Cassava Germplasm Core Collection and Conservation in Thailand

การอนุรักษ์เชื้อพันธุกรรมมันสำปะหลังของโลกในประเทศไทย

Dr. Prapit Wongtiem
Content

Importance of Cassava Conservation

Cassava Core Collection and RYFCRC

Research and Utilization
- Plant genetic resources
- Characterization
- Somatic embryogenesis
- Breeding programme
- Cassava propagation
- Plant protection
- Insect pests of cassava
- Natural enemies
Importance of Cassava Conservation

• Cassava is the fourth most important food calorie crop in the tropics.
• Cassava is growing in importance both for food security (especially Africa).
• Cassava in multiple commercial and industrial uses (mainly Latin America and Asia).
Cassava Core Collection

• The International Center for Tropical Agriculture (CIAT) is considered the most important worldwide for the number of conserved accessions, the genetic diversity and the geographic area represented.

• A total of 6,592 accessions from 28 countries, represented in 5,709 clones of M. esculenta and 883 genotypes of wild species are conserved using in vitro techniques for its conservation and safe distribution.
Cassava Core Collection

The zones of origin and high diversity

- Colombia: 38%
- Brazil: 24%
- South American: 21%
- Central America & the Caribbean: 7%
- Asia: 7%
- Others: 3%
• In 2001, CIAT and the Department of Agriculture of Thailand agreed to establish a duplicate of the CIAT cassava core collection, presently held in trust for FAO at CIAT headquarters in Colombia, for safe keeping an utilization in Thailand.

• Thus, from 2002, the Rayong Field Crops Research Center (RFCRC) has received test tubes with in vitro cassava plants core collection almost the total of 628 accessions.
Transfer Cassava Core Collection to RYFCRC

- RFCRC has received 628 accessions from CIAT
- Kept in-vitro for conservation
- In the field for specific traits under Thai conditions.
# 266 accessions at RYFCRC

<table>
<thead>
<tr>
<th>Source</th>
<th>No. of accessions</th>
<th>Scientific name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thai local varieties</td>
<td>10</td>
<td><em>Manihot esculenta</em> Crantz</td>
</tr>
<tr>
<td>Imported varieties:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Virgin Island</td>
<td>70</td>
<td><em>M. esculenta</em> Crantz</td>
</tr>
<tr>
<td>- Indonesia</td>
<td>17</td>
<td><em>M. esculenta</em> Crantz</td>
</tr>
<tr>
<td>- CIAT</td>
<td>5</td>
<td><em>M. esculenta</em> Crantz</td>
</tr>
<tr>
<td>- CIAT</td>
<td>48</td>
<td><em>M. esculenta</em> Crantz</td>
</tr>
<tr>
<td>wild species</td>
<td>1</td>
<td><em>M. Glaziovii</em></td>
</tr>
<tr>
<td>Selected breeding lines from RFCRC</td>
<td>185</td>
<td><em>M. esculenta</em> Crantz</td>
</tr>
</tbody>
</table>
RFCRC has received 628 accessions from CIAT

<table>
<thead>
<tr>
<th>Sequence</th>
<th>Varietal prefix</th>
<th>Origin</th>
<th>No. of Accessions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MArg</td>
<td>Argentina</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>MBol</td>
<td>Bolivia</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>MBra</td>
<td>Brazil</td>
<td>99</td>
</tr>
<tr>
<td>4</td>
<td>MChn</td>
<td>China</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>MCol</td>
<td>Colombia</td>
<td>160</td>
</tr>
<tr>
<td>6</td>
<td>MCr</td>
<td>Costa Rica</td>
<td>21</td>
</tr>
<tr>
<td>7</td>
<td>MCub</td>
<td>Cuba</td>
<td>18</td>
</tr>
<tr>
<td>8</td>
<td>MDom</td>
<td>Dominican Rep.</td>
<td>3</td>
</tr>
<tr>
<td>9</td>
<td>MEcu</td>
<td>Ecuador</td>
<td>30</td>
</tr>
<tr>
<td>10</td>
<td>MFji</td>
<td>Fiji</td>
<td>2</td>
</tr>
<tr>
<td>11</td>
<td>MGua</td>
<td>Guatemala</td>
<td>15</td>
</tr>
<tr>
<td>12</td>
<td>MInd</td>
<td>Indonesia</td>
<td>7</td>
</tr>
<tr>
<td>13</td>
<td>MMal</td>
<td>Malaysia</td>
<td>15</td>
</tr>
</tbody>
</table>
RFCRC has received 628 accessions from CIAT

