A six-decade journey of maize

OP Yadav

1st Foundation Day
Indian Institute of Maize Research
13 November 2015
AICMIP establishment

Rockefeller foundation

Dr. Edwin J. Wellhausen from Mexico

Dr. Ulysses J. Grant from Columbia

Dr. R.W. Cummings Director, India

Recommendations (1954)

Implementation (1957)
Making a humble beginning

All Indian Coordinated Research Project on Maize

• To have **wide-scale** multi-location and multi-disciplinary testing and evaluation
• To **shorten** the time duration of releasing widely adapted cultivars
• To **share** experience and knowledge

1957 AICMIP
Extending the concept

All Indian Coordinated Research Project on Maize

- Other AICRPs - 60
- Network projects - 19

1957 AICMIP
Strengthening maize research

1957 AICMIP

1997 Directorate of Maize Research
Further consolidating maize research

1957
AICMIP

1997
Directorate of Maize Research

2014
Indian Institute of Maize Research
Strong leadership

1957-1968

1968-1986

1987-2005

2006-2010

2010-2012
Maize area and production

- 3X area
- 4X productivity
- 7X production
Maize improvement programme
How we have progressed so far?

<table>
<thead>
<tr>
<th>Phase</th>
<th>Duration</th>
<th>Target cultivar type</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>1951-56</td>
<td>Local and traditional cultivars</td>
</tr>
<tr>
<td>II</td>
<td>1957-69</td>
<td>Multi-parent hybrids (seed production issues)</td>
</tr>
<tr>
<td>III</td>
<td>1970-88</td>
<td>Composites and DCHs, DTCHs</td>
</tr>
<tr>
<td>IV</td>
<td>1991-2001</td>
<td>Hybrids</td>
</tr>
<tr>
<td>V</td>
<td>2002 onwards</td>
<td>Single-cross hybrids</td>
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</table>
Rate of improvement in maize productivity in different periods

Trend of improvement in maize productivity (kg/ha/year) in India during different periods from 1951 to 2014 (Yadav et al., 2015)
Rate of improvement in maize productivity in different periods

Trend of improvement in maize productivity (kg/ha/year) in India during different periods from 1951 to 2014 (Yadav et al., 2015)
Combination of high yield, disease resistance and preferred phenotypic traits
Maize hybrids released since 2000

**No. of hybrids**

- Public: 54
- Private: 55

**No. of hybrids**

- Extra-early + Early: 24
- Medium: 34
- Late: 51
Number of **maize** hybrids released and notified for cultivation for different states since 2000
Impact on yield enhancement

<table>
<thead>
<tr>
<th>Block year</th>
<th>Crop yield (kg/ha)</th>
<th>% Yield enhancement over 1986-90</th>
</tr>
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<tr>
<td></td>
<td>Rice</td>
<td>Wheat</td>
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<td>2066</td>
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<td>2388</td>
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<td>2603</td>
</tr>
<tr>
<td>2001-05</td>
<td>1957</td>
<td>2679</td>
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<td>2775</td>
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Five-year means for grain yield and percent improvement in yield over average yield of 1986-90 of principal food crops in India during 1985-2014 (Source: DAC, Government of India available at [http://www.agricoop.nic.in](http://www.agricoop.nic.in))
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Impact - Maize export

Average export (2010-11 to 2014-15): Rs. 5127 cr / 3.6 million tonnes
How could we do that?
How could we do that?

- **Proper priorities**
  - More emphasis on single cross hybrid breeding
- **Supportive policies**
  - Liberal seed policies
- **Wider choice** to farmers
- **Incentive for more** investment by farmers
- **Efficient seed delivery** mechanism
  - Highly efficient seed production system
  - Involvement of private sector
Changes happening in recent past
Rainfed ecologies: 66,000 plants/ha

Winter season: Higher plant population (80 to 90 thousands/ha)
Nutrient management in hybrid maize

- **Kharif season (irrigated):** FYM @ 10 t/ha + 150:75:75 kg/ha N:P₂O₅:K₂O
- **Kharif season (rainfed):** FYM @ 10 t/ha + 120:40:40 kg/ha N:P₂O₅:K₂O
- **Winter season:** 250:105:105 kg/ha N:P₂O₅:K₂O
- **Five-split application** enhanced N-use efficiency
Maize to enhance cropping intensity

137% cropping intensity

- New choice of hybrids in niche areas of cultivation
  - Spring and rabi maize
- Specialty maize
- Intercropping
  - Vegetables

- Higher income
- Regular income
- Better soil health
- Risk insurance
Conservation agriculture in maize

- Zero Till
- Conventional Till
- Permanent Bed

Yield (t/ha)

Pantnagar  Dholi  Delhi

Karnal farmers get climate-smart
They're back to growing maize due to drop in groundwater level

