Hybrid Rice Breeding Program

IN THE PHILIPPINES

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Presentation Outline

- Rice varietal improvement in general
- Hybrid Rice Breeding Program

  Breeding Performance & achievements

  Current Directions

GOAL

Increased productivity in the different rice growing ecosystems

OBJECTIVE

To identify high yielding rice lines with tolerance to biotic and abiotic stresses and good grain quality that can adapt to the different rice growing ecosystems

PLANT BREEDING PRIORITIES

1. Increasing yield potential

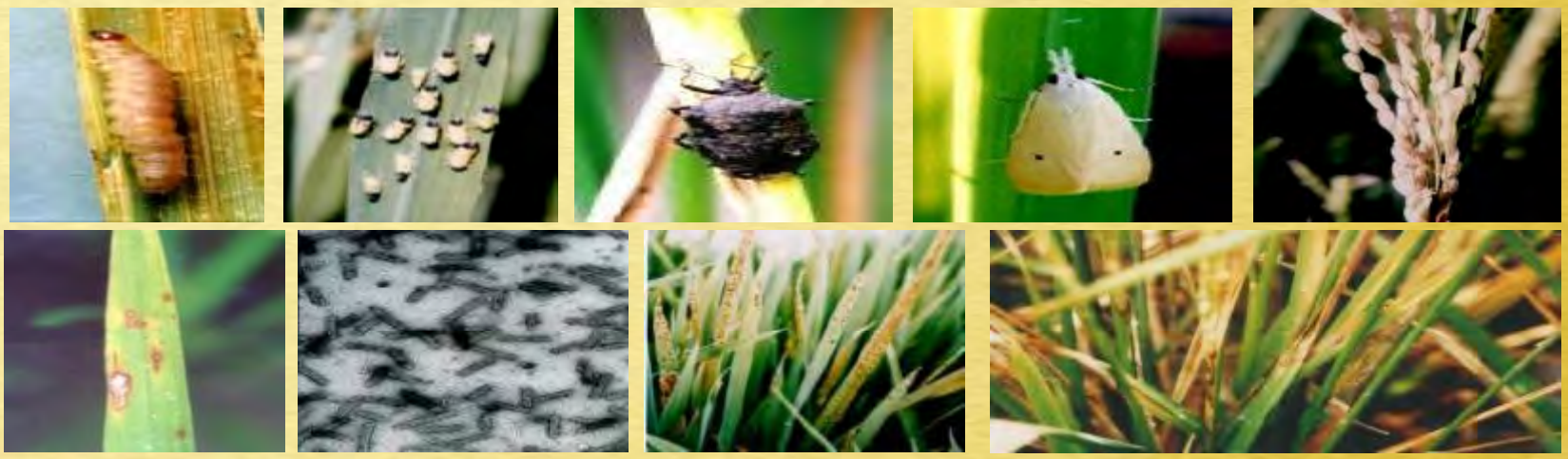
Exploiting diverse germplasm

Changing plant architecture

Exploiting heterosis

2. Multiple resistance to diseases and insects

Varieties should be able to resist current strains or biotypes of insects and diseases



3. Increasing tolerance to abiotic stresses

Water stresses	Drought ; Flood/Submergence
Soil problems	Salinity Alkalinity(Fe def); Acidity(Al & Fe tox) Deficiencies(Zn,N,P,K);Toxicities(Fe,Mn,B,Al)

4. Superior quality

- Good grain quality
  - Kernel/milling quality
  - Physico-chemical quality
  - Eating quality

- Nutritional enhancement
  - Vit. A- rich rice
  - Protein-rich rice
  - Iron-dense rice

5. Appropriate growth duration

- Increase cropping intensity
- Stress avoidance

6. Adaptation to climate change

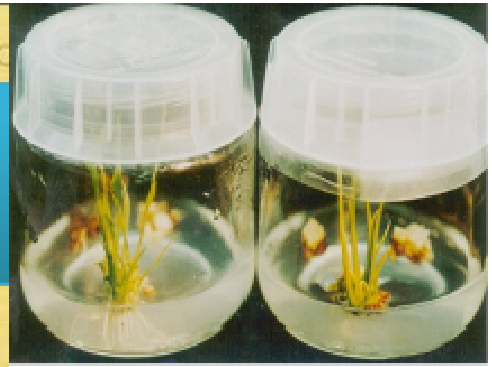
- Extreme temperature
- Drought or Flooded conditions

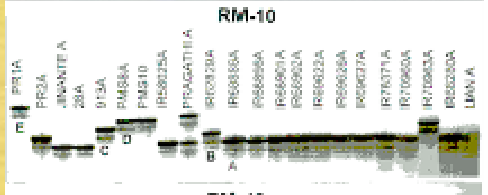
Conventional hybridization and selection procedures

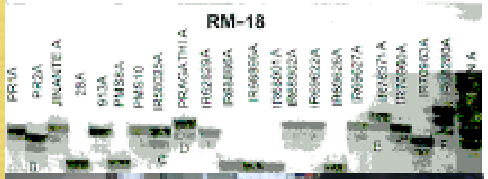
- Basic, time-tested
- To generate and utilize existing genetic variation
- Generates a wide array of combinations of the genes coming from the parent plants
- Cross-pollination followed by several cycles of selection and self-pollination → stable promising lines → candidate varieties

Cutting-edge Technology Development in support to breeding

- Biotechnology
  - increasing breeding efficiency
  - improving resistance/tolerance to biotic & abiotic stresses
- Molecular marker technology
  - using marker-aided selection
  - germplasm characterizations
- Induced mutations
  - *In vitro* techniques- developing lines for adverse environments
  - Physical & Chemical mutagenesis
- Genetic engineering
  - cloning/introduction of important genes
- Wide hybridization
  - transferring resistance genes



