts of maize seed processing.

2. By Products of Maize Seed Processing

- **2.1. Sorted out off-spec maize**
- This is maize that is not suitable for use as seed but is otherwise in good condition.
- It is separated from the rest of the raw material during sorting on the conveyor belt before drying of the unshelled maize.
- It should be dried separately, shelled, cleared and sold as a by-product to be used for food or feed or any other purpose.

2.2 Surplus Maize Cobs

- These are maize cobs over and above what is required as fuel for heating the drying air. It can be managed in a number of ways.
- It can be sold as it is without any processing for use as fuel or for conversion to other products.
- It can be used generate electricity that is used to provide power and lighting in the factory and the surplus sold.
- In this way there will be saving in the electricity bill as well generation of extra income.
- It can be converted to higher value products by treatments such as pyrolysis, gasification and composting

2.3 Shelling and aspiration DVST

- This can be collected by passing the exhaust air through a cyclone

- Can be sold for use as an ingredient in animal feed manufacture.

3. **Byproducts of other seeds**

  - Sunflower screenings:
    - Light and blank sunflower seeds, chaf, etc.
    - Used as livestock feed. High in oil and is an excellent fibre source.

- **Bean culls:**

  - Split and damaged beans.

  - Approximately 20% protein.

  - Used as livestock feed.

- **Sunflower Seeds:**

  - Seeds that are too small for seed planting purposes:

  - Recleaned and used as bird seed for birds such as parrots.

- **Others:**

  - Cotton Seed hulls

  - Cotton seed screenings

  - Barley screenings

  - Sunflower hulls

  - Peanut hulls

4. Concluding remarks

- Seed manufacture inevitably leads to production components other than the desired seed.
- Some of these components can be used directly, others can be used after further processing or conversion to other products.
- Efficient utilization of byproducts can go along way towards improving the profitability of seed processing and treatment plants.

THANKYOU

PROCESSING AND TREATMENT PLANTS

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Introduction

- There is no doubt that, compared to other continents, agricultural productivity is still very low in Africa.
- This is particularly true in sub-saharan Africa.
- The main reason for this is that there is poor adoption of modern improved technology.
- Small-scale farmers have not benefited from advances in plant breeding mainly because the seeds and the required inputs are perceived to be too expensive.

- For seed prices to be lowered, their production costs must come down.
- Seed processing and treatment contributes significantly to the final seed price.
- It is therefore important for seed processors to pay particular attention to cost management.
- Low production costs and hence low seed prices will not only expand the market but also lead to both higher productivity and higher profitability for the seed processors.

2. Factors affecting processing costs…

- Jugenheimer (1985) has listed the factors that must be considered in determining the costs of processing seed.
- I list these factors with brief comments.

2.1. Salaries and labour

- Increases the level of salaries and benefits is to a great extent determined by the market forces,
- The total wage bill can be controlled by the seed processors.
- The human resource requirements must be rationalized.

2.2. Supplies

- These include:
- a) Bags, tags
- b) Treating materials
- c) Thread
- d) Bag stencils
- All these factors are production dependent.
- However, the consumption of treating materials can be minimized by not exceeding the recommended levels of usage.

2.3. Buildings

- Including storage, processing plant, and other buildings used in the operation
- The factors include:
- a) upkeep and repairs
- b) insurance
- c) depreciation
- d) fuel
- e) power

- Upkeep and repairs of buildings must be regular to avoid very expensive extensive damage.
- Insurance and depreciation depend on the initial cost of putting up the buildings.
- The buildings must be professionally designed and constructed to minimize their costs.
- In addition insurance services must be professionally procured.

- Fuel refers to the fuel used in the boiler or drier furnace.
- Fuel cost can be minimized by ensuring that the boiler or furnace has higher thermal efficiency and the seed driers are also efficient in design and operation.
- There should be minimal heat energy losses throughout the processing plant.

- Power refers to electricity used for lighting and other non-processing applications.
- Energy efficient light bulbs and appliances should be used.
- Appropriate elective energy saving measures should be taken to minimize electricity costs.

