

# **Rice Seed Production**

**- Video Seminar on Rice Seed Production -  
organized by CARD Secretariat**

**April 23 - 24, 2014**

# 1. Objective of Seed Production

1. To ensure cultivation in the next crop season
2. To harvest high quality and homogeneous products

**Seeds have direct effects on the product.  
Hence, farmers have to use high quality seeds**

High quality seeds enables farmers to attain crop;

1. Most economical planting rate;
2. Higher % of emerging in the field
3. A more uniform plant stand
4. Uniformity in ripening
5. Uniformity of product

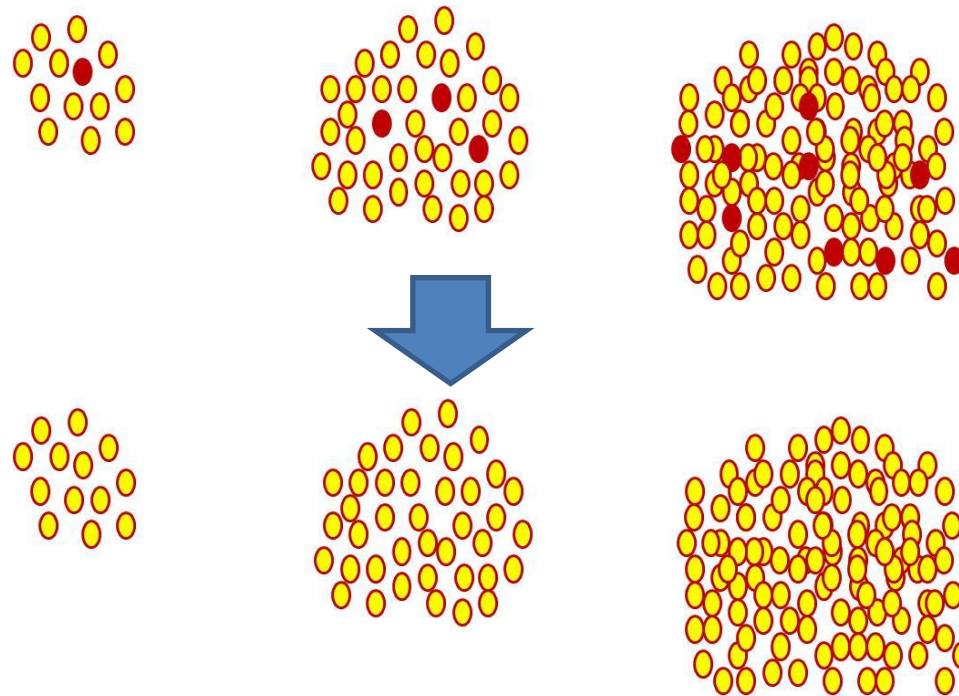
# 1. Objective of Seed Production: Factors Affecting Quality

1. Genetic factors
  - Genetic makeup
  - Seed size
  - Seed density
  
2. Physical / environmental factors
  - Growth condition during seed development
  - Nutritional condition of the mother plant
  - Damage during production or storage (including pest)
  - Moisture and temperature during storage
  - Age or maturity of seeds