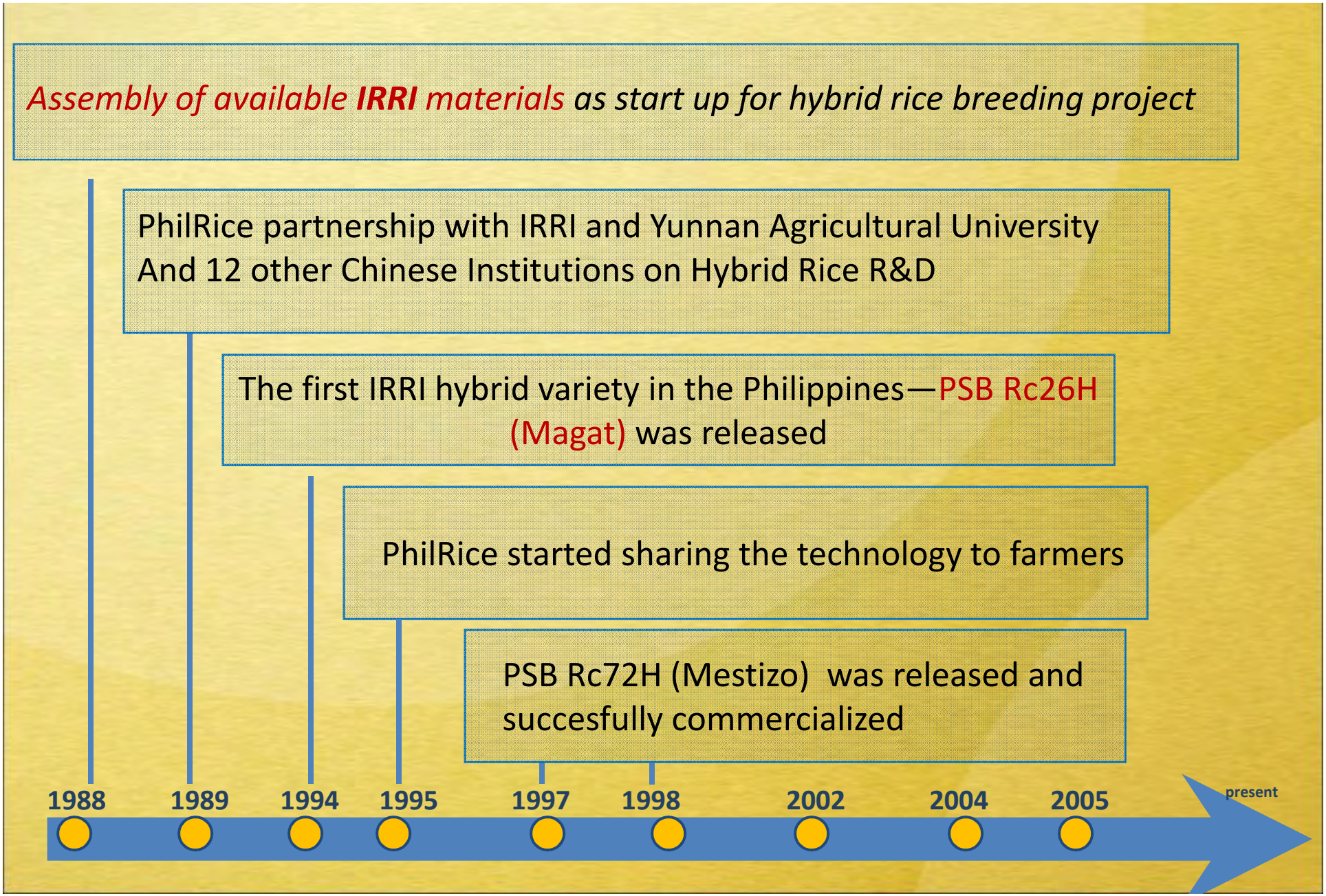




Hybrid Rice

Breeding Performance and Achievements

PHILRICE HYBRID RICE R & D TIMELINE



Target breeding environments

Phase 1 (1985-1997)

1. Irrigated lowland
   Inbred
   Hybrid - 1988
2. Rainfed lowland
3. Saline-prone areas
4. Cool-elevated areas
5. Upland

Phase 2 (1998-2005)

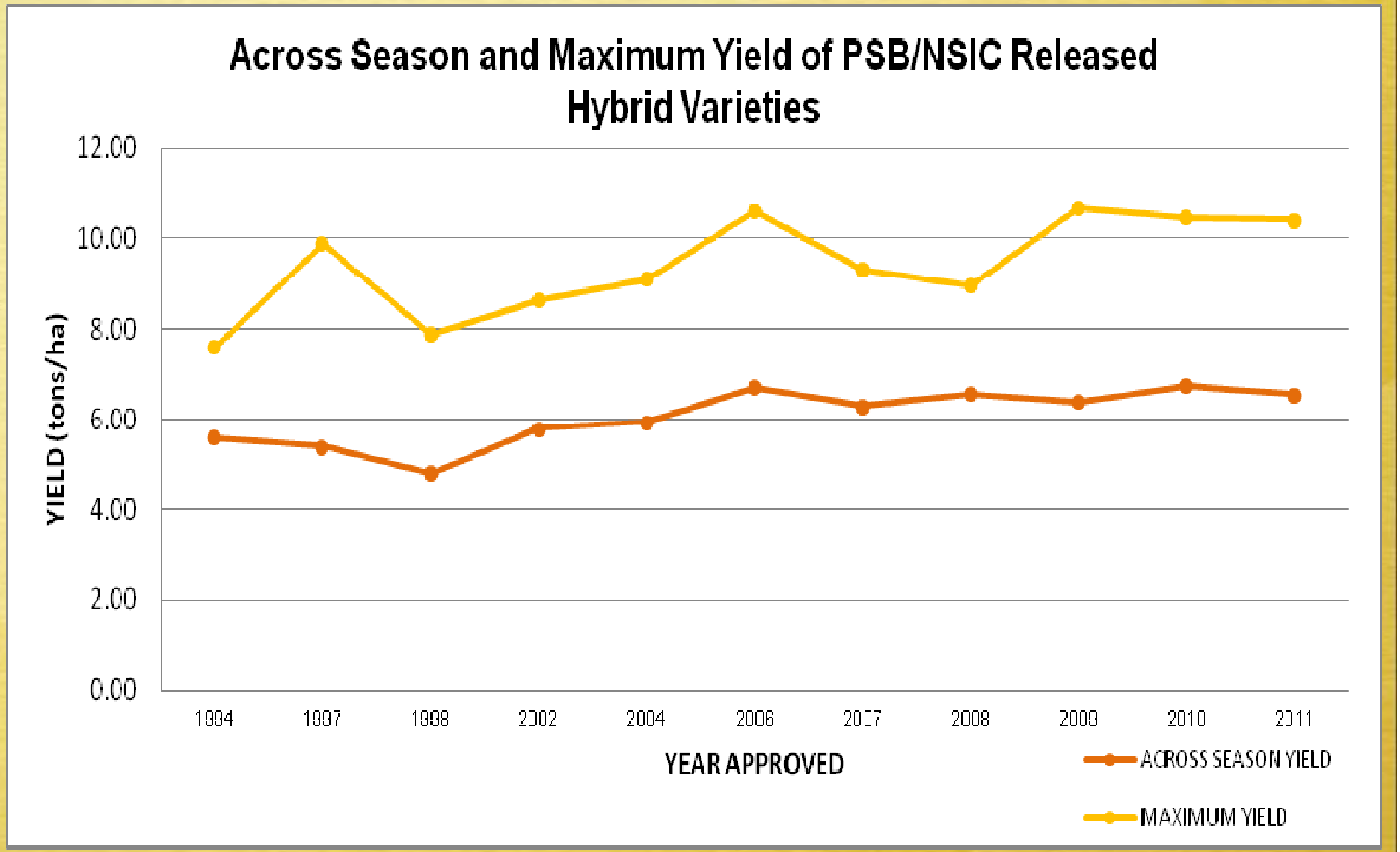
Phase 3 (2006 to 2010)

1. **Favorable environment**
   Irrigated lowland
   Transplanted
   Direct seeded
   Hybrid rice
2. **Unfavorable environment**
   Rainfed lowland
   Drought-prone (Direct dry seeding)
   Submergence-prone
   Saline Prone

