Maize Production and Maize Breeding in Myanmar
Maize Production in Myanmar

- Maize can be widely grown across different ecological zones in Myanmar: potential for horizontal & Vertical
  - Mainly grown in rainy season: in Shan, Kayar states and Magwe, Mandalay and Sagaing (Lower/South) Bago (Upper/north)
  - In post monsoon season; maize is grown across the country with supplementary irrigation (Ayeyarrawady Magwe, Mandalay and Sagaing Bago)

- High Market Demand in the world for various utilization (Bio-fuel, Animal Feeding, Value Added Products)
Maize Cultivation in Myanmar

![Graph showing maize cultivation in Myanmar from 2001-02 to 2014-15. The graph indicates a rising trend in maize cultivation over the years.](image-url)
Maize Production of Myanmar

Metric tons in thousand

Source: Agriculture in Brief
Factors Needed to Improve Maize Production System in Myanmar

- Private participation and seed sectors
- Application Productive and Efficient & Sustainable Production Technologies (i.e.; Integrated Nutrient Mgt)
- Post Harvest Technologies & Facilities (Harvesting, Drying, Threshing, Storage)
- Systematic Establishments of Various Stakeholders’ Association
- Sustainable Markets by cooperation of Private-Private, Public-Private
- Policy development, regulation and supports for Maize & Value Chain
Maize Breeding in Myanmar

Background

- Maize breeding was initiated with the establishment of Central Agriculture Research Institute in 1974-75.
- At the beginning, many open pollinated varieties were evaluated and selected, and successfully released (OPVs varieties).
- Hybrid maize was initiated by introducing exotic inbreds from CIMMYT, but not adapted in Myanmar.
- The first Hybrid maize varieties (Yezin Hybrid Maize-1 and 2) were released in 1991-1992 by developing own inbred lines and Hybrid breeding research.
Major Pipe-Line for the Development of Hybrid Maize

- Introduction Trial
  - International Maize and Wheat Improvement Center (CIMMYT)
  - International Corn Foundation (ICF)

- Development of Inbred Lines
  - Standard Method
  - Composite Line Selection Methods

- Evaluation of Inbred Lines
  - Banded Leaf and Sheath Blight Resistance
  - Northern Corn Leaf Blight Resistance
  - Drought Resistant Inbred Lines

- Testing of Combining Ability of Inbred Lines
  - Top-Cross Hybrid Yield Trial (CYT)
  - Experimental Hybrid Yield Trial (EYT)
  - Elite Experimental Hybrid Yield Trial (EEYT)
  - Demonstration – Cum Trial (DCT)

- Producing of Hybrid Seeds
  - Parental Line Seed Increase
  - Planting of Crossing Field
    - (2 male rows : 6 female rows) or
    - (1 male row : 3 female rows)
Major Pipe-line for the Development of Hybrid Maize

1. Introduction Breeding
2. Development of Homozygous Inbred Lines
3. Inbred Line Evaluation
4. Testing of Combining Ability of Inbred Lines
5. Producing of Hybrid Seeds
1. Introduction Breeding

- Genetically diversified high yielding OPVs and hybrids from local and exotic germplasms are used as source materials in the extraction of inbred lines.
- Plants with good agronomic characters are selected and self-pollinated to obtain segregation generation - 1 ($S_1$).
- This step is carried out in Maize and other cereal crops Section, Yezin, Tatkone, Aung Ban and Naungmon Research Farm.
- CIMMYT has been a main partner and source of germplasm since 1972.
Selection Criteria in Line Development

- **Female Parent**
  - Two ears per plant
  - Good Shelling Percentage
  - 2-3 days flowering than male parent
  - Easy to Detassal
  - Resistance to lodging

- **Male Parent**
  - More pollen producing
  - Long pollen producing time
  - Plenty number of branches of tassel
  - Higher plant height than female parent
  - Later than female parent in flowering time
2. Development of Homozygous Inbred Lines

- Development of S1 to S6, S7 generation by Standard Method (Ear to Row)

- Development of inbred lines by Composite Line Selection Methods
Inbred Line Development by Standard Method