# 1. Objective of Seed Production: Genetic impurity

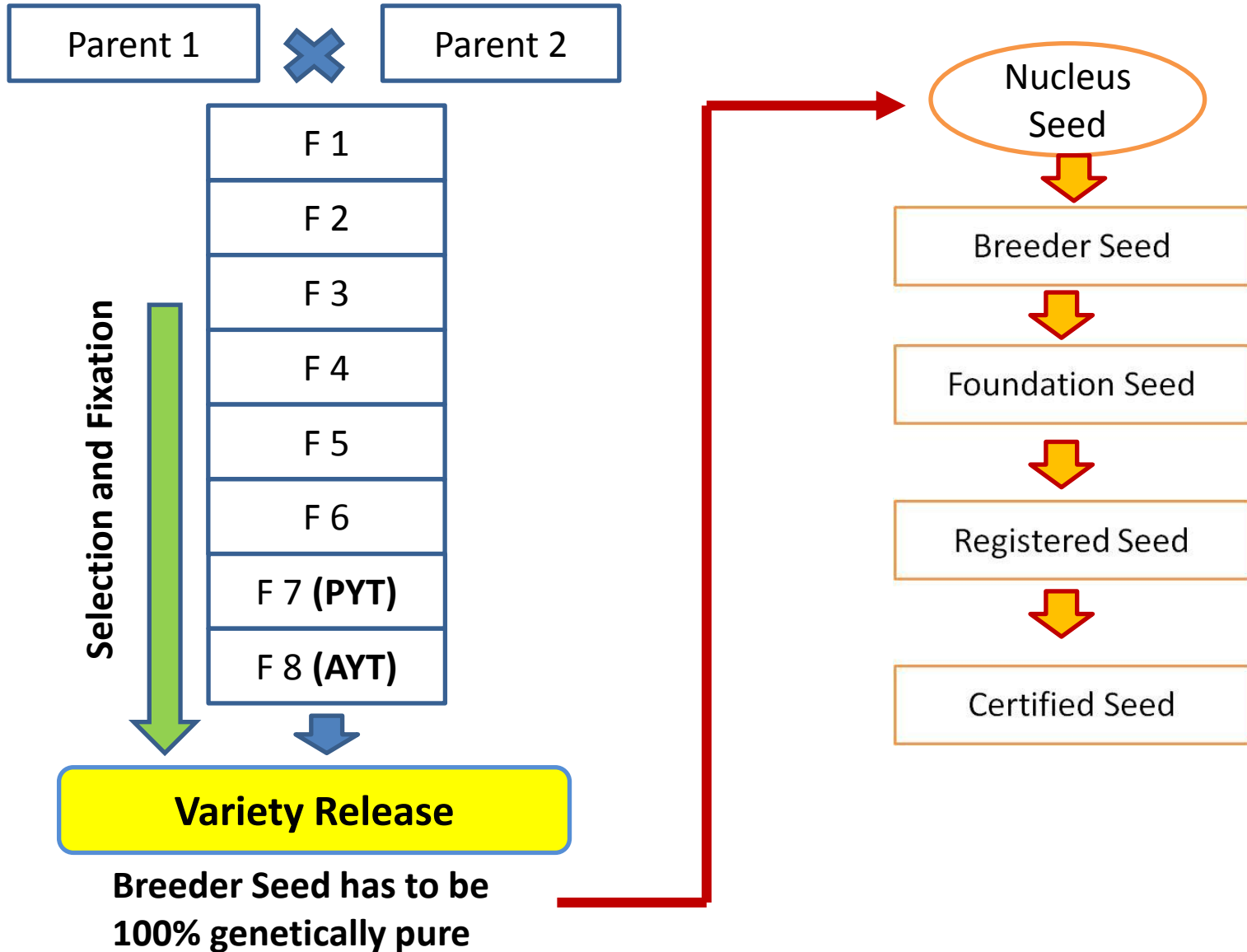
## Factors increasing genetic impurity

1. Natural mutation ( $10^{-5}$  -  $10^{-6}$  per gene)
2. Out-crossing with other varieties
3. Physical mixture with other varieties  
(harvesting, threshing, drying; all steps from harvest to storage)



