Pembaikbakaan Mutasi Untuk Pembangunan Varieti Padi Baharu

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Kandungan

- Pengenalan
- Kemudahan penyinaran
- Current Mutation Breeding Project
- Success Story/Achievement
- Future challenges and Mission
Introduction

1967: Rubber Research Institute (RRI) has conducted the first induced mutation breeding: X-ray

The wintering period

During this period, which last approximately 4 to 6 weeks, the leaves of the rubber tree die and fall off, and new leaves are formed. Both the metabolism of the tree and latex production are substantially affected.
Gamma ray (250Gy) induced mutant variety Calrose 76 in 1977

Dr. J. Neil Rutger

Calrose 76

Calrose

sd₁ locus = GA 20-oxidase gene
MUTANT VARIETIES (2016)

Total Number: 3222

Asia: 1953 (60%)

Plant Species: 214

Sources: FAO/IAEA Mutant Varieties Database

- Cereals, 1593
- Ornaments, 706
- Legumes, 483
- Vegetable, 77
- Fruit/Nuts, 77
- Oil Crops, 68
- Others, 144
- Fibre crops, 74

nt FAO/IAEA Program
MUTANT VARIETIES (2016)

- Asia, 1953
- Europe, 953
- North Amerika, 200
- Latin Amerika, 50
- Afrika, 66

IAEA/FAO Program
Objective: Mutant Mahsuri resistant to Blast disease

The first mutant (rice) through radiation induced mutation breeding
Tongkat Ali (MA03)

- In 1984, a coordinated research programme under RCA/IAEA/FAO entitled “Semi-dwarf mutants for rice improvement in Asia and Pacific” using the variety Manik.
- Objective: to generate semi-dwarfs mutants
- Yield: 6.0-7.3 t/ha, higher than the parent, which yielded 5.7 t/ha;
- Resistant to brown planthopper (BPH)
- Resistant to lodging
HISTORY OF RICE MUTATION BREEDING IN MALAYSIA

KOLABORATOR

- National Commitee of Plant Mut Breeding: 1984
- Consist of Nuklear Malaysia, UKM, MARDI, UPM, LGM, MPOB
- Chaired by: UKM (Prof. Tan Sri Zakri Ab Hamid)
- Secretariate: Nuklear Malaysia

1984
Mahsuri Mutants (Q34)

1989
Tongkat Ali (MA03)

1999
MRQ 50 (Puteri) (Q34 x KDM)

2005
MRQ 74 (Maswangi), gene Q34

2013
NMR151 & NMR152 PVP (Registration)
# Rice Mutant Varieties Derived From Induced Mutation Breeding

<table>
<thead>
<tr>
<th>Mutant</th>
<th>Original Parent</th>
<th>Year</th>
<th>Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mahsuri Mutant</td>
<td>Mahsuri</td>
<td>1979</td>
<td>High quality rice</td>
</tr>
<tr>
<td>PS1297</td>
<td>Pongsu Seribu 2</td>
<td>183</td>
<td>Increase amylose content and low spikelet sterility</td>
</tr>
<tr>
<td>Q34</td>
<td>Mahsuri mutant</td>
<td>1984</td>
<td>Good eating quality</td>
</tr>
<tr>
<td>Muda 2</td>
<td>Muda</td>
<td>1989</td>
<td>Good grain elongation</td>
</tr>
<tr>
<td>Manik 817</td>
<td>Manik</td>
<td>1989</td>
<td>Glutinous endosperm</td>
</tr>
<tr>
<td>MA03 (Tongkat Ali)</td>
<td>Manik</td>
<td>1989</td>
<td>High yield and upright panicle, strong stem</td>
</tr>
<tr>
<td>MRQ 50 (Puteri)</td>
<td>Q34 x Khaw Dawk Mali</td>
<td>1999</td>
<td>High quality rice</td>
</tr>
<tr>
<td>SPM129, SPM 130, SPM 142</td>
<td>MR180</td>
<td>2000</td>
<td>Increase 1000 grain weight, reduce maturation period</td>
</tr>
<tr>
<td>NMR151, NMR152</td>
<td>MR219</td>
<td>2011</td>
<td>Wide adaptability (aerobic, saturated, flooded condition), high yield, disease tolerant</td>
</tr>
</tbody>
</table>
1970: The first irradiation facility was installed in National University of Malaysia (UKM)
UTN: 1990–1995


Nuklear Malaysia: 2012–present

**GC 4000A**
Bhabha Atomic Research Centre, India.
(10 kCi, Co-60)

**Gamma Chamber M-109 Irradiator**
J.L Shepherd & Associates, USA.
(24 kCi, Co-60)

**Gammacell BioBeam GM 8000**, Germany.
(4.4 kCi, Cs-137)
Comparative advantage of mutation breeding

• Increase genetic variation and biodiversity
• Accelerate process of developing new varieties
• Effective genetic improvement of vegetatively propagated crops
• Technology accessible to less developed countries
• Allows the improvement of locally preferred varieties
• Genetic background of elite variety retained
• Non-GMO technology – trials and variety release not under GMO regulations
**On Going Mutation Breeding project under IAEA Technical Coorperation Program**

1. **RAS5073** - Supporting Climate-Proofing Rice Production Systems (CRiPS) Based on Nuclear Applications-Phase II (2016-2020)

2. **RAS5069** - Complementing Conventional Approaches with Nuclear Techniques towards Flood Risk Mitigation and Post-Flood Rehabilitation Efforts in Asia

3. **RAS5077** - Promoting the Application of Mutation Techniques and Related Biotechnologies for the Development of Green Crop Varieties