- Developing Stations – Yezin, Tatkone, AungBan, Naung Mon
- Inbred Line Coding System: YZSI-, TKSI-, ABSI-, NMSI-
- Used for F1 Varietal development with targeted traits: Age, Disease Resistant, Drought Tolerant
- Alternative Selfing & Half-sib in Maintenance Breeding
Inbred Line Development by Composite Line Selection Method

- Developing Stations – Yezin, Tatkone, AungBan, Naung Mon
- Inbred Line Coding System: YZCI-, TKCI-, ABCI-, NMCI-
- Used for F1 Varietal development for Superior Yield and Evaluate, Biotic & Abiotic Tolerance before release
- Alternative Selfing & Half-sib in Maintenance Breeding
Maize Hybridization

Single Plant selection & Labeling

Bagging on Ears
Maize Hybridization
Pollination by Hands

Number of hybridization was done due to requirement of the program
3. Inbred Line Evaluation

- Evaluation for yield and adaptability
- Screening for Northern Corn Leaf Blight (NCLB)
- Screening for Banded Leaf and Sheath Blight of Corn (BlSB)
- Screening for drought tolerant Lines
- Genetic Diversity: Clustering by Phenotypic & Genotypic Characters

[Images of corn leaves and stalks showing signs of disease]
5. Evaluation of Promising Maize Hybrids

- Producing and testing of Experimental hybrids (EYT-Trails)
- Producing and testing of Promising hybrids (EEYT-Trails)
- Evaluation of Selected Promising F1 for Biotic and Abiotic Stress Tolerance
- (Demonstration-cum Trial) on Farmers’ Field and Varietal Selection with Farmers’ Participation
4. Testing of Combining Ability of Inbred Lines

- Producing and testing of Top-cross or Test-cross Hybrids for GCA
- Producing and testing of Diallel-cross Hybrids for SCA
- Producing and testing of Elite Experimental Hybrids
- Producing and testing of Promising hybrids (Demonstration-cum Trial) on Farmers’ Field
- High-yielding hybrids resistance to climate
Selection Criteria for Hybrid Maize

- Yield Superior: 20-30% than Commercial Checks
- Age (<100 for Early, > for Moderate HYV)
- Better in Yield and Yield Component Characters
- Other desirable plant characters
  - Profuse Brace Roots, Erect leaves with long Greeness, Strong Stalk diameter,
  - Seed Color, Narrow ASI,
  - Husk cover, Tolerance in Botic & Abiotic Stress
5. Producing of Hybrid Seeds

- Trial / (DUST) for TSC & NSC for New Hybrid Varieties Registration
- Parental Lines Seed Increase
- Planting of Crossing Field
  - (female rows: male row: 4:2, 4:1, 6:2 due to nature of parents)
  - Synchronized flowering, Detasseling of Female Plants
Application of Biotechnology In Maize Breeding

- Genetic Diversity and Identification with molecular marker
- Marker Identification for Specific traits
Department of Agricultural Research

VISION

Food Security and Nutrition with the impact of innovative advanced crop variety and production technology research.
Department of Agricultural Research

MISSION

To systematically conduct research and development on rice and other cereal crops, oilseed crops and food legumes, industrial crops and horticultural crops, soil and water utilization, agricultural engineering, cropping systems and agricultural economics, biotechnology, seed bank and germplasm conservation and plant protection.
Mission of Our Section

RESEARCH AND DEVELOPMENT OF MAIZE AND OTHERS CEREALS CROPS

Maize
Sorghum
Wheat
Millet
<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Qualification</th>
<th>No. of Staff</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ph.D</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>M.Sc</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>PGD.Ag</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>B.Ag</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>Dip.Ag</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>Other Staff</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>27</strong></td>
</tr>
</tbody>
</table>
## On going research