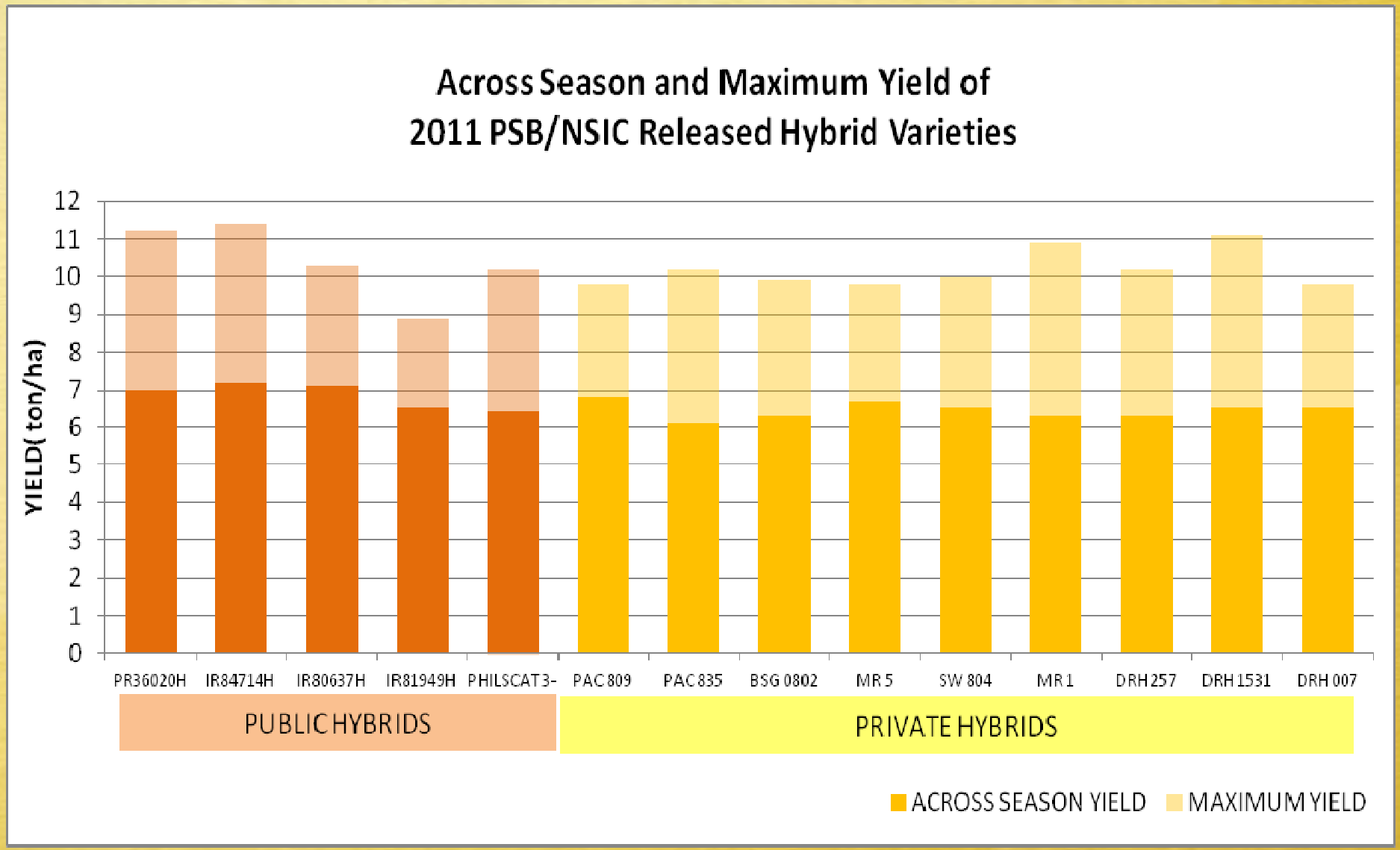
Table 1. Number of recommended varieties by ecosystem from 1960 to 2010

Period	Irrigated lowland	Rainfed lowland	Upland	Cool elevated	Saline	TOTAL
1968-1988	**43**	**4**	**7**	**-**	**-**	**54**
	(29 IRRI, 4 UP, 9 BPI, 1 PAEC)	(2 UPLB, 2 IRRI)	4 UPLB, 2 IRRI, 1 BPI)			
1990-2010	87	**17**	**6**	**6**	**13**	**129**
	(54) inbreds, 30 hybrids, 6 sp purpose	(3 UPLB, 8 inc 4 TRV PhilRice 6 IRRI	(3 IRRI, 3 inc 1 TRV PhilRice)	(5 IRRI, 1 PhilRice)	7 IRRI, 6 PhilRice	
2011	18 (2 inbreds, 2 special purpose, 14 hybrids)	**9** (3 UPLB, 4, IRRI, 2 PhilRice)	**1** (IRRI)	•-	4 (3 PhilRice, 1 IRRI)	**32**
TOTAL	**148**	**30**	**14**	**6**	**17**	**215**