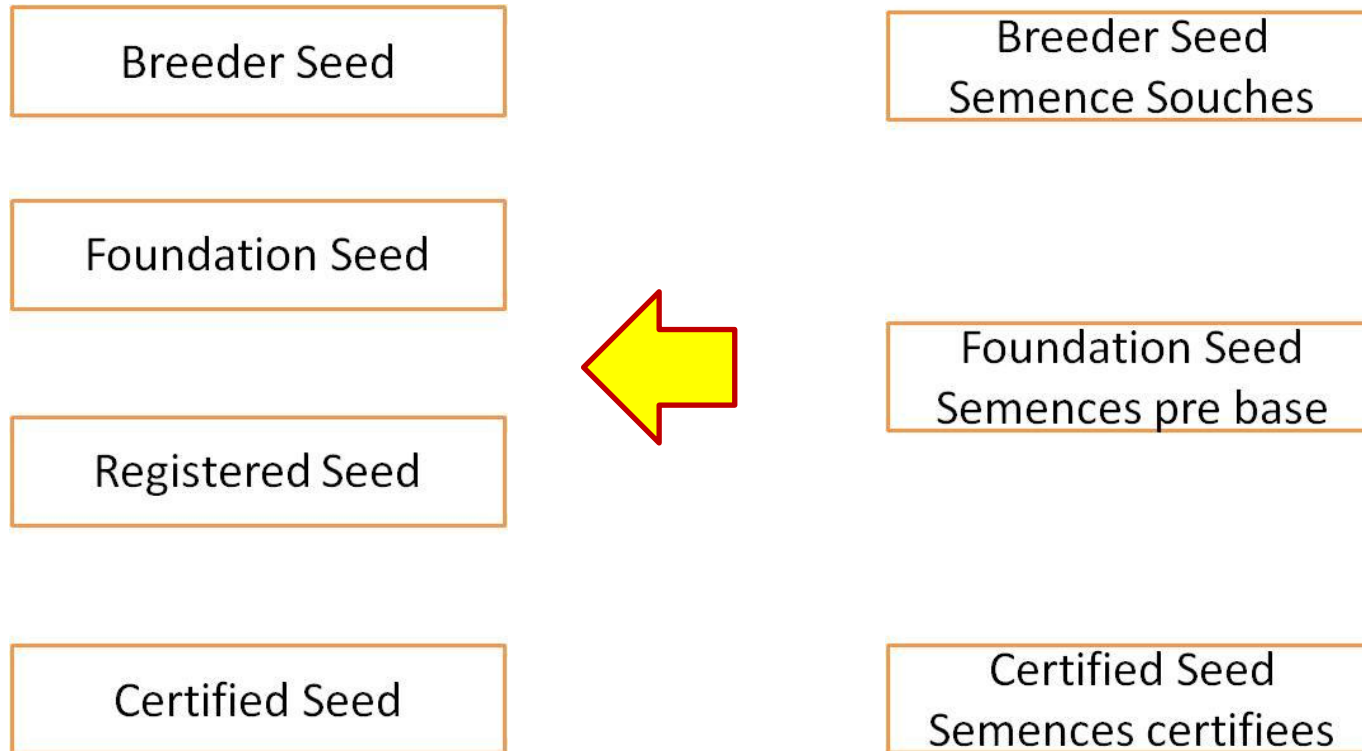
# 2. Structure of Seed Production

- From breeding to Seeds -



# 2. Structure of Seed Production

## - Terms for Stages in Seed Production -



## 2. Structure of Seed Production

### - Quality Standard in Each Class of Seed -

The quality standards become less stringent toward downstream of seed phase. However, genetic purity should be maintained at a high level.

Country	Purity	Unit	Breeder	Foundation	Registered	Certified
Sierra Leone	Variety	%	99.9	99.9	99.7	99.7
	Specific	%	98	98	98	98
	Red rice	Seed / kg	0	0	5	5
	Weed seed	Seed/ kg	10	10	0.5%	0.5%
	Other species	Seed/kg	10	10	0.5%	0.5%
Arkansas (USA)	Other variety	Grain/500 g	0	0	0	2
	Pure seed	%		98	98	98
	Other crop	Grain/500g		0	0	2
	Weed seed	%		0.03	0.03	0.08
	Red Rice	Grain/500g		0	0	0
Philippines	Other variety	Grain/500g	0	2	5	10
	Pure seed	%	98	98	98	97
	Weed other crop	%	0	0	0.05	0.1
	Red Rice	Grain/500 g	0	0	1	2
ECOWAS	Varietal purity	%		99.9	99.9	99.7
	Analytical purity	%	98	98	98	98
	Other crop	Grain/kg	10	10	0.5%	0.5%
	Weed	Grain/kg	10	10	0.5%	0.5%
	Red Rice	Grain/kg	0	0	5	5

## 2. Structure of Seed Production

### - Definition of Purity -

- **Genetic Purity:**

Varietal purity, varietal mixture, other variety, or off-type

Genetic purity can be checked at a field by careful observations.

- **Seed purity:**

Specific purity, pure seed, analytical purity

The Seed Purity is based on seed shape, size, and coloration, but not genetic nor off-type.

Other rice seeds appearing as off-types should be placed under varietal mixture or off-type.



## 2. Structure of Seed Production : An example

<b>Class of Seed</b>	<b>Production</b>	<b>Inspection</b>	<b>Storage</b>	<b>Distribution</b>
<b>Nucleus Seed</b>	Breeding institute	Breeding Institute	Breeding Institute	
<b>Breeder Seed</b>	Breeding institute	Breeding institute	Breeding Institute	Breeding institute
<b>Foundation Seed</b>	Commission to Farmer Coop by State	Seed center of Farmers Coop	Breeding institute	
<b>Registered Seed</b>	Commission to Seed Farmer by State	Farmer's coop seed centers	Farmers cop's seed storage center	Prefecture to Farmers coop
<b>Certified Seed</b>	Contracted farmer by Farmers Coop	Seed center of Farmers coop	Farmer's cop seed storage center	Farmers coop to Farmers group

# 3. Seed Class: Breeder Seed

## What is the Breeder Seed ?

Seed of a new variety with **highest purity**, produced, developed, controlled and provided directly by the breeder or institution for further multiplication.