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Research Title</th>
<th>Research Team</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Development of sweet corn and waxy corn varieties with better eating quality</td>
<td>Daw Ye Ye Nwe, Daw Mi Mi Khaing, Daw Aye Sandar Win, Daw War War War Khaing Soe</td>
</tr>
<tr>
<td>2.</td>
<td>Development of locally adapted High-yielding hybrid maize varieties</td>
<td>Daw Khin Nyein Chan, Daw May Thet Naing, U Nay Aung, Daw Poe Nandar Myo Twin, Daw Moe Moe Soe</td>
</tr>
<tr>
<td>3.</td>
<td>Development of Early hybrid maize varieties</td>
<td>Daw Khin Marlar, Daw Aye Thidar, Daw Pyi Thu Zin</td>
</tr>
<tr>
<td>4.</td>
<td>Development of disease resistant varieties</td>
<td>Daw Phyu Thi Thi Nyein, Daw Shwe Sin Oo</td>
</tr>
<tr>
<td>5.</td>
<td>Development of drought resistant varieties</td>
<td>Daw Kyu Kyu Hlaing, U Nay Aung</td>
</tr>
</tbody>
</table>
### On going research

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Research Title</th>
<th>Research Team</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.</td>
<td>Hybrid Seed Production</td>
<td>U Si Thu Myint, U Myo Min Tun</td>
</tr>
<tr>
<td>8.</td>
<td>Development of sorghum and millet varieties with high yield of grain and fodder</td>
<td>Daw Lwin Lwin Myint, Daw Aye Thidar, Daw Shwe Sin Oo</td>
</tr>
<tr>
<td>9.</td>
<td>Development of wheat varieties with good quality</td>
<td>Daw Ye Ye Nwe, U Maung Maung Swe, Daw Mi Mi Khaing, Daw Chan Myae Thu</td>
</tr>
</tbody>
</table>
Crop Research Centers and Satellite Farms under DAR

<table>
<thead>
<tr>
<th>State/Division</th>
<th>Crop Research Center</th>
<th>Satellite Farm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kayah State</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Sagaing region</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Mandalay region</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Magway region</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Shan State (South)</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Shan State (North)</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Shan State (East)</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>3</td>
<td>8</td>
</tr>
</tbody>
</table>
International Collaboration

- International Maize and Wheat Improvement Center (CIMMYT)
- International Corn Foundation (ICF)
- International Crops Research Institute for Semi-Arid Tropic (ICRISAT).
Achievements

1. Open-pollinated Maize Varieties

<table>
<thead>
<tr>
<th>No</th>
<th>Variety</th>
<th>Year Released</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Akari</td>
<td>1979</td>
</tr>
<tr>
<td>2</td>
<td>Shwe War-13</td>
<td>2010</td>
</tr>
</tbody>
</table>

2. Hybrid Maize Varieties

<table>
<thead>
<tr>
<th>No</th>
<th>Variety</th>
<th>Year Released</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Yezin Hybrid No-6</td>
<td>2010</td>
</tr>
<tr>
<td>2</td>
<td>Yezin Hybrid No-10</td>
<td>2013</td>
</tr>
<tr>
<td>3</td>
<td>Yezin Hybrid No-11</td>
<td>2013</td>
</tr>
</tbody>
</table>

3. Fresh Corn Variety

<table>
<thead>
<tr>
<th>No.</th>
<th>Variety</th>
<th>Year Released</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Yezin Fresh Corn-1</td>
<td>2013</td>
</tr>
</tbody>
</table>
Salient Characteristics of Widely Grown Hybrid Maize Varieties
Yezin Hybrid –10

Variety Characteristics

Type of Hybrid: Single Cross Hybrid (YZI-C₂ x YZI-C₇)

Days to maturity: 100 - 110 days
Ear per plant: 1.5
Ear length: 18 cm
Kernel color: Reddish Orange
1000 kernel weight: 317 g

Shelling %: 84%
Yield: 7.4 - 7.7ton ha⁻¹
Location: Lowland region

Salient characters: Drought resistant, big ear, good husk cover, tip fill, good shelling %, moderately resistant to banded leaf and sheath blight of maize.
Yezin Hybrid –11

**Variety Characteristics**

- **Type of Hybrid**: Single Cross Hybrid (YZI-D₁₅ x YZI-C₇)
- **Days to maturity**: 105 - 115 days
- **Ear per plant**: 1.5
- **Ear length**: 18 cm
- **Kernel color**: Orange
- **1000 kernel weight**: 285 g
- **Shelling %**: 85 %
- **Yield**: 7.1 - 7.8 ton ha⁻¹
- **Location**: Highland region
- **Salient characters**: Semi-flint type with seed colour of orange. Grain filling to ear tip. Drought resistant variety with good shelling percentage.
## Yezin Fresh Corn – 1