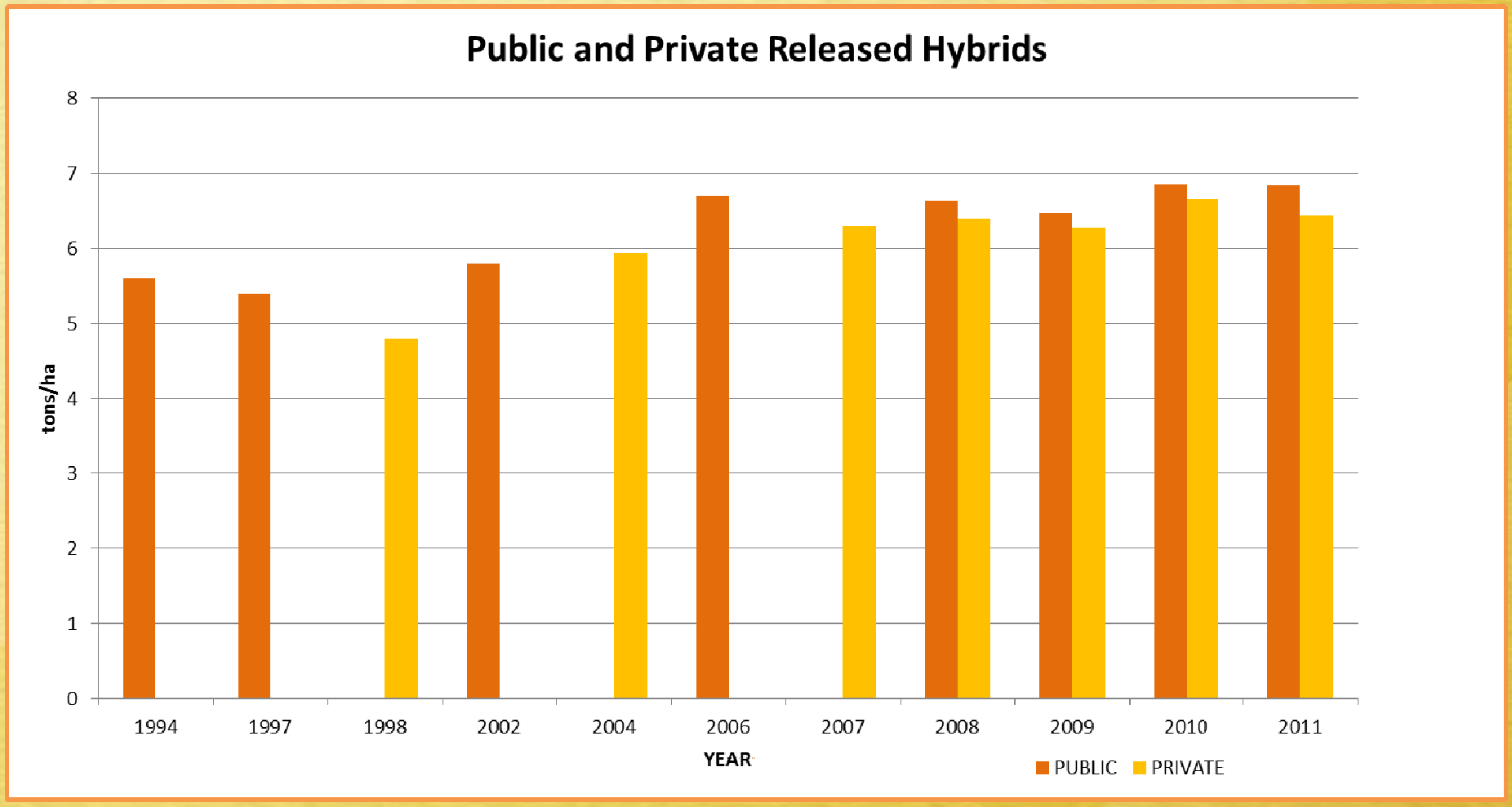
Variety Performance



Yield Profile (maximum, average WS & DS, & AS) NSIC approved public and private hybrid varieties (1994-2011

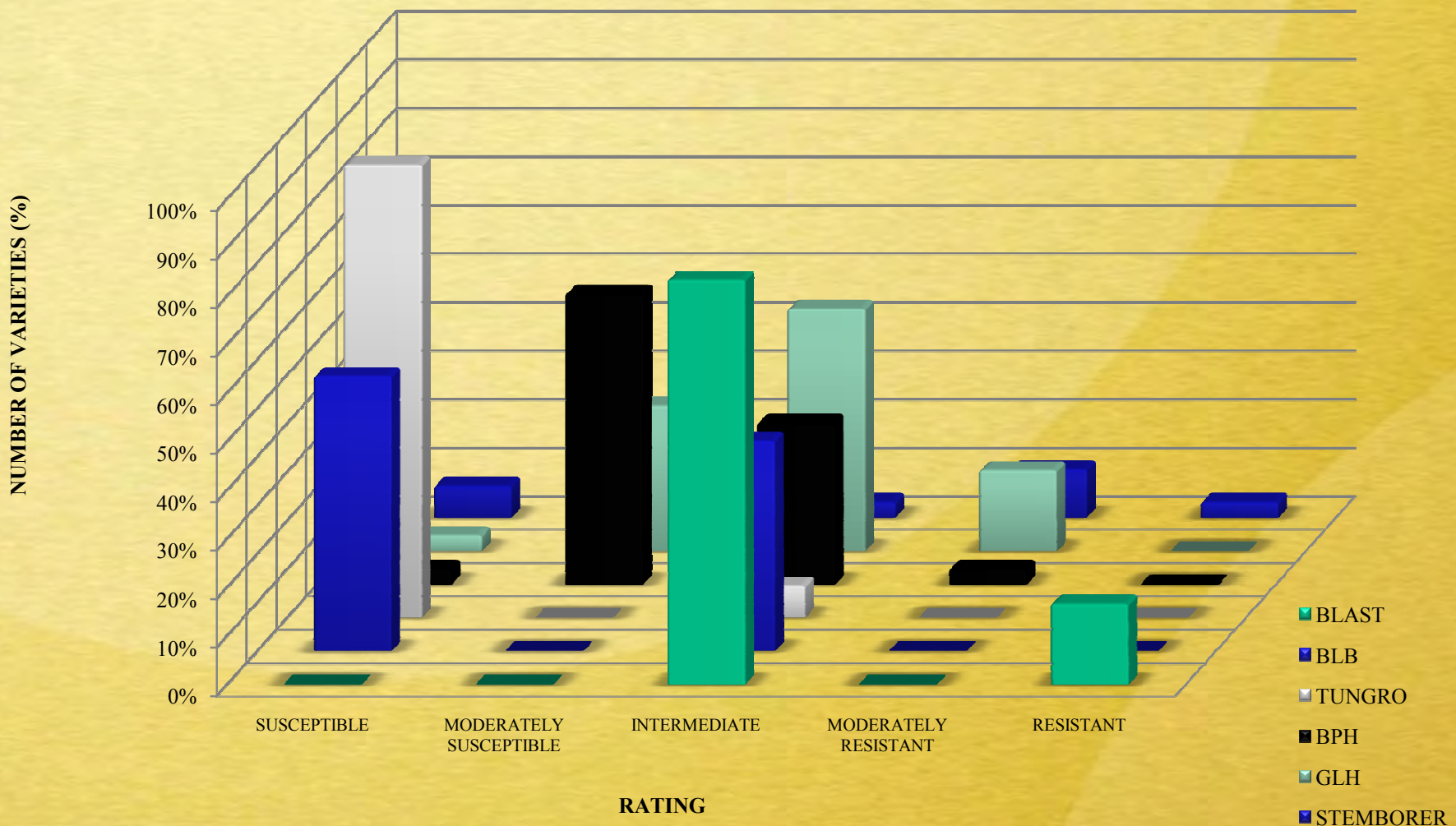


Yield Profile (Across Season) NSIC approved public compared with private hybrid varieties (1994-2011)