Image of maize field and farmers.
Maize to enhance water productivity

- Rice-rice was major cropping system
- Water shortage in peninsular India
- Maize replacing rice in rabi season
  - Less water
  - Very high yield (>10t/ha)

Per drop – more crop
Quality hybrid seed production

- >1,000,000 tonnes
- Parental line productivity
  - Up to 3.5 t/ha maize
- Potential market Rs. 3500 (Crores)
Adoption of hybrids and improved technology

- >65% under maize hybrids
- Plant population
- Disease and pest management
- Fertilizer application
- **100-120 q/ha grain yield**
Facilitating small and medium-sized enterprises

1. No strong R & D
2. Little germplasm and breeding material
3. Small player in marketing

<table>
<thead>
<tr>
<th>Public sector institute and hybrids</th>
<th>No. of MOUs for outsourcing seed production and marketing</th>
</tr>
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<tbody>
<tr>
<td>CCS HAU, Hisar: HQPM-1, HQPM -5, HQPM -7, HM-4, HM-5, HM-7, HM-8, HM-9, HM-10, HM-11 and HSC-1</td>
<td>11</td>
</tr>
<tr>
<td>ANGRAU, Hyderabad: DHM 117</td>
<td>3</td>
</tr>
<tr>
<td>VPKAS, Almora: Vivek QPM 9, and VL Baby Corn</td>
<td>4</td>
</tr>
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Number of hybrids tested under AICRP-M

National Live Demonstration of Maize Hybrids

- Total: 828 (Public) + 839 (Private)
Terrific ten years
Terrific ten years

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<tr>
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<th>2014</th>
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<tr>
<td>Area ('0000 ha)</td>
<td>734</td>
<td>907</td>
</tr>
<tr>
<td>Production ('0000 tonnes)</td>
<td>1498</td>
<td>2426</td>
</tr>
<tr>
<td>Yield (kg/ha)</td>
<td>2041</td>
<td>2676</td>
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23% 62% 31%
Terrific ten years

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<th>2004</th>
<th>2014</th>
<th>% change in 2014 over 2004</th>
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Area ('0000 ha) Production ('0000 tonnes) Yield (kg/ha)
Rabi area (‘000 ha) enhancement from 2004 to 2014

[Graph showing the increase in Rabi area across different states in India from 2004 to 2014. The graph includes states such as Andhra Pradesh, Karnataka, Bihar, Tamil Nadu, Maharashtra, Rajasthan, Jharkhand, and Odisha.]
Way forward
Increased demand

- Growing **poultry** sector (>15% per annum)
- Growing organised **dairy** and **piggery** sectors
- Rising **international demand** for various uses (ethanol, starch)
- Rapid **urbanization**, leading to increased demand for processed foods
- Govt. **policy** to enhance maize cultivation in NW plains of India to promote crop diversification

### 2012 vs 2020

- **Breeders**
  - 2012: 32 Million
  - 2020: 53 Million
- **Broilers**
  - 2012: 60 mil/wk
  - 2020: 100 mil/wk
- **Eggs**
  - 2012: 65 Billion
  - 2020: 93 Billion
Genetic and cultural improvement

1. Enhancing rate of genetic gains
   - Germplasm diversification
   - Developing hybrid oriented germplasm
   - Recycling of inbreds
   - Using new tools and techniques

2. Climate resilient hybrids
   - Drought
   - Water-logging
   - High temperature

3. More efficient breeding programmes
   - Doubled haploid
   - Marker-assisted selection

4. Disease resistance (BLSB, SDM, Polysora rust)

5. Nutritional traits
   - QPM + Vitamin A, Low phytic acid, high methionine, iron and zinc contents

6. Partnership for germplasm exchange

7. Enhancing resource use efficiency
   Up-scaling hybrid adoption
Biofortification - Nutritional security

<table>
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<tr>
<td>Pratap QPM Hybrid-1 (EHQ-16)</td>
</tr>
<tr>
<td>HQPM-4</td>
</tr>
<tr>
<td>HQPM-7</td>
</tr>
<tr>
<td>Vivek QPM 9 (FQH 4567)</td>
</tr>
<tr>
<td>HQPM-5</td>
</tr>
<tr>
<td>HQPM-1</td>
</tr>
<tr>
<td>Shaktiman-3</td>
</tr>
<tr>
<td>Shaktiman-4</td>
</tr>
<tr>
<td>Sakthiman-2</td>
</tr>
<tr>
<td>Shaktiman-1</td>
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<td>Shaktiman-5</td>
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- QPM + Pro-vit. A + high oil
- To be promoted in National Food Security Mission
Expanding horizons

• Beyond India
• Reaching the unreached (Africa)
• Appropriate policies
Scaling-up
Thanks