## Varietal Purity

**Should be very close to 100%.**

Each country decides % as shown before

**A single plant per hill has to be secured for the production**

## How to maintain purity?

1. By isolation of plot for breeder seed
2. **By careful checking plant in the field (Next Slide)**  
**As frequent as possible**

# 3. Seed Class: Breeder Seed

## - How to maintain genetic purity -

Throughout entire growth stage, as frequent as possible, with special emphasis on the following stage, observe and remove any off-type

### 1. Vegetative Stage

- 1) seedlings floating in a plot,
- 2) hill out of row,
- 3) plant shape (number of tiller, plant height, leaf sheath and leaf color)

### 2. Heading Stage

- 1) hill out of row,
- 2) uniformity of heading,
- 3) uniformity of plant height

### 3. Maturing Stage

- 1) uniformity of maturing,
- 2) panicle length,
- 3) uniform seed shape and size
- 4) color of the glume,
- 5) sterility

# 3. Seed Class: Foundation Seed

## What is the Foundation Seed ?

Progeny of the breeder seed, produced by trained officers of an agricultural station in accordance with national standards, handled to maintain genetic purity and identity of the variety.

## Varietal Purity

Each country decides % as shown before

**A single plant per hill has to be secured for the production**

## How to maintain purity?

1. By isolation of plot for breeder seed
2. **By careful checking plant in the field  
mainly focusing on the three stages**

# 3. Seed Class: Foundation Seed

Inspection on the plants in the field should be done by scientists, technicians and inspectors who **are fully familiar with a variety.**

## 1. Vegetative Stage

- 1) seedlings floating in a plot,
- 2) hill out of row,
- 3) plant shape (number of tiller, plant height, leaf sheath and leaf color)

## 2. Heading Stage

- 1) hill out of row,
- 2) uniformity of heading,
- 3) uniformity of plant height

## 3. Maturing Stage

- 1) uniformity of maturing,
- 2) panicle length,
- 3) uniform seed shape and size
- 4) color of the glume,
- 5) sterility



# 3. Seed Class: Registered Seed

## What is the Registered Seed ?

Progeny of the foundation seed, grown by selected farmers, handled to maintain genetic purity and identity and undergone field inspections to ensure the standards

## Varietal Purity

Each country decides % as shown before

## How to maintain purity?

1. By isolation of plot for registered seed
2. **By careful checking plant in the field  
mainly focusing on the three stages**

# 3. Seed Class: Certified Seed

## What is the Certified Seed ?

Progeny of the foundation, registered seed or certified seeds handled to maintain sufficient variety identity and purity, grown by selected farmers, under prescribed conditions and culture and isolation and subjected to field and seed inspection by certified agency.

**Harvest from certified seeds is used for commercial planting**

## Varietal Purity

Each country decides % as shown before

## How to maintain purity?

1. By isolation of plot
2. **By careful checking plant in the field  
mainly focusing on the three stages**

# 3. Seed Class: Seed multiplication Rate

- Multiplication rate from one seed class to the next class will be influenced by;
  - cropping ecology,
  - varieties,
  - cultivation condition.
- A good estimate can be obtained by pre-cultivating a variety of concern under the same condition as seed production.
- The table below is an expected rate in three different ecologies.

Seed Class	Cultivation Ecology		
	Upland	Lowland	Irrigated
Breeder	20	50	100
Foundation	20	50	100
Registered	20	50	100
Certified	20	50	100

**Even an upland variety, seed production is better to be done in irrigated condition, to ensure higher multiplication rate.**



# 3. Seed Class: Seed amount for each seed class

Following factors have to be considered to calculate the necessary amount of seeds for each level of seed;

1. Number of plant per
2. Spacing
3. Germination rate (80%, as standard)
4. Insurance for an emergency (20 – 30%)
5. Method of transplanting
6. Cultivation environment (upland, lowland, irrigated)
7. Variety