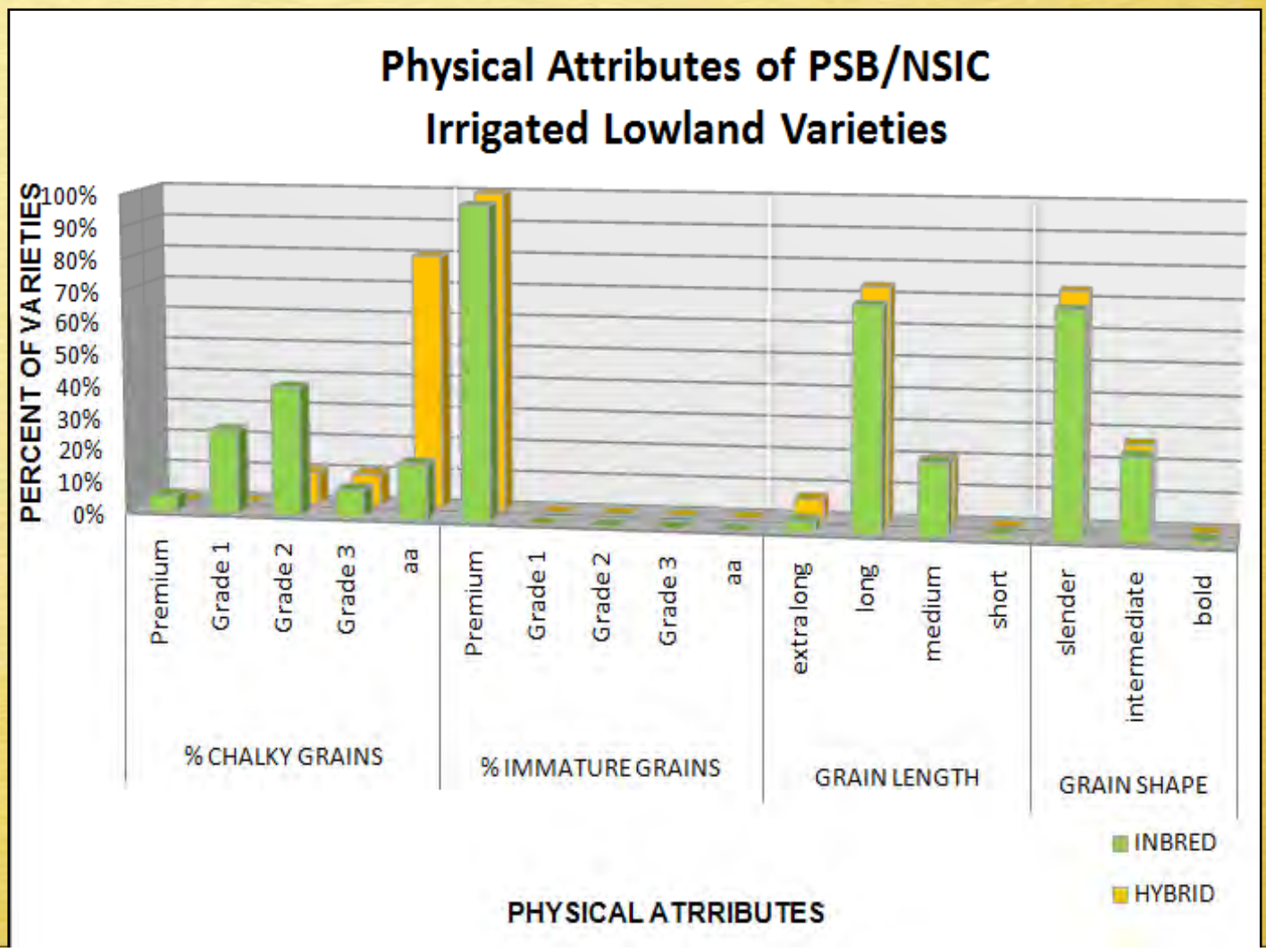


*1995, 1996, 1999, 2000, 2001, 2003, 2005 no released hybrids

Pests reaction profile of NSIC approved hybrid varieties (2006-2011)



Grain Quality Profile of NSIC Approved Varieties (2006-2011)



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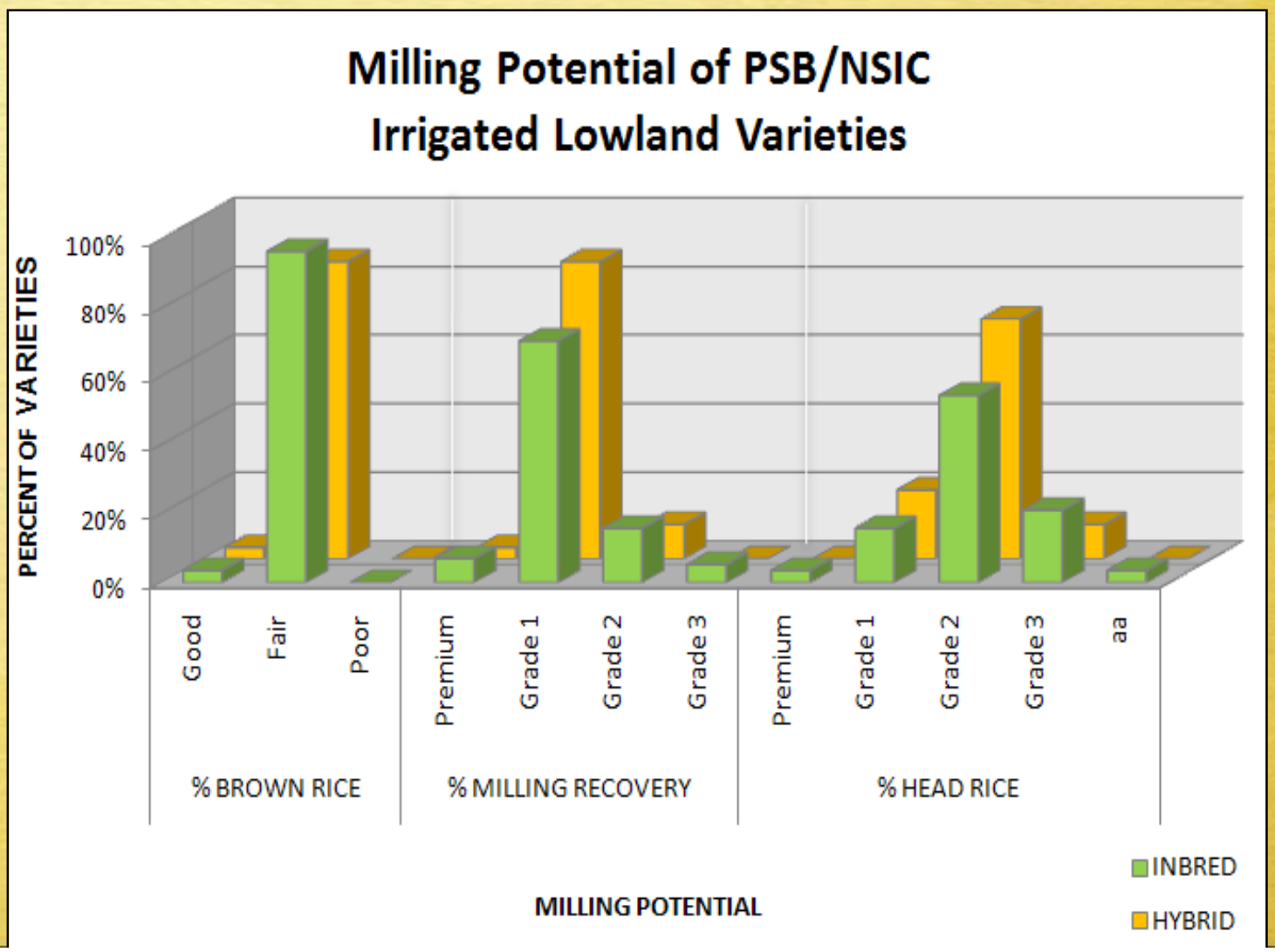