2.4. Processing and handling equipment

- These contribute to processing cost in the following ways:
- a) depreciation
- b) upkeep and repairs
- c) insurance
- d) power
- e) gasoline and oil for trucks

- Depreciation and insurance costs should be reduced by ensuring that the processing and handling equipment are not over designed.
- Planned preventive maintenance will keep the costs of upkeep and repairs low.
- Electrical power costs can be reduced by ensuring that, among other measures,
- The equipment is not over designed, energy efficient electric motors are used,
- The equipment is properly maintained, and no equipment is left to run when idle.
- Efficient layout design will minimize the cost of gasoline and are for trucks.

2.5. Other processing and handling costs

- These include:
- Insurance on inventory
- Taxes on inventory
- Transportation costs for moving seed to and from the processing plant.
- Loss due to seed stocks going out of condition
- Handling and disposing of screenings
- Quality control costs, including purity and germination tests
- Certification cists
- Record-keeping
- Warehouse handling and shipping costs
- Other items, such as insect bird, and rodent control

- Appropriate location of the plant and good transport management can reduce costs for moving seed to and from the processing plant.
- Production planning and good sales and marketing can minimize loss due to seed stocks going out of condition.
- If market is found for screenings they may become a source of income rather than a cost item.
- Rationalization of personnel establishment and appropriate training programmes can reduce many of the processing and handling costs mentioned above.

2.6. General expenses

- Listed under this are:
- a) interest on investment
- b) taxes on property
- c) advertising and promotion
- d) General overhead.

- Optimization of the processing plant at the design stage can reduce interest on investment as well as taxes on property.

- Advertising and promotion activities need to be very closely monitored and regularly reviewed to ensure that they do not become counterproductive.

2.7. Additional costs of buying and selling

- Other costs of buying and selling include losses due to seed deterioration during storage and marketing, and shrinkage while cleaning.

- These costs can be reduced by proper quality control when buying the seed and following recommended storage practices.

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1. Why Instrumentation and Control?

- There are many reasons for instrumentation and control in a seed processing plant.

- These include:-

- To ensure safety of workers, visitors neighbours and passers-by
- Safety of equipment, machines, buildings and other structures
- Efficient use of utilities such as steam, water and electricity
- Increase productivity of machines
- Increase product quality regularity
- Increase flexibility of machines and processes
- Meet regulatory requirements such as consistent package weights within specifications

2. Boiler instrumentation and Control

- The use of boiler is preferable to direct mixing of maize cob combustion products with air

(i) Steam pressure

- The steam pressure must meet the processing requirement,
- i.e. the drying air must be heated to the desired temperature and other steam using operations such as cleaning and disinfection must be effective.
- This means that there is a minimum pressure.

- Boilers always have a maximum allowable steam pressure beyond which material failure leads to boiler explosion with dire consequences.
- In an oil-fired boiler, an automatic control system that measures the steam pressure and turns the fuel flow on when it is tat the minimum and off when it is at the maximum level.

- In seed processing plants, the boiler is often fired by maize cobs.
- The on-off control described above is therefore not easy to implement.
- The minimum steam pressure is assured by maintaining adequate fire.
- A safety value that releases steam to the atmosphere ensures that the maximum allowable pressure is not exceeded.
- In all cases a steam pressure gauge is installed.

(ii) Boiler water level

- The boiler tubes must always be covered with water to avoid overheating that leads to material failure and release of steam in the working environment. Two measures are taken:

1. An automatic control system measures the water level and switches the water feed pump on when it is at the specified minimum value.
2. A sight glass gauge is installed to enable the boiler operator to monitor the water level and to intervene when necessary.

3. Control of in-bin aeration

- The main objective of aeration is to maintain seed grain stored at 12-15% moisture content to within 3-6oC of ambient temperature.
- An aeration controller decides if, when, and for how long air blowing is needed.
- Sophisticated aeration controllers measure the temperature and relative humidity of the ambient air and the temperature and equilibrium relative humidity of the grain.
- Less sophisticated aeration comptrollers base their decisions solely on the air and grain temperature.

4.Control of in-bin supplemental heat drying

- The objective of in-bin supplemental heat drier controllers is to dry seed grain at minimum energy use without significantly affecting the storability and quality.
- Control of drying air temperature is important to ensure that the drying is effective and seed quality is maintained.
- An automatic control system measures the drying air temperature and adjusts the steam flowrate to maintain it at the desired value.

