Seed Production Strategies and Progeny Selection in Greater Yam Breeding

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Greater yam – a food crop of great potential

• Its yields are high
• Tuber storability is very long
• Tremendous variation in tuber shapes & chemotypes
• Value addition remains unexplored
• Breeding potential remains untapped

Basic information for breeding

• Dioecy imposes synchronous flowering of males and females for breeding
• Cultivars are polyploid races: 2n= 40, 60, 80
• 2n = 40 types are more frequent, fertile and mostly males

Bottleneck & Solution

 getField
• Fertile female cultivars rare
• Erratic in flowering
 getField
• Female clones developed from true seeds
• They are floriferous and more regular flowering
 getField
 It is an outcome of seed production & progeny selection
Seed production

- Hand pollination
  - Pencil method
- Natural pollination
  - Mediated by thrips
- Directed natural pollination
  - Using selected males and females
- Non-directed natural pollination
  - Open pollination of non-selected parents

Directed natural pollination

- Directed between particular male and female parents
- One male- one female combinations grown in plots
- 3 rows of 4 plants each
- Middle row male; outer rows female
- Vines trailed on common stake

Hand pollination
Directed natural pollination

• Requirements
  – Males and females flowering together
  – Large number of males and females
  – Fertility of parents
  – Thrips to mediate pollination

• Advantages
  – Less laborious
  – Large number of seeds produced
  – Large number of recombinants
Necessity of outbreeding

- Results of extensive pollination studies of related and unrelated parents showed:
- Inbreeding depression for seed germination
- But fruit set and seed set not affected
- Seeds non-germinable in majority of the crosses of related parents
  - Germinability: 0.5 – 10.4 %
- Seed germination in all crosses of unrelated parents
  - Germinability: 22.4 – 60.8 %

Seedling tubers

- Seedlings – low vigour & low yields
- Seedling tuber shapes highly variable: cylindrical, round to oval and irregular
Progeny selection – tuber shape

• At seedling harvest: selection by tuber shape
• Cylindrical tubers are rejected from seedlings
• Oval and irregular tubers are carried over to clonal-I generation wherein cylindrical tubers are again rejected
• It is repeated in clonal II generation

Progeny selection – tuber flesh traits

• Clonal I harvest - Graininess & browning of cut tuber examined
• Clonal II harvest – mean plant yields and cooking quality
• Clonal III onwards – quality testing and comparative yield assessment in trials

In the sexual progeny…..

• Cylindrical tuber shape remains stable from seedling generation
• Oval and irregular tubers of seedlings change shape in initial clonal generations
Tuber shape of 115 seedlings and their derived clones in Family 2

Female Parent

Seedlings

Clonal I

Clonal II

Clonal III

* Figures in brackets indicate number of seedlings / clones

In the study of two families

• About 75 % of oval tubered seedlings changed tuber shape
• About 47 % of irregular tubered seedlings changed tuber shape
• End result in stabilized clonal generation:
  – Oval tubers reduced by 1/3 to ¼
  – Cylindrical and irregular tubers increased by 2 -3 times
• After clonal II harvest, number of clones reduced to about 25 % by rejection of cylindrical tubers

In the sexual progeny…

• Tuber yield of seedlings have no strong correlation with clonal tuber yields
• Tuber yield & tuber shape stabilize in clonal II generation
  And hence…
• Management of sexual progeny up to clonal II generation is laborious
• And we need to speed up breeding by using markers for early selection of seedlings – great savings of time, effort, land, money etc.

Conclusions

• Seed production is possible in greater yam by natural pollination which can be directed between specific clones
• There is inbreeding depression for seed germination
• Oval and irregular tubers in many cases, recorded change of shape through seedling to clonal generations, with the result that:
  – Oval tubers reduced
  – Cylindrical & irregular tubers increased by clonal II
• Methods for early selection of seedlings are to be developed
• Tremendous scope exists for breeding and improvement of greater yam
Yams in yesterday’s presentations..

- Africa – need for increasing yield
- Japan – production is slightly increasing
- Caribbean - limited research
  – Domestication of *D. cordata*
- Sub-Saharan Africa – lack of locally adapted varieties due to lack of breeding

### Per cent increase of production of tuber crops during the last 10 years

<table>
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<tr>
<th></th>
<th>Cassava</th>
<th>Sweet potato</th>
<th>Yams</th>
<th>Taro</th>
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</thead>
<tbody>
<tr>
<td>Area</td>
<td>8.5</td>
<td>-2.8</td>
<td>35.9</td>
<td>49.5</td>
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<tr>
<td>Production</td>
<td>20.6</td>
<td>-6.5</td>
<td>24.1</td>
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<tr>
<td>Yield</td>
<td>11.2</td>
<td>-3.9</td>
<td>-3.9</td>
<td>3.0</td>
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</tbody>
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Source: FAO

Perspectives for future

- Early selection of seedlings – markers
- Utilizing the genetic wealth in Pacific, Caribbean and SE Asia
- New morphotypes to avoid staking
- Polyploidy breeding
- Interspecific hybridization
- Greater collaboration & international networking

Thank You