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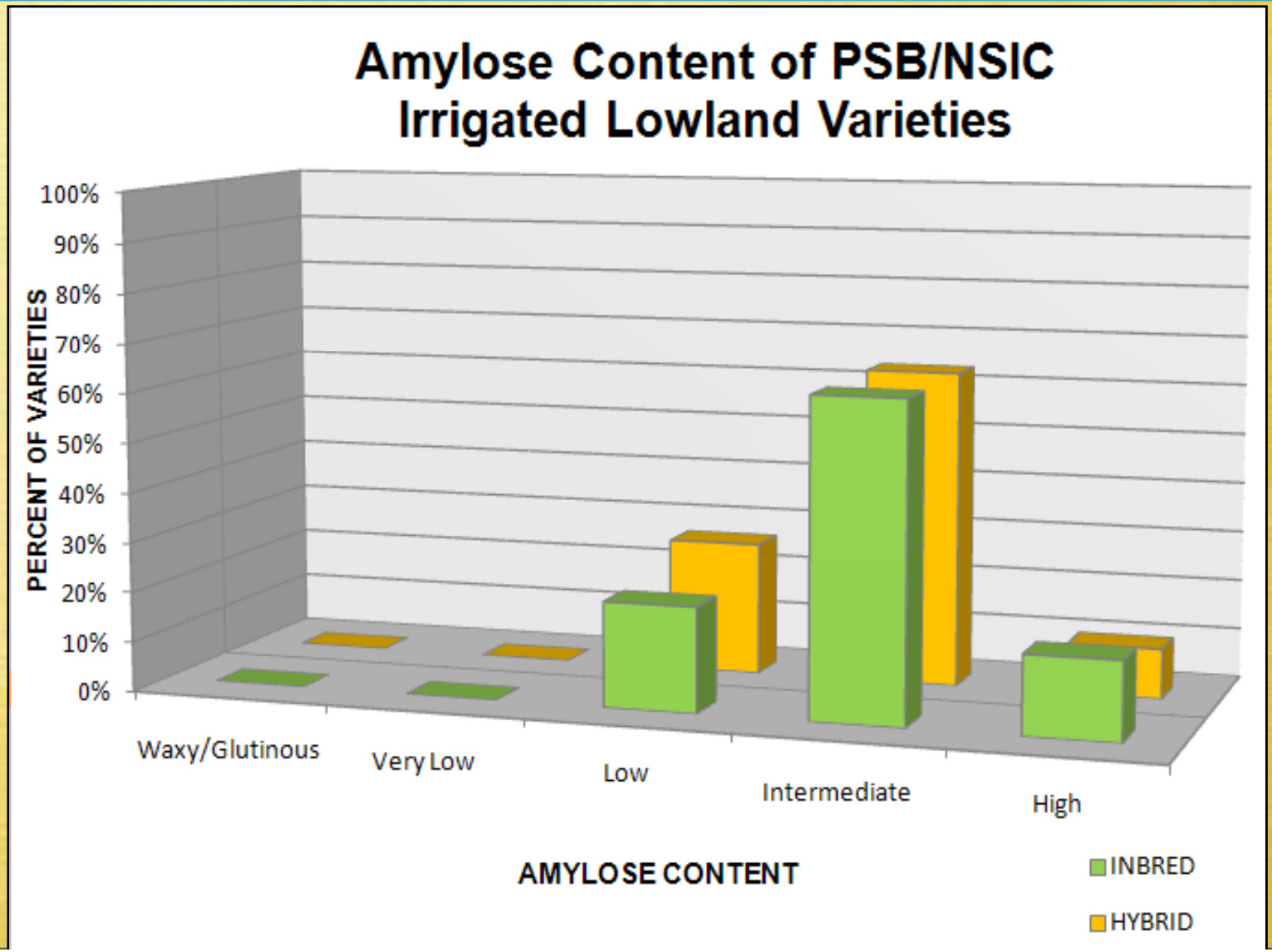


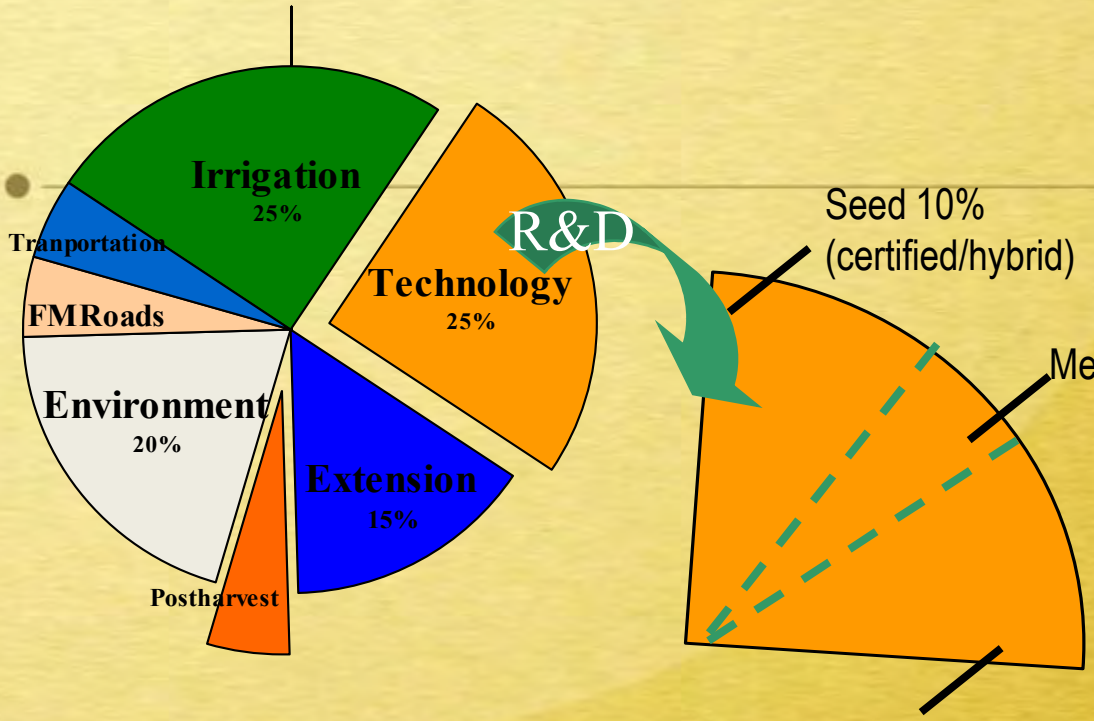
LOCATION AND TECHNOLOGY SPECIFIC R&D PROGRAMS

Phase 1 (1985-1997) | Phase 2 (1998-2005) | Phase 3 (2006 to 2010) | PHASE 4 (2011-2016)