### 3. Seed Class: Example of Seed Production Plan

One of examples of seed production plan

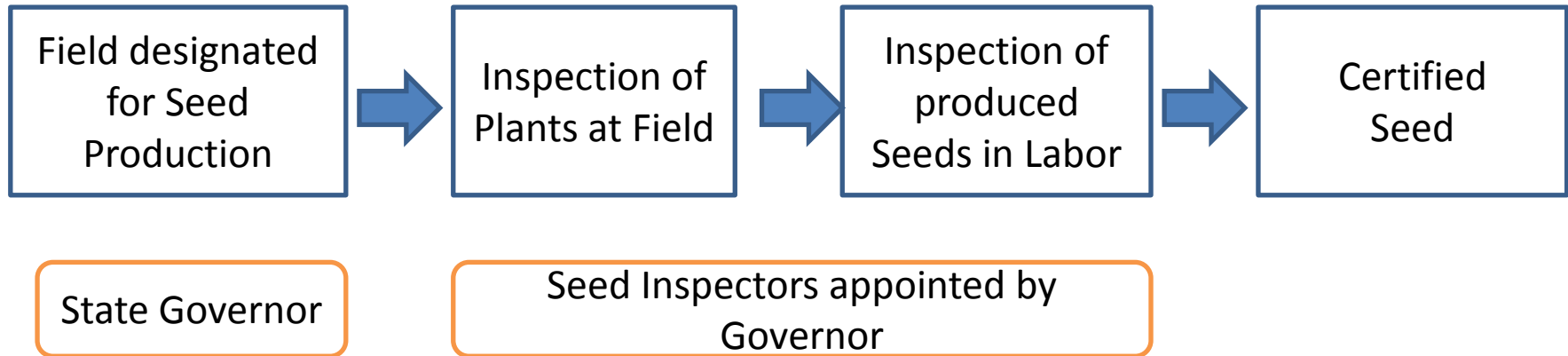
Seed Class	Producing Party	2014	2015	2016	2017	2017
Breeder (kg)	NARS	10	20			
Foundation (kg)	NARS		500	1000		
Registered (ton)	Registered Coop			25	50	
Certified (ton)	Registered Farmers				1250	2500

For each variety, following points need to be clear

1. Place of production
2. Multiplication rate
3. Parties involved in seed production
4. Amount of certified seed required in year xx

# 4. Inspection

## Flow of Quality check



## 4. Inspection: Roles of Public Institute

- Development of seed policy
- Establish seed production agency
- Establish standard of seed quality
- Develop seed production plan, annually
- Quality Check
  - Field inspection
  - Plant inspection in the field
  - Quality inspection of seeds produced
- Issuance of seed certificate

# 4. Inspection : Field

## Timing of the Inspection

1. Vegetative stage
2. Heading stage
3. Maturing stage (dough-ripe stage)

## Points to be checked

- Vegetative Stage
  1. Seedlings floating in a plot
  2. Hill out of row,
  3. Plant shape; number of tiller, plant height, leaf sheath leaf color (if applicable)
- Heading Stage
  1. Hill out of row
  2. Uniformity of heading
  3. Uniformity of plant height
- Maturing Stage
  1. Uniformity of maturing
  2. Panicle length
  3. Uniform seed shape and size
  4. Color of the glume
  5. Sterility

**Field inspection is mainly for removal of off-types .  
(Lab inspection rarely detects off-types)**



# 4. Inspection : Reference

## Variety Catalogue:

Usually available at a variety release committee or an institute

### Fiche descriptive de la variété Sahel 329

Nom de sélection: WAS 169-B-B-4-2-9  
Parents: Jaya / Basmati 370  
Origine: AfricaRice / Saint-Louis  
Espèce: *Sativa*  
Groupe variétal : Indica  
Date de création : 1997  
Date de Vulgarisation : 2009



### Caractéristiques Agronomiques

- Ecologie : Irrigué  
- Cycle semis-épiaison : 87 jours  
- Maturité : 116 jours  
- Rendement potentiel : 7 t ha<sup>-1</sup>  
- Résistance à la verse : Moyenne

### Caractéristiques Morphologiques de la Plante

- Hauteur : 107 cm  
- Tallage : Bon  
- Couleur de la gaine : Vert pâle  
- Port de la plante : Semi-érigé  
- Port de la feuille paniculaire : Erigé  
- Panicule : Semi-compacte  
- Exsertion panicule : Bonne

### Caractères du grain (paddy)

- Longueur : 8 mm  
- Largeur : 2.5 mm  
- Poids de 1000 grains : 23 g  
- Aristation : Mutique  
- Couleur glumelle : Jaune paille  
- Couleur de l'apex à maturité : Incolore  
- Couleur caryopse : Blanche, translucide  
- Forme de la graine : Mince longue

