Mainstreaming Zn in Rice

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Why Mainstreaming?

• Deliver the maximum impact
• Leverage existing breeding capacities, infrastructure and relationships
• Deliver packages of solutions in high quality varieties – nutrition with consumer expectations, yield, stress resistance, pest & disease resistance
• Leverage existing seed systems capacities and relationships
• Avoid expensive, inefficient and relatively low impact “niche” breeding programs
Potential Impact

• 2.7 billion rice farmers and consumers who depend on irrigated rice for their food supply will have access to rice with high levels of zinc in the grain.

• Number of DALYs (Disability Adjusted Life Years) saved annually in Asia from 500,000 to 1,000,000 depending on the level of adoption.

• Hundreds of millions of dollars savings in health costs.

• Higher productivity and economic growth due to healthy workforce.

Cost: US$5 m per year over for 10 years
$5-$10 cost per DALY saved
IRRI’s Rice Breeding

Variety Replacement Strategy

• Product development pipeline
• Integration of all traits needed for market acceptance
• Population improvement strategy to drive genetic gain in complex traits
• Strategy increases the frequency of favourable alleles for key traits
• High zinc becomes an additional complex trait in across the program rather than a specialty niche product
# High Zinc rice varieties released in Bangladesh

<table>
<thead>
<tr>
<th>Variety</th>
<th>Season</th>
<th>Yield (t/ha)</th>
<th>Maturity</th>
<th>Zn (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRRI dhan62</td>
<td>T. Aman</td>
<td>4.0-4.5</td>
<td>100</td>
<td>19.6</td>
</tr>
<tr>
<td>BRRI dhan64</td>
<td>Boro</td>
<td>6.0-7.0</td>
<td>145</td>
<td>24.6</td>
</tr>
<tr>
<td>BRRI dhan72</td>
<td>T Aman</td>
<td>6.0-6.5</td>
<td>128</td>
<td>22.2</td>
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</tbody>
</table>

**Proposed for release**

<table>
<thead>
<tr>
<th>Variety</th>
<th>Season</th>
<th>Yield (t/ha)</th>
<th>Maturity</th>
<th>Zn (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BR7671-37-2-2-3-7</td>
<td>Boro</td>
<td>6.1-6.2</td>
<td>145</td>
<td>23.9</td>
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<td>BRRI dhan28 (ck)</td>
<td>Boro</td>
<td>6.0-6.1</td>
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<td>16.8</td>
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</tbody>
</table>
First high Zn rice released in the Philippines among ASEAN

Rc460 has Zn levels 4.5 ppm higher than the baseline comparison variety
High Zn Rice Genetics

Zinc increase genes identified but are not in themselves sufficient to generate lines with target Zn levels through a simple backcrossing strategy (for example as was used for sub1).

In addition to existing genetic loci, we need to combine multiple “small effect” loci through enrichment of elite populations using high efficiency breeding methodologies.
Breeding Process

Sources of Genetic Diversity
Genebank & Wild Rice

Trait Discovery, Validation & Introgression

Stage Gate 2

Rapid Crossing
Advance

Early Generation Selection

Stage Gate 3

Multi Environment Trials

Stage Gate 4

NARES Partners

Stage Gate 5

Varietal Release

Yield
Abiotic Stress
Pests & Diseases
Market Acceptance
Nutrition

Genotyping & Phenotyping Services

Breeding Informatics & Biometric Services
Progress To The Target

- 2017 to 2028
- 28 ppm
- 14 ppm

- 500,000 to 1,000,000 DALYs saved in Asia alone
- Cost $5-10 USD/DALY

- Progressive Accumulation of Favorable Alleles
- Zn increase 1.5 ppm per year

Minimal Impact on Rate of Genetic Gain for Yield, Climate Resilience, Pests & Disease, Market Acceptance

Global Reach Through IRRI, AfricaRice and CIAT through the RICE CRP