Contribution of Food Crops Mutant Varieties to the National Demand

Totti Tjiptosumirat
Head,
Center for Isotopes & Radiation Application
National Nuclear Energy Agency - BATAN, Indonesia

totti-t@batan.go.id
General Information

• Population continues to increase (± 1.3% per year; ± 257.9 mill. in 2017)
• Rice and soybean are the main staple food for Indonesia.
• National demand is bigger than supply.
• Rice production is facing problem with shrinking growing areas due to land utilization for the non-agriculture purposes such as industries, roads and properties.
• Tempe, on the other side, is also a protein source side-dish based on soybean.
• Nuclear technology has been proven to help Indonesia to increase food crops production including rice, soybean, sorghum etc.
• In collaboration with the Ministry of Agriculture, BATAN has conducted joint research on increasing food crops productivity and quality by using mutation breeding.
Background: Agriculture Threats

1. Climate change:
   1. Increasing temperatures ➔ increase pest and diseases
   2. More frequent extreme climate events ➔ flood and drought
   3. Sea level rise ➔ saline water intrusion and reduction of agricultural land in the coastal areas

2. Import:
   1. Low quality food crops.
   2. Inadaptive varieties (cannot be grown).
National Objectives

In response to increasing demand on food crop varieties and concern re negative effect of climate change for food security, BATAN:

1. Enhances the adaptability of crops to climate change using mutation breeding techniques
2. Strengthens capacity for mutation breeding
3. Develops improved rice varieties with special focus on drought tolerance and disease resistance
4. Disseminates rice mutant varieties to farmers in different provinces
5. Collaborates with local governments and the Ministry of Agriculture, to establish Agro Techno Parks (ATPs) in some provinces which are expected to become Center of Excellence for developing qualified seeds of mutant varieties
6. Reduces imports.
Joint FAO/IAEA Division supports Indonesia mutation breeding programme through:

- Promoting the establishment of Collaborative Centre for Plant Mutation Breeding for Climate Smart Agriculture (PMBCSA)
- Technology transfer and support to enhance R&D activities in collaboration with Plant Breeder Lab;
- Human capacity building through FE, SV, EM and training courses
- Provide policy advice and technical support in mutation breeding
- Upgraded facilities for plant breeding and genetics
Mutation breeding scheme

Determination breeding objective & Preparation breeding materials

Mutagenesis, Radio-sensitivity study & generating M1 Plant population

Generating segregation population of M2 & selection of Putative Mutants

Screening process of Mutants

Panoramic Irradiator 80 kCi  Gamma Chamber 4 kCi  Gamma Cell 220 9 kCi
Gamma Irradiator Facilities – BATAN:

Gamma Irradiators

GC-4000A

GC-220

Panoramic Batch

Irradiator Lateks
Nuclear techniques utilized result in mutant crops, particularly rice and soybean, adapt to climate change and increased production proven

- 22 rice mutant (+ 1 non mutant) and 10 soybean mutant varieties released;
- 4.7% of the dedicated area cultivated (average per year ~450,000 ha);
- 800,000 farmers profited from rice mutant varieties;
- Produced enough rice for 20 million people;
- Increased productivity of BATAN rice mutant varieties, 1 – 3.5 t/ha compared to other varieties, and 1 – 1.5 t/ha for soybean;
- Since 2012, officially released 6 rice and 5 soybean mutant varieties.
Distribution Map of BATAN Varieties Utilization (Partnership Scheme)
## Down-streaming food crops varieties: The impact