### Variety Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>50% flowering</td>
<td>45 days</td>
</tr>
<tr>
<td>Ear length</td>
<td>18.9 cm</td>
</tr>
<tr>
<td>Row Length</td>
<td>16.3 cm</td>
</tr>
<tr>
<td>Ear diameter</td>
<td>4.3 cm</td>
</tr>
<tr>
<td>No. of rows per ear</td>
<td>12</td>
</tr>
<tr>
<td>Kernels per row</td>
<td>32</td>
</tr>
<tr>
<td>Seed colour</td>
<td>Milky</td>
</tr>
<tr>
<td>Fresh ear weight</td>
<td>250 g</td>
</tr>
<tr>
<td>Marketable ear</td>
<td>16500 (ear/ac)</td>
</tr>
<tr>
<td>Eating quality</td>
<td>Very Good</td>
</tr>
<tr>
<td>Location</td>
<td>All lowland maize growing regions</td>
</tr>
<tr>
<td>Salient characters</td>
<td>It can be harvested 20-25 days after flowering, good eating quality, sticky and sweet, open pollinated variety.</td>
</tr>
</tbody>
</table>
## Distribution of Hybrid Seed from 2011 to 2015

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Name of Varieties</th>
<th>Distribution (kilo)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Yezin Hybrid-6</td>
<td>3200</td>
</tr>
<tr>
<td>2</td>
<td>Yezin Hybrid-10</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>Yezin Hybrid-11</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>Yezin Hybrid</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td>3200</td>
</tr>
</tbody>
</table>
## Distribution of Open-pollinated Varieties from 2011 to 2015

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Shwe War – 13</td>
<td></td>
<td>75</td>
<td>100</td>
<td>150</td>
<td>100</td>
<td>75</td>
</tr>
<tr>
<td>2</td>
<td>Akari</td>
<td></td>
<td>15</td>
<td>20</td>
<td>15</td>
<td>50</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>90</td>
<td>120</td>
<td>165</td>
<td>150</td>
<td>100</td>
</tr>
</tbody>
</table>
# Distribution of Wheat Varieties from 2011 to 2015

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Name of Varieties</th>
<th>Distribution (kilo)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Zaloke White-1</td>
<td>82</td>
</tr>
<tr>
<td>2</td>
<td>Zaloke White-2</td>
<td>112</td>
</tr>
<tr>
<td>3</td>
<td>Zaloke White-4</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>204</td>
</tr>
</tbody>
</table>
Research Activities Related To New Plant Variety Protection for DUS Testing
## Characterization of DUS Testing In 2016

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of tested varieties</td>
<td>94 Inbred Lines</td>
</tr>
<tr>
<td>Date of sowing</td>
<td>19.6.2016</td>
</tr>
<tr>
<td>Date of harvesting</td>
<td>20.9.2016</td>
</tr>
<tr>
<td>Plot size</td>
<td>4 m x 1.67m</td>
</tr>
<tr>
<td>Spacing</td>
<td>0.8 m x 0.25m</td>
</tr>
<tr>
<td>Data collection</td>
<td>UPOV TG</td>
</tr>
</tbody>
</table>
First leaf: anthocyanin coloration of sheath

Absent

Weak

Medium

Strong

Very Strong
Ear: anthocyanin coloration of silks

- Line 55: Absent
- Line 25: Weak
- Line 47: Medium
- Line 29: Strong
- Line 43: Very Strong
Root: anthocyanin coloration of brace root

Absent

Weak

Medium

Strong

Very Strong
Ear Shape

1. Conical

2. Conico-cylindrical

3. Cylindrical
Characterization of DUS Testing In 2017

No. of tested varieties → 215

Date of sowing → 8-11-2017

Plot size → 4 m x 1.67m

Spacing → 0.8 m x 0.25m

Data collection → UPOV TG