<table>
<thead>
<tr>
<th>Sequence</th>
<th>Varietal prefix</th>
<th>Origin</th>
<th>No. of Accessions</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>MMex</td>
<td>Mexico</td>
<td>20</td>
</tr>
<tr>
<td>15</td>
<td>MPan</td>
<td>Panama</td>
<td>12</td>
</tr>
<tr>
<td>16</td>
<td>MPar</td>
<td>Paraguay</td>
<td>39</td>
</tr>
<tr>
<td>17</td>
<td>MPer</td>
<td>Peru</td>
<td>73</td>
</tr>
<tr>
<td>18</td>
<td>MPhi</td>
<td>Philippines</td>
<td>2</td>
</tr>
<tr>
<td>19</td>
<td>MPTr</td>
<td>Puerto Rico</td>
<td>6</td>
</tr>
<tr>
<td>20</td>
<td>MTai</td>
<td>Thailand</td>
<td>4</td>
</tr>
<tr>
<td>21</td>
<td>MVen</td>
<td>Venezuela</td>
<td>52</td>
</tr>
<tr>
<td>22</td>
<td>MUSA</td>
<td>U.S.A.</td>
<td>4</td>
</tr>
<tr>
<td>23</td>
<td>HMC</td>
<td>*ICA Variety</td>
<td>1</td>
</tr>
<tr>
<td>24</td>
<td>CG</td>
<td>CIAT Breeding line</td>
<td>12</td>
</tr>
<tr>
<td>25</td>
<td>CM</td>
<td>CIAT Breeding line</td>
<td>18</td>
</tr>
<tr>
<td>26</td>
<td>SG</td>
<td>CIAT Breeding line</td>
<td>2</td>
</tr>
</tbody>
</table>
Cassava Germplasm Conservation Methods

1. *In Vitro*

2. *Field genebank*
RYFCRC

Cassava Germplasm
The process of sterilization
The process of sterilization
• Small genebanks may be able to effectively and economically conserve all material.

• Larger genebanks should prioritize the conservation of local landraces.
Research and Utilization
Plant genetic resources

Laboratory

Field
Descriptors to be scored at three months after planting (2)

- Color of apical leaves
- Pubescence apical leaves
1. Color of apical leaves
Color of apical leaves
2. Pubescence apical leaves

Present

Absent
Descriptors to be scored at six months after planting (14)

- Leaf retention
- Shape of central leaflet
- Petiole color
- Leaf color
- Number of leaf lobe
- Length of leaf lobe
- Width of leaf lobe
- Ratio of lobe length to lobe width of central leaf lob
- Lib margins
- Petiole length
- Color of leaf vein
- Orientation of the petiole
- Flowering
- Pollen
3. Leaf retention

(   ) very poor retention
(   ) average leaf retention
(   ) outstanding leaf retention
4. Shape of central leaflet

- รูปแฉบ: (linear)
- รูปปีร: (elliptic)
- รูปใบหอก: (lanceolate)
- รูปใบหอกกลับ: (oblanceolate)
- ใบโค่ยสัน: (pandurate)
Shape of central leaflet
Shape of central leaflet
5. Petiole Color

1. Yellowish-green
2. Green
3. Reddish-green
4. Greenish-red
5. Red
6. Purple

Yellowish-green
Green
Reddish-green
Greenish-red
Red
Purple
Petiole Color
6. Leaf color
7. Number of leaf lobe
8. Length of leaf lobe
9. Width of leaf lobe
10. Ratio of lobe length to lobe width of central leaf lobe

width : length
11. Lobe margins

Smooth  Winding
12. Petiole length

- **Short** (≤15cm.)
- **Medium** (16-25cm.)
- **Long** (>25cm.)
13. Color of leaf vein

- **Pink**
- **Red**
- **White**
- **Reddish white**
14. Orientation of petiole

- Inclined upwards
- Horizontal
- Inclined downwards
- Irregular
15. Flowering

(   ) Absent
(   ) Present
16. Pollen

( ) Absent

( ) Present
Descriptors to be scored at nine months after planting (9)