<table>
<thead>
<tr>
<th>Province</th>
<th>Regency</th>
<th>Productivity (t/Ha)</th>
<th>GKP Tingkat Petani* (per kg)</th>
<th>Income /Ha</th>
<th>Difference/ha</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Regency Regency</td>
<td>Non BATAN</td>
<td>BATAN</td>
<td>Differenc Non BATAN</td>
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<tr>
<td>Bali</td>
<td>Klungkung</td>
<td>6,00</td>
<td>7,02</td>
<td>8,36</td>
<td>1,34</td>
<td>4.400</td>
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<td>7,02</td>
<td>8,46</td>
<td>1,44</td>
<td>4.400</td>
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<td>Banten</td>
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<td>5,76</td>
<td>6,3</td>
<td>5,87</td>
<td>-0,43</td>
<td>3.775</td>
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<tr>
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<td>Serang</td>
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<td>7,05</td>
<td>0,75</td>
<td>4.250</td>
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<tr>
<td>Jawa Barat</td>
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<td>6</td>
<td>5,65</td>
<td>-0,35</td>
<td>4.400</td>
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<td></td>
<td>Sumedang</td>
<td>6,06</td>
<td>6</td>
<td>7,26</td>
<td>1,26</td>
<td>4.900</td>
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<tr>
<td>Jawa Tengah</td>
<td>Boyolali</td>
<td>5,89</td>
<td>6,2</td>
<td>5,71</td>
<td>-0,49</td>
<td>4.025</td>
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<td>Jepara</td>
<td>6,09</td>
<td>6,5</td>
<td>7,52</td>
<td>1,02</td>
<td>4.211</td>
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<td>Kebumen</td>
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<td>6,53</td>
<td>7,40</td>
<td>0,87</td>
<td>3.665</td>
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<td>Jawa Timur</td>
<td>Jember</td>
<td>6,12</td>
<td>7</td>
<td>7,26</td>
<td>0,26</td>
<td>5.067</td>
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<tr>
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<td>Malang</td>
<td>7,13</td>
<td>7</td>
<td>9,42</td>
<td>2,42</td>
<td>4.700</td>
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<tr>
<td>Sulawesi Selatan</td>
<td>Maros</td>
<td>7,218</td>
<td>7,218</td>
<td>8,65</td>
<td>1,43</td>
<td>3.300</td>
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<tr>
<td>Yogyakarta</td>
<td>Kulonprogo</td>
<td>6,82</td>
<td>6,2</td>
<td>7,25</td>
<td>1,05</td>
<td>3.650</td>
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<td><strong>Rata-Rata</strong></td>
<td>*</td>
<td><strong>7,37</strong></td>
<td><strong>0,81</strong></td>
<td><strong>3.476.253</strong></td>
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</tbody>
</table>

In average, in each hectare of rice fields farmers gained IDR 3,476,252 or 12% benefit raise.
• At national level, 22.8% increase in farmers income was measured during 2016
• in the last 10 years, almost 6M ha of rice fields utilizing the mutant varieties.
Controlling Agencies: Ministry of Agriculture

GERmplasm (Local & Introduction)

R & D (Mutation Breeding Approach)

Promising Lines
Introduction Seed

Variety Assessment & Release

Superior Variety (Breeder seed/BS)

Foundation Seed (BD)
Stock Seed (BP)
Extension Seed (BR)

Supervisor Circulation:
Seed Certification Unit

Search and Collection:
- Government
- Private
- Personal

Adaptation trials:
- Seed Certification Unit
- Breeder
- Private

Research Institutions and Breeding:
- Government
- Private
- Personal

Certification:
- Seed Certification Unit
- Private

BBN/TP2V

Plant Breeder:
- Government
- Private
- Personal

- Provincial Seed Hall
- Regency Seed Hall
- Seed Producer

- Seed Producer
- Seed Breeder
Controlling Agencies: Bapeten
Legislation and Regulation
Security of Radioactive Sources

- Act No. 10 Year 1997 on Nuclear Energy
  - GR No. 33 Year 2007 on Safety of Ionizing Radiation and Security of Radioactive Sources
  - GR No.29 Year 2008 on Licensing of Ionizing Radiation Sources and Nuclear Material
  - GR No. 58 Year 2015 on Radiation Safety and Security in Transport of Radioactive Material

- Government Regulation (GR)
  - BCR No. 6 Year 2015 on Security of Radioactive Sources (Amended BCR No. 7 Year 2007)

- BAPETEN Chairman Regulation (BCR)
## Bapeten: Inspection

<table>
<thead>
<tr>
<th>Group of Risk</th>
<th>Activities</th>
<th>Year/ Inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Industrial radiography, Irradiator, Radio-therapy &amp; Nuclear medicine</td>
<td>1</td>
</tr>
<tr>
<td>Medium</td>
<td>Well logging, gauging, CT scan, import/ export &amp; transportation</td>
<td>2</td>
</tr>
<tr>
<td>Low</td>
<td>Photo-fluorograph, radio diagnostic &amp; others</td>
<td>3 – 4</td>
</tr>
</tbody>
</table>

About 1,200 facilities per year
In Closing

Downstream programme for BATAN R & D products is expected to contribute to achieve national seed independency, food security and increasing the competitiveness of national commodities.

• The success of the downstream program can only be achieved with good collaboration between BATAN and partners / stakeholders;
• Gamma irradiator facilities are still a mainstay for mutation breeding process
Thank You

BADAN TENAGA NUKLIR NASIONAL
Jl. Kuningan Barat, Mampang Prapatan Jakarta, 12710
(021) 525 1109 | Fax. (021) 525 1110
humas@batan.go.id