4. **RICE NBOS** - Seed Certification, Dissemination of NM Rice Package, Conduct Demonstration/Pre-comm/MSI Rice Plantation Projects

5. **CRP D2.30.30** - Evaluation and selection of rice mutants/varieties for utilization to increase yield and production, and for quality fodder

6. **FNCA** - Mutation Breeding of Rice for Sustainable Agriculture
Achievement of Rice Mutation Breeding & Socio-economic Impact
Successful Examples

**Indonesia** - high yielding mutant rice varieties
- 4.7% of the dedicated area cultivated (~450 000 ha)
- 800 000 farmers profited from these 3 mutant varieties
- Produced enough rice for 20 mil. people

**Vietnam** - salinity tolerant rice varieties
Rice mutant varieties
- Income: >1 billion USD since release of the mutant varieties
- 4.5 million farmers benefited
New mutant rice varieties

DT37

DT38

DT50

KD Mutant

http://agi.gov.vn
Impact on Agriculture and Socio Economic

• DT 10 rice mutant variety
  - productivity 6-8 ton/ha vs average 3.3 ton/ha. (≥ 40%)
  - in peak year the area reached 200000 ha
  - Accumulated area: 2,400,000 ha
  - Total harvest: 9,456 million ton
  - Increase: 1,536 million ton compare to control
  - Increase Income 536.6 million USD
  - 3 million farmers benefited from the variety
• Khang Dan rice mutant variety
  - Introduced to production in 2007
  - Very fast adoption rate
  - Accumulated area to 2014: 1,200,000 ha
  - In peak year 400,000 ha.
  - Become one of the most popular variety in the North and Middle of Viet Nam
  - Increased income for farmers: 268,8 million USD
  - 1,5 million farmers benefited from the variety
Thailand

• In 1965, KDML105 had been induced mutation by 20 Kilorad gamma irradiation of Cobalt 60 source. One promising glutinous mutant had been released in 1977 namely RD6.

• RD6 had very good grain physical properties similar to its original KDML105. It also gives very cooking quality with soft sticky without paste-like and aromatic cooked rice. More than 80 percent of glutinous rice cultivated
Bangladesh: New Salt Tolerant Rice Mutant Variety

Binadhan-8
(EC: 8.0 dS/m)

BRRI dhan28
(EC: 8.0 dS/m)
Development of high functional rice

○ Development of high amino acid rice cv. Goldami-1 through cell line selection with 5MT resistance and gamma-ray irradiation
  - Goldami-1 increased amino acid content 1.8 times than original cv. Dongan.
  - Useful for baby food, patient food, and porridge, etc

○ Development of mutant rice cvs. Tocomi-1, Tocomi-2, Tocohongmi with high tocopherol
  - Tocopherol content increased about 50% more than original cv.
Breeding Program  Indirect Mutant Q34

- Seraup x Y 442
  - RU 2179, F10
  - RU 2171, F1
  - RU 2578, BC1F2
  - RU 2741, BC2F3
  - RU 3490, BC3F1
  - RU 3708

- Mahsuri Mutant

Q22  Q33  Q35
NMR152: RICE MUTANT ADAPTABLE TO MINIMAL WATER CONDITION

KAJIAN BERSAMA

2006-2008
IRPA- Mutant Generation

2010-2011
ScFund (06-03-01-SF0110): Mutant Development

2015
PVP - DOA

2016
Extension to farmers (MSI)

2017-2020
Certified Seed
DEMONSTRATION OF RICE MUTANT AT FARMERS FIELD

FARMERS FIELD

FIELD DAY
DEVELOPMENT AND UP SCALING OF MOSTI RICE NMR152

Radiation Facilities → Screening & selection → Established Varieties

Project Coordinator

Project Monitoring & Technical Expertise

Technology Provider & Project Implementor

Seed Certification

Pest & Disease Screening; Quality & Sensory Test
Joint trials and semi-scale production
Testing of Plant Growth Promoter and Biofertilizer
### DEVELOPMENT AND UP SCALING OF MOSTI RICE NMR152 EXECUTION PLAN

**NO.** | **DETAILS** | **YEAR 1** | **YEAR 2** | **YEAR 3**
---|---|---|---|---
OS : Off Season MS : Main Season | | | |
1. Pest & Disease Screening | | | |
2. Sensory Test | X | | |
3. Advance Yield Trial (AYT) | X | X | |
4. Multi Location Trial (MLT) | X | X | X
5. Local Verification Trial (LVT) | | X | X
6. Upscaling | | X | X
7. Released | | | X
Future Targets for Mutation Breeding

- Continuous priority of high crop productivity
- Enhancing adaptability to climate changes
  - Tolerance to abiotic stress
  - Resistance/tolerance to disease/pest
- High quality and nutrition
- Improved value of economic crops and ornamental plants
**future Mission of Mutation Breeding**

- Supporting government policy to increase SSL of rice production from 70 to 100% (SDG 2—End Hunger, Achieve Food Security and Improved Nutrition and Promote Sustainable Agriculture,)

- Emphasize on mitigating impacts of climactic variability and natural disasters – Resilient crop to CC (SDG 13 – Climate Action)
IAEA recognises plant mutation breeding efforts

Excellent contribution: Dr Noorul Anum (second from right) receiving the award on behalf of Nuclear Malaysia from Malaysia. With them are (from left) Nuclear Malaysia director-general Datuk Dr Muhamad Labid Juri and Malaysian Ambassador to Austria and Malaysia’s Head of the Permanent Mission to the United Nations Office to Vienna Daksh Selwyn Das - Bernama

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