### Caractéristiques Organoleptiques et Technologiques

- Amylose : 30.9%  
- Rendement à l'usinage : 61%  
- Arôme : Parfumé

### 1. Identification

1.1. Name: WAB 880-1-38-20-17-P1-HB  
1.2. Species: *Oryza sativa*  
1.3. Variety group: Indica  
1.4. Pedigree: WAB 56-50/CG 14  
1.5. Geographical origin: WARDA/IVORY COAST  
1.6. Year introduced (in Rwanda): 2007  
1.7. Year released (Farmer): 2010  
1.8. Popular name: RUMBUKA  
1.9. Recommended site: BUGESERA, CYUNUZI, KANYONYOMBA

### 2. Morphological characteristics

#### 2.1 Plant

a. Height: Intermediate  
b. Leaf color: Green  
c. Flag leaf attitude: Erect  
d. Leaf angle: Erect  
e. Leaf senescence: Late  
f. Phenotypic acceptability: Good

#### 2.2 Panicle

a. Type: Intermediate  
b. Exsertion: Well exserted  
c. Length: 27.9 cm  
d. Nr of grains/panicle: 118  
e. Threshability: Intermediate  
f. Spikelet fertility: Fertile

#### 2.3 Paddy/Caryopsis

a. Length: 9.8 cm  
b. Width: 3.1 cm  
c. Awning: Absent  
d. 1000 grains weight: 34 gr  
e. Chalkiness: Small  
f. Shape: Slender

### 3. Agronomical characteristics

3.1 Ecology: Rainfed lowland and Irrigated  
3.2 Duration: 154 Days  
3.3 Days to 80% heading: 115  
3.4 Potential yield: 7.1 T/Ha  
3.5 Tillering ability: Medium  
3.6 Lodging: No  
3.7 Shattering: Very Low  
3.8 Resistance to RYMV: Tolerant  
3.9 Resistance to Blast: Tolerant  
3.10 Water requirement: Low

### 4. Grain quality

4.1 Cooking quality: Intermediate  
4.2 Aroma: No  
4.3 Degree of Milling: 87 %  
4.4 Milling recovery: 69 %  
4.5 Endosperm type: Non glutinous

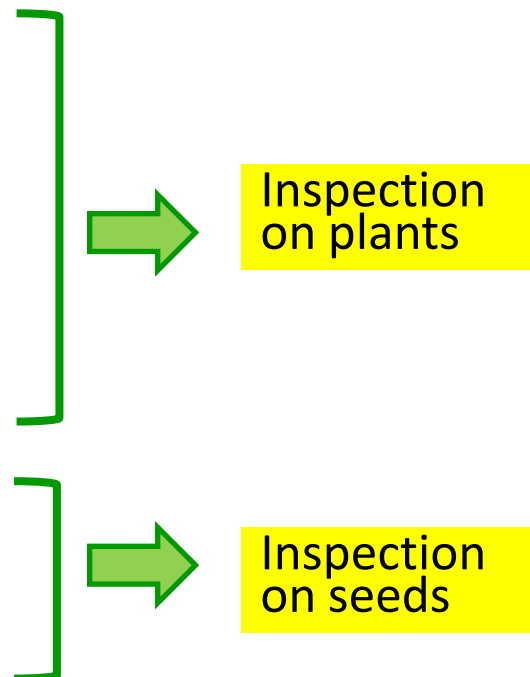


# 4. Inspection : Reference

## Variety Catalogue:

What kind of information can be used as a reference of purity?

- Identification  
Name, pedigree, origin
- Morphological characteristics  
**Height, leaf color, flag leaf angle, panicle exertion, panicle length, shattering**
- Agronomical characteristics  
**Duration, 50% flowering, tillering, yield**
- Grain characteristics  
**Size, color, awn**
- Grain quality  
Aroma, amylose,  
Cooking property



# 4. Inspection : Produced Seed

## Item to be checked

- Germination rate
- Seed moisture content
- Mixture of other rice varieties
- Mixture of other crop seeds
- Mixture of weed seeds
- Seed infected by noxious diseases
- Seed infected by other diseases
- Inert matter (soil, stones others)



Country	Items	Breeder	Foundation	Registered	Certified
Sierra Leone	Germination %	80	80	80	80
	Moisture %	12	12	12	12
	Inert matter %	2	2	2	2
Arkansas (USA)	Germination %		80	80	80
	Moisture %		14	14	14
	Inert matter %		2	2	2
Philippines	Germination %	80	80	80	80
	Moisture %	14	14	14	14
	Inert matter %	2	2	2	3
ECOWAS	Germination %	80	80	80	80
	Moisture %	12	12	12	12
	Inert matter %	2	2	2	2



# 4. Inspection : Definition – Seed Purity

- Pure Seed

The true seed of the variety based on seed shape, size, coloration.

