Mainstreaming biofortification in maize and wheat

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System Council Meeting

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Maize and wheat: what the world eats
PREFERRED STAPLE FOOD TO 2.5 billion people in 89 countries

WHEAT PROVIDES 18% OF OUR TOTAL AVAILABLE CALORIES

PREFERRED STAPLE FOOD TO 900 million people living on less than $2 a day

MAIZE PROVIDES 15-56% OF TOTAL CALORIE INTAKE in Sub-Saharan Africa, Latin America and Asia
Biofortification – progress so far

- **PROVITAMIN A MAIZE**
  - 100,000 households reached

- **QUALITY PROTEIN MAIZE (QPM)**
  - Grown on 1.2 million hectares

- **HIGH ZINC MAIZE**
  - Hybrids to be released in 2017

- **HIGH ZINC WHEAT**
  - 50,000 farmers reached

**Biofortification benefits**

- **PROVITAMIN A MAIZE**
  - Good vision and cell differentiation – 25% of daily vitamin A

- **QUALITY PROTEIN MAIZE (QPM)**
  - Provides full range of amino acids

- **HIGH ZINC MAIZE**
  - Boosting the immune system – provides up to 50% of daily zinc needs
MAIZE
Provitamin A-enriched Maize

1500 tons of seed of provitamin A enriched certified seed produced per year

Number of households growing pro-vitamin A maize in Africa in 2013: 100,000

Total number of pro-vitamin A varieties released: 4 in Malawi, 3 in Zambia and 1 in Zimbabwe
Impact: QPM

• QPM is estimated to be grown on about 1.2 million hectares worldwide

• 2010 meta analysis from 5 countries showed consumption of QPM instead of conventional maize leads to a 12% increase in the rate of growth in weight and a 9% increase in the rate of growth in height in infants and young children with mild to moderate undernutrition from populations in which maize is the major staple food.

• Use for animal feed - China
Impact: High Zn

- High Zn 3-6 hybrids and additional OPVs to be released in Guatemala, Colombia and Nicaragua in 2017

- Not all QPM are high in Zn, but CIMMYT has identified good sources of High Zn in QPM background
Constraints

1. **Cultural preferences** - orange vs. white maize, different consumption patterns and market situations – need to work in a targeted manner with both public and private sector partners.

2. **Compromise for other traits.**

3. **Risk of little genetic diversity** – one pathogen could wipe out all varieties.

4. **Best lines for nutritional traits are often agronomically inferior** – biofortification programs are playing catch up.

5. **Lag in grain yield compared to existing white hybrids** – more investment has gone into white maize.
Priorities for mainstreaming

• Still need explore best way to mainstream biofortification:
  - Needs are different in different regions
  - Mainstreaming can take different forms
  - Zinc, iron and proVA are nutritionally related

• “Bridging” breeding program applying all available to tools to introgress combinations of traits

• Would require an investment of at least 4-5 million USD per year in only SSA over a 10 year period.
WHEAT
From genetic resources to farmers’ fields in less than 10 years

- **Zincol 2016:** 1st high zinc wheat in Pakistan with +6 ppm Zn = 2000 tons of seed to be sown in 2016-17
- **Zn-Shakti’ PVS variety:** Extra-early with +14 ppm Zn (40% increase) adopted by >40000 farmers in NEPZ
- **Two sister Mayil lines (+6 ppm Zn):** identified in 2016 for release in NWPZ of India in 2017
High Zn Wheat Delivery progress & target in South Asia

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<th>Year</th>
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<td>2016</td>
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Zn in tall, semidwarf and ‘biofortified wheat varieties’
(mean 2013-14, 2014-15 & 2015-16 seasons in Zn-enriched fields at Ciudad Obregon, Mexico)

- Grain Zn concentration shows declining trend over year of breeding, however
- Zn yield/hectare shows increasing trend over year of breeding; i.e. newer varieties harvest more Zn from soil
- Biofortified varieties combine high grain Zn with high Zn yield/hectare

Velu et al. (Unpublished)
Constraints

• Early generations selections on individual plants level not possible, grains from small-plots can be useful if obtained from soil with more uniform Zn content/availability. - this limits the total number of plots that can be sown and harvested (as small plots and yield trial plots).

• Need appropriate testing program in target countries e.g. high zinc lines in Obregon might not be high in India)

• Continuous funding focused on improving grain micronutrients - funding for Wheat H+ has gone down
Priorities for mainstreaming

• Maintaining annual genetic gains of 1% to 1.5% in grain yield (& other traits) needs additional funding of 30% increase

• Major increase in costs for main-streaming are for:
  ▪ Increased land for growing plots (advanced lines and yield trials) in Zn homogenized soil.
  ▪ Increased scientific, technical capacity and machines (XRF).
  ▪ Upscaling phenotyping for disease resistance and other traits.
  ▪ Molecular markers development for combining multiple QTLs.
  ▪ Working on genomic selection approaches- prediction of crosses and selecting lines with multiple traits.
Thank you for your support!