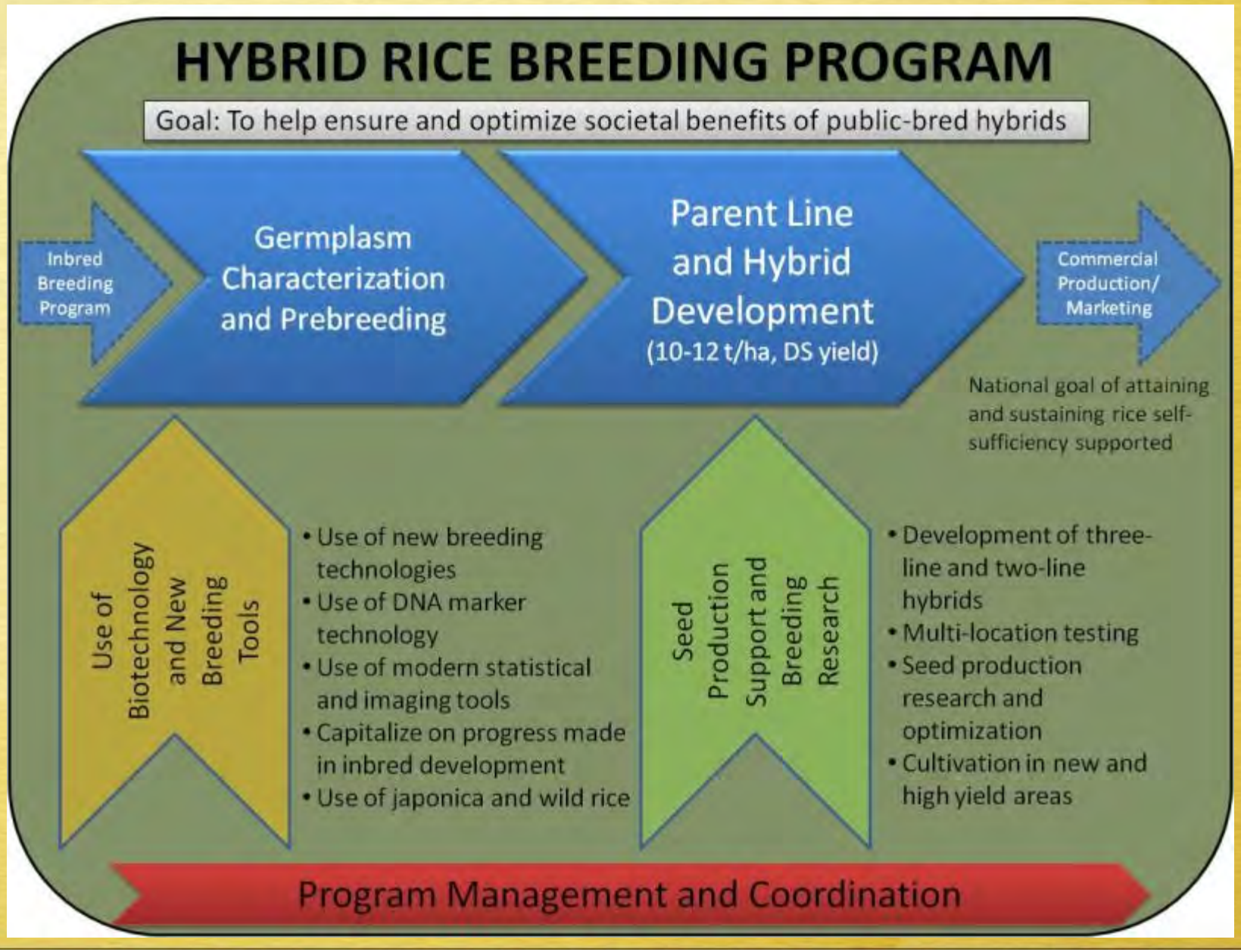
- Developing Technologies to Surpass the Dry Season Irrigated Lowland Rice Yield Plateau (SYP)
- Developing Technologies to Break the Low Rice Yield Barriers in Rainfed, Upland, & Other Adverse Environments (BYB)
- Natural Products and Value-Adding Systems Development (NVP)

Philippine Rice R&D Program Framework, 2011-2016

Sustainable rice productivity



Current Research Strategy



Hybrid Breeding Priorities

Morpho-Agronomic Characteristics

1. Yield (Heterosis)
2. Plant architecture
3. Outcrossing rate (A line)
4. Pollen load and strong restoring ability (R line)
5. Stable sterility (CMS and TGMS line)
6. Good combining ability