**Other rice seeds appearing as off-types should be placed under varietal mixture or off-type.**

# 5. Seed Production : Preparation

## 1 . Site Selection

Field used for growing certified seeds must meet several criteria

- Not have grown rice for the previous year, unless the same variety is planted
- Separation from other field of same variety to avoid out cross (next slide)
- Eliminate volunteer plants and weed through land preparation

## 2. Original seed to multiply

Seeds for propagation must be original officially approved.

This may be proved by the presentation of certificates and bags of seeds use or purchase invoices .

# 5. Seed Production : Field Management

## 3. Planting Density (Spacing)

Seed Class	Isolation <sup>1)</sup> distance (m)	Between row (cm)	Within row (cm)	Number of plant per hill
Nucleus		40	20	1
Breeder	10 m	40	20	1
Foundation	5 m	20 – 30	20	1
Registered	5 m	20	20	3 - 4
Certified	3 m	20	20	3 - 4

REF: 1) ECOWAS

# 5. Seed Production : Harvesting

## 1. Time of harvesting

Optimal stage to harvest: 20-25% grain moisture  
80-85% of grain the **grains yellow coloring**.  
(about 30 days after flowering)

## 2. Harvesting

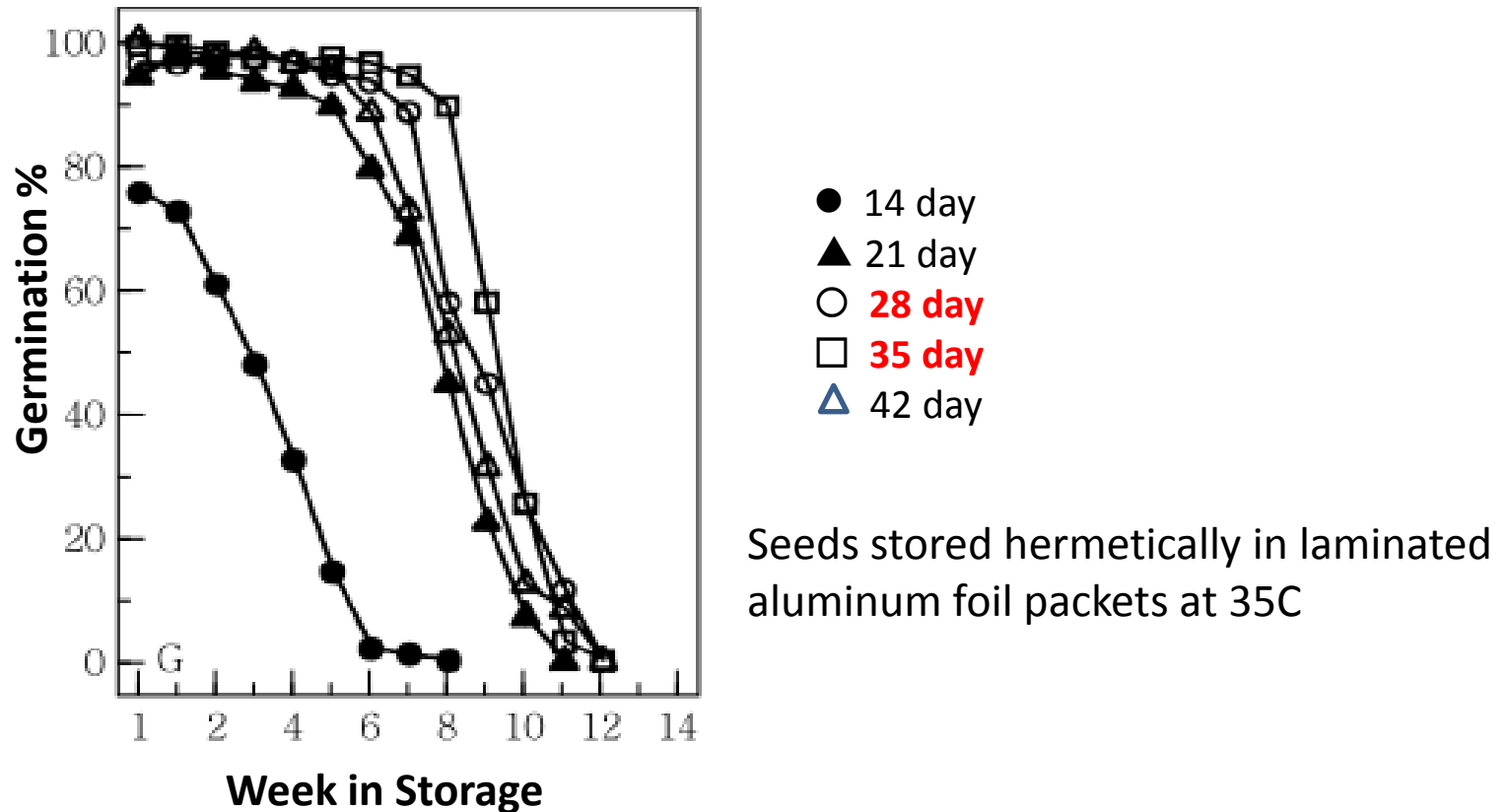
The higher the quality of the seeds, the greater the care at harvest and threshing