- Prominence of foliar scars
- Color of stem cortex
- Color of stem epidermis
- Color of stem exterior
- Distance between leaf scars
- Growth habit of stem
- Color of and branches of adult plant
- Length of stipules
- Stipule margin
17. Prominence of foliar scars

little prominence  moderately prominent  prominent
Prominence of foliar scars

Little prominence  Moderately prominent  Prominent
18. Color of stem cortex

Orange  Light green  Dark green
19. Color of stem epidermis

- Cream
- Light brown
- Dark brown
- Orange
20. Color of stem exterior

Orange  Greeny-yellowish  Golden  Light brown  Silver  Gray  Dark brown
Color of stem exterior
21. Distance between leaf scar

- Short
- Medium
- Long
22. Growth habit of stem

- **Straight**
- **Zig-zag**
Growth habit of stem

Straight

Zig-zag
23. Color of end branches of adult plant

Green
Green-purple
Purple
24. Length of stipules

Long

Short
25. Stipule margin

Straight

Forked
Descriptors to be scored at harvest (25)

- Fruit
- Seed
- Plant height
- Height to first branching
- Levels of branching
- Branching habit
- Angle of branching
- Shape of plant
- Number of storage roots/plant
- Number of commercial roots/plant
- Extant of root peduncle
- Root constriction
- Root shape
- External color of strong root
- Color of root pulp
  (parenchyma)
- Color of root cortex
- Cortex: ease of peeling
- Texture of root epidermis
- Root Test
- Cortex thickness
- Dry mater content
- Starch content
- Harvest index
- Cyanogenic potential
- Postharvest deterioration
26. Fruit

(   ) Absent

(   ) Present
27. Seed

( ) Absent
( ) Present
28. Plant height
29. Height to first branching
Height to first branching

< 100 cm.

> 120 cm.
30. Level of branching

Three levels

one levels

no level
Level of branching

Present

Absent
31. Branching habit

- Erect
- Dichotomous
- Trichotomous
- Tetrachotomous
32. Angle of branching
33. Shape of plant

- Erect
- Semi-erect
- Spread
- Full-spread
Shape of plant

- Erect
- Semi-erect
- Spread
- Full-spread
34. Number of storage roots/plant
35. Number of commercial roots/plant
36. Extent of root peduncle

Absent

Present
37. Root constriction
38. Root shape

- Conical
- Conical-cylindrical
- Cylindrical
- Fusiform
39. External color of storage root

- White or cream
- Yellow
- Light brown
- Dark brown
40. Color of root pulp

White  Cream  Yellow  Pink
Color of root pulp
41. Color of root cortex

- **Pink**
- **Purple**
- **White or cream**
- **Yellow**
42. Ease of peeling

( ) Easy

( ) Difficult
43. Texture of root epidermis

Smooth

Rough
44. Root taste

(  ) Sweet
(  ) Intermediate
(  ) Bitter
45. Cortex thickness

( ) Thin
( ) Intermediate
( ) Thick
46. Starch content
47. Postharvest deterioration
Somatic embryogenesis
Mass Propagation in Cassava by Somatic Embryogenesis
Preparing from aseptic condition to greenhouse
Preparing young cassava in greenhouse
Cassava field crops from agar to soil
Breeding Programme

- Breeding Programme
- Fertilization
- F1 seeds
- F1 Seedling
Breeding Programme

Main Objectives

➢ Industry
  - High yield and High starch content
  - Early bulking
  - Ethanol

➢ Edible
  - High yield, low HCN
  - Good test, texture, nutritions

➢ Resistant to pest & Disease
Cassava propagation

- Healthy stem
- 8 – 12 months

Steak 20-25 cm.
Plant protection

Diseases

Cassava bacterial blight
(*Xanthomonas axonopodis pv. manihotis*)

Cassava anthracnose disease
(*Colletotrichum gloeosporioides f.sp. manihotis*)
Plant protection

Brown leaf spot
(*Cercospora henningsii*)

Root rots
(*Phytophthora drechsleri, Pythium spp., Sclerotium sp.*)
Insect pests of cassava in Thailand

- Red spider mite
- Whitefly
- Mealy bug

Red spider mite

Whitefly

Mealy bug
Natural enemies

Parasite

Anagyrus sp.

Predators
Natural enemies

Parasitoid for pink mealy bug controlling in Thailand

*Anagyrus lopezi*

*A. lopezi* has efficiency for controlling pink mealybug about 35-50 mealy bug per day
Thank you for your listening