# ■GA CCCV Sustainable Supply of Consumer-Satisfied Safe ACT and High Value-Added Food TCTATA Session 4 A TCTATAAGA

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## Consumer-Satisfied Safe and High Value-Added Food

Dr. Howarth Bouis "Breeding crops for better nutrition" Dr. Toru Fujiwara "Mineral Nutrient Transporters: Their Potentials for Croptanct Improvement " Dr. Vanavichit Apichart "Molecular Breeding for Doubly Green Revolution: The **Jasmine Rice Model**" Dr. Naoko K Nishizawa "Molecular Breeding for Enhancing Tolerance to Low iron Availability in Calcareous Soil" Dr. Khurram Bashir "Agricultural Problems of Pakistan"

# Breeding Crops for Better Nutrition



#### **A Massive Problem**



#### Iron Estimated 2 billion

500,000 children each year

r Iodine Estimated 1.5 billio



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# HarvestPlus Biofortification Strategy

Breed micronutrient dense staple crops with higher levels of vitamin A, iron, and zinc that will improve human nutritional status when eaten.

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# **Nutrients** in Plants of C

Increased Co<sub>2</sub> levels will generally lead to higher yields offsetting some of the negative impacts (higher temp, drought), but will result in <u>lower nutritional quality</u>.

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 Protein and micronutrient levels likely to drop (both metabolic processes and nutrient uptake at roots affected)
Source: Nature, Vol. 448, August 2007



#### **Consultative Group on Int'l Agricultural Research**

**Partners with HarvestPlus** 

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# Mineral Nutrient Transporters: Their Potentials for Crop CTAACT Improvement AATTAATA

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#### RRF\/IZ

#### **Plants Tolerant of High Boron Levels**

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**B** oron (B) is an essential nutrient for plants and animals, but in high concentrations it is toxic. Living organisms, including plants, must control the B distribution to maintain adequate levels of B in their cells. Reduced crop quality and yields in soils containing toxic levels of B are a worldwide problem in food production, es-

pecially in arid areas (1). By manipulating B transport, we have generated plants that are tolerant of high levels of B.

B accumulation occurs both naturally and through artificial means such as irrigation. About five million ha of soils containing greater than 15 mg kg<sup>-1</sup> B, above the threshold for normal plant growth, exist in southern Australia, corresponding to 30% of the region (www.dwlbc. sa.gov.au/land/topics/ rootzone/boron.html). Up to 17% of the barley yield loss in this area was estimated to be caused by B toxicity (2). B-tolerant We focused on *AtBOR4* (The *Arabidopsis* Information Resource code At1g15460 and GenBank code NM\_101415), one of the six *BOR1* paralogs present in the *A. thaliana* genome. B transport activities of BOR4 and BOR4–green fluorescent protein (GFP) fusion were confirmed in yeast (fig. S1). We generated



seven independent transgenic *A. thaliana* lines producing the BOR4-GFP fusion under the control of cauliflower mosaic virus 35S RNA promoter.

Immunoblot analysis of a generated transgenic line showed that BOR4 accumulated in the presence of a high B supply (Fig. 1A), suggesting that BOR4 is exempt from the posttranslational BOR1 degradation system.

The supply of 10 mM boric acid was substantially lethal to wild-type plants, but much more vigorous root and shoot growth with varying degrees was observed in all the homozygous Pro35S-BOR4-GFP transgenic lines grown on solid medium containing 10 mM boric acid (Fig. 1B and fig. S2). Accumulation of BOR4-GFP and tolerance of B were positively correlated (fig. S2). The B concentrations in the roots and shoots of these transgenic plant lines were lower than that in the wild type in the presence of 3 mM boric acid (Fig. 1C). Overall tracer B uptake was also reduced in the transgenic line 4 (fig. S3). These results suggest that the overproduction of BOR4-GFP improved growth under conditions of B toxicity through B efflux.

Furthermore, GFP fluorescence derived from BOR4-GFP was strongly detected in the plasma membranes of the distal sides of epidermal cells in the elongation zone of roots of the transgenic lines carrying *ProBOR4-BOR4-GFP* (Fig. 1D). The distal localization of BOR4 is likely important for the directional export of B from the roots to the soil to prevent the accumulation of B in the xylem and growing cells. This enhanced B efflux from the roots of crop plants is expected to result in improved crop productivity in the B-toxic soils found in a number of regions of the world. Reduction of wheat yield by B toxicity in South Australia=11% Average annual wheat production in Australia=25 M ton. Annual wheat import in Japan=4.5 M ton.



http://www.dwlbc.sa.gov.au/land/topics/rootzone/boron.html



## Roadmap to Improve Aromatic Rice

- Making it more durable and sustainable in extreme environment
- Enhancing strong and prolong aromatic grains
- Enriching more nutritious
- Making it higher grain yielding



Molecular breeding for enhancing tolerance to low iron availability in Calcarious Soils

Naoko K. Nishizawa The University of Tokyo, Japan

March 14, 2008, GIES 2008

# Plant production is critical for our life





Takahashi *et al*, *Nature Biotechnol* 2001 Ishimaru *et al*, *Proc Natl Acad Sci USA* 2007

### Agricultural Problems of Pakistan



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### Consumer-Satisfied Safe and High Value-Added Food

- High value-added food targets not only people in the advanced countries, but also in the developing countries
- Following R&D should be promoted; ATC A AAGA C CTAACT
  - □ Breeding micronutrient dense staple crops<sup>AGA</sup> CTCTAACT
    - Pro-vitamin A, Iron, Zinc, Boron
  - Nutrient stress-tolerant plants to improve its growth and fertility against global warming
  - Technology-integrated sciences for clinical crops c r projects
- Effective supports from industry and finance are needed NPO or NGO ex. Gates Foundation Framers-Industry Collaboration Framework

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## International Schemes 1/2

- Promotion of international human exchange and creating the fields international joint research projects integrating the fields of agriculture and engineering ATTAATC A AAGA CCTAACT
- Examination of production potential through the formation of international networks of producer region/consumer region coordinators. This examination will encompass matters such as consumer needs in each country/region (including local tastes) and available water supplies

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# International Schemes 2/2

Construction of optimum production systems for each country and region by an international agricultural consortium, and formulation of an agricultural vision and indicators

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Promotion of appropriate and effective distribution of internationally standardized technologies with intellectual property protections

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Construction of an international resource recycling system to promote reuse of resources related to agricultural production

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#### Annual Rainfall distribution of the world