- Fan control is also important to ensure that it stops operating when the seed moisture content reaches a specified minimum value and starts operating when it reaches a specified maximum value.
- Indirect heating systems, a mixing valve connects the hot and cold channels and controls the drying air temperature.
- The required drying conditions (T and RH) can be programmed based on the desired equilibrium moisture of the seed.
- The air flow is dynamic: higher at the beginning of the process and lower at the end of the process as the seed gets drier.
- Relative humidity of the incoming air is compared with that of the exhaust air. The drying process stops when the former is higher than the latter.
- Measuring and parameter settings are read out on a control screen and PC.
- Graphics are used to visualize the drying process.

5. Control of Seed cleaning and treatment

- The seed feed rate is determined by the speed of the bucket elevators which can be controlled if variable speed drives are used.
- Control of air flow rate in the aspiration cleaner is important to ensure that the impurities are adequately removed without blowing away the good seed grains.
- Control of closing of the treatment chemicals is important to ensure that good seed quality is achieved without excessive use of chemicals.

6. Control of seed packaging

- Instrumentation and control enables the selection of throughout and packaging size and maintenance of package weights consistently within specifications.

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- Water exists as solid (ice), liquid or vapor
- At the temperature at which seeds are stored in Africa, only liquid and vapor phases of water are important
- If liquid water is introduced into an enclosed vacuum space at constant temperature, evaporation takes place until equilibrium vapour pressure is reached.

- Let us say at temperature To, equilibrium vapour pressure is Po.

- If the water is in an air space or is in contact with air at temperature To, the water evaporates into the air until the partial pressure of water vapour is Po; the equilibrium vapour press at temperature To.

- The equilibrium vapour pressure increases with increase of temperature.
- Seeds contain varying quantities of water. If instead of water we introduce seeds into a vacuum space or an air space, the equilibrium vapour pressure developed at temperature To is Pe where Pe < Po.
- Pe depends on the temperature, the nature of the seeds and the seed moisture content.

- We define a parameter water activity (air) as follows:
- Aw = Pe/Po
- At a given temperature, aw depends on the nature of the seed and its moisture content
- Water activity of a seed can be interpreted as availability of water to microorganism.
- It is 1 when the water is completely available and O when is completely unavailable, i.e. it varies between 0 and 1.

- A minimum value of water activity is required for spoilage microorganisms to grow on stored seed.
- The minimum value of water activity for moulds is 0.70 – 0.90.
- For cereal seed, this corresponds to a moisture content of 14.0 – 20% while for peanuts it is 8.5 -15%
- Each seed has a specific relationship between moisture content and water activity.
- In all cases water activity increases with increase in moisture content, and vice versa.

- Seed must therefore be dried and stored at a moisture content that corresponds to a water activity that does not exceed the minimum required for spoilage by microorganisms.
- Seed absorbs or loses moisture depending upon the relative humidity of the surrounding air.
- If the relative humidity (decimal) is less than the water activity it loses water through evaporation and it is greater than the water activity it absorbs water vapour from the air and its moisture content increases.

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considerations

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1. Pilot Plan

- Pilot plan shows how the buildings, parking lots and driveways fit on the lot. It also shows highways, utilities drains, electrical systems, and any other relevant information.
- Starting with the plot plan, add the main roads that border the property.
- Determine where access roads will enter the property
- Indicate the utilities on the plant
- Plate the building so that the front faces a road; expansion will occur behind the building.
- Indicate where receiving and delivery will be, and connect this area to the main road.

2. Materials handling considerations

- Materials handling should be part of the planning from the start.
- Product movement costs money, and it must be kept to a minimum.
- The most efficient materials handling involves raw materials being received at one end of the plant with the final product emerging at the other and without backtracking or sidetracking.

- Planning should reduce the travel of product, people, and handling equipment. This will:
- -increase material flow
- -reduce bottlenecks and stoppages
- -reduce unsafe situations and practices
- -increase product quality

- Consideration should also be given to the type of equipment to be used in materials handling,
- e.g. if forked trucks are to be used, the passages should be wide enough for the truck to pass workers at a safe distance.
- These passages (aisles) must also be kept free of any obstacles or overhanging machinery and be well lit so that the truck operators can see limiting clearances easily.