Diseases/Pest

1. Bacterial Leaf Blight
2. Tungro
3. Blast
4. Brown planthopper
5. White-backed planthopper
6. Stemborer

Hybrid Breeding Priorities

Grain Quality Characteristics

1. Chalkiness
2. Milling yield (Head rice recovery)
3. Amylose content/GT/GC
4. Eating quality

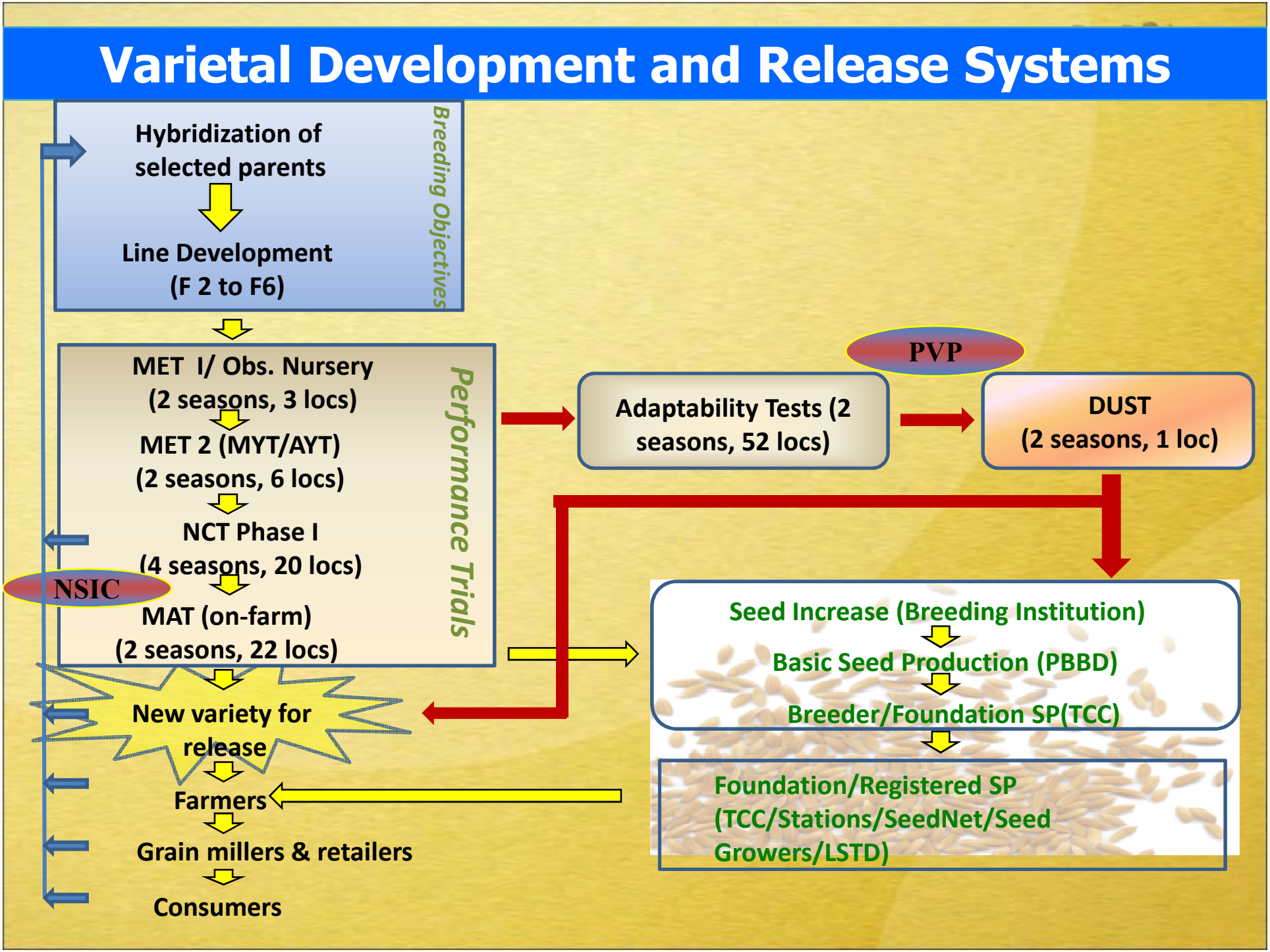
Abiotic stress

1. Drought
2. Submergence
3. Salinity

Value-adding

1. Vit A
2. Iron
3. Zinc

Varietal Development and Release Systems



POLICIES AND GUIDELINES FOR HYBRID RICE TESTING AND RELEASE

- **Main criteria in selecting the hybrid variety:**
  Superior yield performance, pest and disease resistance, grain quality characteristics, and ease of seed production

1. When yield of the best performing inbred check is below 6.6 t/ha, hybrid yield advantage should be 15% or more.
2. Yield advantage of 1.0 t/ha or more is required when yield of the best performing check is 6.6 t/ha or higher.

Variety release and registration shall be considered based on the following:

1. **National recommendation –** yield advantage is satisfied in 50% of the valid trials, i.e. C.V. = ≤ 20%, across all regions (Luzon, Visayas, Mindanao) in both dry and wet season.
2. **Seasonal recommendation** – yield advantage is satisfied in 50% of the valid dry season or wet season field trials across locations-years combinations or data points, and there is clear and consistent season effect.
3. **Regional recommendation** – yield advantage is satisfied in 50% of the valid regional field trials in Luzon, Visayas, or Mindanao across seasons-years combinations or data points, and there is clear and consistent region effect.

- **Duration and timetable of testing**

  1.Field testing of hybrids in the NCT requires a minimum of four (4) seasons in the identified testing sites.

  2.The timetable for testing shall cover at least two dry season and two wet season trials conducted within three years.

  3.Other tests like those for disease and insect resistance and grain quality are to be completed and reviewed during this period. These tests are conducted separately in the NCT and data are obtained from different set-ups.

  4.An entry could be dropped from the NCT at any time due to poor performance or for other valid reasons.

Other Concerns:

1. Tests in more locations for better chances of identifying excellent hybrids
2. Conduct seed production research in sites with different climatic conditions
3. Enhance PPP collaboration and explore innovative modalities such as joint venture, non-exclusive licensing to fast track commercialization of public hybrids.

Some Hybrids developed in the Philippines


PSBRc 72H
(MESTIZO 1)


PSB Rc 72H
(Mestizo 1)


PSB Rc 72H
(Mestizo 1)


PSB Rc 72H
(Mestizo 1)

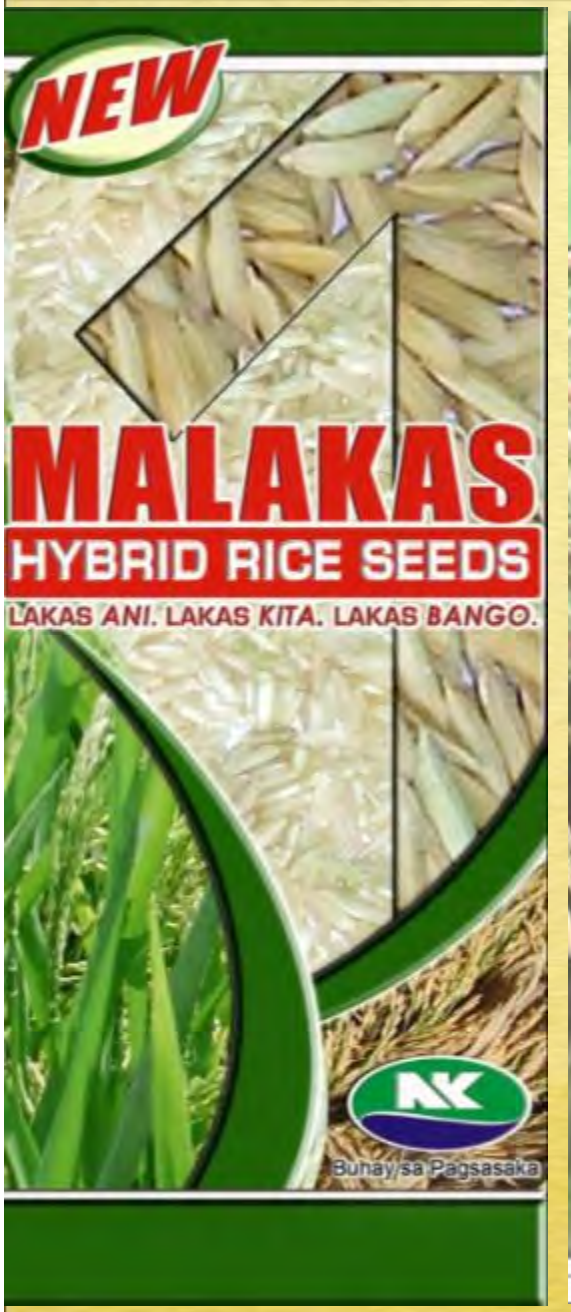

PSB Rc 72H

NSIC Rc 198H (Mestiso 17)

Very early maturing: 108 days
Moderate to field diseases
Moderate to SB, BPH & GLH
Intermediate AC (24.3%)
Comparable grain Q to IR64

NSIC Rc202H (Mestiso 19)

- Suitable both in dry and wet seasons.
- Better yield performance over PSB Rc82 and PSB Rc72H across all seasons and among selected locations.
- Early maturing variety at 110 days
- Resistant to whiteheads and moderately resistant to GLH


NEW
MALAKAS
HYBRID RICE SEEDS
LAKAS ANI. LAKAS KITA. LAKAS BANGO.
NK
Bunay sa Pagsasaka


BIOSEED 401
HYBRID RICE
Taas ani... Taas kita..
Mabango na.. Masarap pa..
BIOSEED RESEARCH PHILIPPINES, INC.
BIOSEED.


Arize™
H64
Early Maturing
Hybrid Rice Seed
Mabilis ang Kita
Sa Umaani ng Maaga
Arize
H64
Hybrid
Rice
Seed
Bayer CropScience

End Message:

"Hybrid rice remains to be a strong and reliable technology for our quest of self-sufficiency and competitiveness".

Society supports plant breeders for only one purpose:

" to develop more productive varieties for farm use"

Thank you for listening

Plant Breeding and Biotechnology Division

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PHILRICE
PHILIPPINE RICE RESEARCH INSTITUTE

RICE SCIENCE FOR DEVELOPMENT