- Breeder seed  
Hand harvested and threshed with a self cleaning thresher
- Foundation, Registered seed  
Harvest by a machine with thorough cleaning

# 5. Seed Production : Harvesting

## Importance of harvesting time

### Effect of harvest time after anthesis on seed longevity



Ref: N. KAMESWARA RAO , M. T. JACKSON

Seed Longevity of Rice Cultivars and Strategies for their Conservation in Genebanks

Annals of Botany 77: 251–260, 1996

# 5. Seed Production : Drying

Rice seed should be dried to less than 14% moisture content as soon as possible after threshing.

For long term storage, it should be dried to 12 % or less and preferably stored in a sealed container

Storage Period	Optimal Moisture Content (%)	Potential Problems
2 – 3 weeks	14 – 18%	Fungi, Discoloration, Respiration loss
8 -12 months	Less than 13%	Insect damage
More than 1 year	Less than 9%	Loss of viability

Ref: Seed Quality, IRRI Rice Knowledge Bank

# 5. Seed Production : Cleaning

- Threshed seed contains all kinds of trash
  - Vegetative parts, chaff, straw, empty grains, foreign seed soil and stones
- Seeds should be cleaned as soon as possible after harvesting and threshing
  - Mechanical winnower can be used

# 5. Seed Production : Storage

## For storage for extended period;

Less than 13 – 14% moisture content

Protected from insects and rodents

Restricted from re-absorbing moisture through rain or atmosphere

### Storage Condition

1. LTLH storage conditions : temperature:15 C ; relative humidity:30%
2. Ambient condition

### 80% of germination

LTLH	60 months
Ambient	24 months

### Germination after 60 months

LTLH	86.1%
Ambient	61.9%
Polylined jute bag	75.3%
Jute bag	72.8%

Ref: Storage Technologies to Enhance Longevity in Paddy (*Oryza sativa* L.) Seed of Parental Lines IR58025A and IR58025B of Hybrid PRH-10. A Gupta(2010) *East Africa Journal of Science*



## 6. Remarks : Terminology

- **Improved seeds vs Improved varieties**

Improved seeds are not equivalent to improved varieties.

- **High quality seeds vs improved seeds**

Improved seeds are not equivalent to high quality seeds.

## 6. Remarks : Conservation of Germplasm at Genebank

Important points for genetic resource conservation  
(except for breeder seed conserved in Genebank)

1. Maintain genetic diversity of accessions
2. No selection (except for off-type removal)
3. No intensive selfing
4. Just maintain the diversity at the collection



# 6. Remarks : PVS

## **PVS = Participatory Variety Selection**

- **Objective**

By letting farmers grow promising breeding lines by their hands,

- 1) learn farmers preference,
- 2) facilitate smooth dissemination upon the release of a variety.

- **Seed System**

No direct contribution in seed system

If the variety of farmers preference is not released, the seeds remained in the farmers might contribute in producing a new variety by themselves.

- **Only fixed lines shall be provided to PVS**

# 7. Conclusion

1. Quality should not be compromised in seed production / multiplication.
2. The higher levels of seed (e.g. breeder seeds, foundation seeds) of requires more care and intensity of quality control efforts.
3. The cost and time required for quality control is smaller at the higher stages of seed production/multiplication, while its impacts are larger.

it makes sense to strengthen quality control measures at higher levels.

Thus, the roles and responsibility of NARS is important;  
it will affect both formal and informal seeds.

4. Seed genetic purity maintenance requires purity control measures (observation, identification and removal of off-types) at field level, and it calls for significant efforts by researchers and their appropriate demonstration and instruction to workers, inspectors and seed producers.



***This is the key for quality seed production***

***Thank you !***