3. Processing plant layout

- Three main types of processing plant layouts are multistory, single level and combination
- Multistory: Here seed is carried by elevators to the top floor and stored in large bins.
- Processing machines are arranged in a vertical series on the lower floors.
- Flow of seed from one machine down to the next is by gravity.

- Single Level: In this system, seed is moved from one machine to the next by elevators place between the machines.
- This layout enables one person to supervise the processing line without running up and downstairs.
- Closer supervision of all operations can thus be maintained.

- Combined Designs: These involve a compromise between the single and multistory system.
- Whatever the design, equipment should be arranged to provide:
- 1. a sequence of cleaning and handling that is proper, efficient, complete, and as simple as possible.

- 2. economical distribution and maintenance of space
- 3. orderly and continuous flow of seed and waste products with a minimum cost
- 4. flexibility to handle different seed that require different processing.
- 5. possibility of orderly expansion as capacity needs increase.
- 6. maximum safety and comfort of operating personnel
- 7. effective and economical means of handling waste products

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1. WHY WASTE MANAGMENT

- Seed processing and treatment produces solid, liquid and gaseous wastes.

- Each of these has its problems. We focus on maize seed.

1.1. Solid Waste

- The main solid waste is excess maize cobs from the maize shelling process.

- It, as often happens, it is simply dumped on land in the vicinity of the factory it causes a number of problems

- It lowers the aesthetic appeal of the environment.
- It is a source of obnoxious smell
- It harbors rodents that are a health risk in addition to being a nuisance
- It promotes proliferation of insects such as flies and mosquitoes that are known to be disease vectors.
- It is a fire hazard.
- It occupies valuable space

1.2 Liquid Wastes

- Liquid wastes in seed processing and treatment plants include:

- waste water from cleaning operations and sewerage from washrooms and kitchens.

- If not properly treated and disposed of waste water causes a number of undesirable effects.

- It lowers the aesthetic appeal of the environment.
- It causes obnoxious smells
- It promotes proliferation of insects that may be disease vectors.
- It lowers the quality of receiving water such as rivers and groundwater
- It lowers the level of dissolved oxygen in the receiving water and therefore adversely affects aquatic life such as fish.
- It may contain toxic chemicals that harm aquatic life, human beings and animals.

1.3 Gaseous Wastes

- Gaseous wastes from seed processing and treatment plants include:
- Flue gases from boilers, furnaces and standby generators as well as exhaust gases from aspiration, aeration and drying processes.
- Gaseous emissions cause a number of undesirable effects.

Effects of gaseous emissions

- Eye and skin irritation
- Allergic reactions
- Lowered aesthetic appeal of the environment
- Lower visibility
- Increased green house gases such as carbon dioxide
- Increased acidic gaseous emissions such as sulphur dioxide

2. Waste Management

- **2.1 Solid Wastes**
- Maize cobs are often used as fuel for air heating in drying operations.
- This may involve direct mixing of incoming air with the hot products of combustion.
- This leads to a load of suspended particulate matter in the drying air that finds its way to the drier exhaust gases.
- There is however, always excess maize cobs to be disposed of. Dumping on land is not recommended. It could be sold as a by product of converted to other higher value by-products.

- One such by-product is electricity that can be generated by burning all the maize cobs in a high pressure boiler and using the steam to generate electricity as well as provide process heat such as drier air heating.
- Ash from the furnace can be given out or sold as a sold conditioner or dumped in a landfill.
- Dust from seed cleaning operations should be collected and sold as a by-prodduct to be used in feed manufacturing.

2.2. Liquid wastes

- Waste water can be discharged to the municipal/city waste treatment plant or an in-house waste treatment plant.
- Sewerage can be discharged to the municipal/city waste treatments plants or suitably designed and constructed septic tanks
- Wash waters containing treatment chemicals should be incinerated.

Gaseous Emissions

- Boiler/furnace and generator flue gases should be managed by ensuring that there is efficient combustion and by designing and constructing the chimney correctly.
- Exhaust gases from aspiration, aeration and drying operations should pass through cyclones to minimize dispersal of particulate matter to the environment.

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