International Nurseries:

Data generation, curation, sharing and utilization

BigData meeting

Rabat 9-14 December 2018

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1. Background
   • Mandate, vision and mission

2. Operations of International Nurseries
   - Germplasm development and IN assembling
   - Seed multiplication, processing
   - Seed quarantine monitoring and clearance
   - Seed packaging
   - IN seed distribution to cooperators
   - Data recovery, analysis and sharing

1. Challenges and Way Forward
1. Background

- **ICARDA’s mandate**
  - Develop climate and farming system change resilient improved germplasm with high yield and quality and resistant or tolerant to (a)biotic stresses
    - Cereals: bread & durum wheat, food & malt barley
    - Legumes: Faba bean, chickpea, lentil & grass pea

- **International Nurseries (IN)**
  - **Vision**
    - Make germplasm under development for ICARDA mandate crops available to global community of collaborators
  - **Mission**
    - Ensure safe movement and transfer of germplasm among countries free of quarantine pests
Programs/sections

Genetic Resources Section
- Crossing
- Evaluation
- Testing
- Assembling elite lines

Crop Improvement Units

Seed Section & IN
- Multiplication
- Processing
- Storage
- Packaging
- Distribution
- Data recovery, analysis & sharing

NARS
- Testing
- Data collection
- Direct release
- Crossing

Conservation Pre-breeding
- Crossing
- Evaluation
- Testing
- Assembling elite lines

Seed Health Lab
- Field inspection
- Seed health testing
- Quarantine clearance

NVRC/PVP
- Release
- Registration
- Protection
International Nurseries...

Key IN operations:

- Developing elite germplasm to assemble IN trialing system (breeders)

- Seed production of elite germplasm for IN trialing system (Seed Section)

- Processing, preparation, packaging and storage of IN (Seed Section)

- Announcement, allocation and distribution of IN requests (Seed Section with breeders)

- Data recovery, analysis and sharing with community of breeders (Seed Section)

- Ensuring seed health and issuing phytosanitary certificates for IN recipient countries (Seed Health Laboratory)
International Nurseries...

Location

Within ICARDA’s decentralization strategy, IN is handled from its headquarters in Lebanon.

IN operation is based at AREC with the following facilities:

- **Fields for seed multiplication**: 20 ha (including rotation)
- **Farm machinery**: Primary and secondary tillage (AREC) and plot planters and harvesters (ICARDA)
- **Seed cleaning and treatment machines**: Mini-scale seed cleaning and treatment equipment
- **Post-harvest facilities**: Seed preparation and storage facilities (renovated)
- **Mini-seed laboratory**: seed quality testing for IN
- **IT and Biometrics support**

Seed Health Laboratory based in Terbol for quarantine clearance.
Identification of lines and provision of seed

Seed and International Nurseries Section

Seed multiplication

Seed cleaning, treatment, weighing, and packaging storage

Seed Sanitation and storage

Wrapping, labeling, field book preparation and dispatch

Data collection, processing, sharing and reporting

Quarantine services (seed health lab)

Plant breeders

IT & Biometrics

Consolidated processes and major contributors into International Nurseries
International Nurseries processes visualized...

Operation of International Nurseries

Seed production —> Temporary seed storage & fumigation —> Quarantine clearance —> Bypass option —> Seed cleaning —> Seed washing —> Seed treatment —> Automated counting, packaging & labeling —> Seed storage —> Seed distribution

NARS

Geoinformatics based database
International Nurseries.

Seed production

- Seed Section operates close to 20 ha of land from AREC (AUB) in Beka’a Valley, Lebanon

- AREC provide land and farm machinery for field operations and infrastructure for irrigation

- Seed Health Laboratory provides field inspection
### Summary of seed production in 2017-18 season

<table>
<thead>
<tr>
<th>Crop</th>
<th>Nursery</th>
<th># entry</th>
<th>Plot/m² (ha)</th>
<th>Tons</th>
<th>(T/Ha)</th>
<th>Range</th>
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<tbody>
<tr>
<td>Cereals</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Barley</td>
<td>Elite lines</td>
<td>130</td>
<td>24</td>
<td>0.3</td>
<td>2.5</td>
<td>8.1</td>
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<td>Observation</td>
<td></td>
<td>211</td>
<td>11.2</td>
<td>0.2</td>
<td>2</td>
<td>8.6</td>
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<tr>
<td>Bread wheat</td>
<td>Elite lines</td>
<td>389</td>
<td>20.5</td>
<td>0.8</td>
<td>5.8</td>
<td>7.3</td>
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<tr>
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<td></td>
<td>619</td>
<td>3.4</td>
<td>0.2</td>
<td>1.7</td>
<td>8</td>
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<tr>
<td>Durum wheat</td>
<td>Elite lines</td>
<td>145</td>
<td>43</td>
<td>0.6</td>
<td>3.7</td>
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<td>510</td>
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<td>2.3</td>
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<tr>
<td>Subtotal cereals</td>
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<td>2004</td>
<td>109.12</td>
<td>2.4</td>
<td>18</td>
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<td>Legumes</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Chickpea</td>
<td>Elite lines</td>
<td>400</td>
<td>18</td>
<td>0.7</td>
<td>2.5</td>
<td>3.5</td>
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<tr>
<td>Lentil</td>
<td>Elite lines</td>
<td>212</td>
<td>21.6</td>
<td>0.5</td>
<td>0.6</td>
<td>1.2</td>
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<tr>
<td>Observation</td>
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<td>90</td>
<td>18</td>
<td>0.2</td>
<td>0.2</td>
<td>1.2</td>
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<tr>
<td>Faba bean</td>
<td>Elite lines</td>
<td>271</td>
<td>18.2</td>
<td>0.5</td>
<td>1.3</td>
<td>2.5</td>
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<tr>
<td>Grass Pea</td>
<td>Elite lines</td>
<td>100</td>
<td>21.6</td>
<td>0.2</td>
<td>0.5</td>
<td>2.2</td>
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<tr>
<td>Subtotal legumes</td>
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<td>1073</td>
<td>97.4</td>
<td>2.1</td>
<td>5.1</td>
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<tr>
<td>Total</td>
<td></td>
<td>3077</td>
<td>206.5</td>
<td>4.6</td>
<td>23.1</td>
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## Variety maintenance and early generation seed production from ICARDA originated varieties released by NARS

<table>
<thead>
<tr>
<th>Crop</th>
<th>Class</th>
<th># entries</th>
<th>areas (ha)</th>
<th>Production (kg)</th>
<th>Ton/Ha</th>
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<tbody>
<tr>
<td>Barley</td>
<td>Pre-bas</td>
<td>5</td>
<td>0.05</td>
<td>360</td>
<td>8.0</td>
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<tr>
<td></td>
<td>Breeder</td>
<td>6</td>
<td>0.01</td>
<td>25</td>
<td>3</td>
</tr>
<tr>
<td>Bread</td>
<td>Pre-bas</td>
<td>3</td>
<td>0.05</td>
<td>390</td>
<td>6.3</td>
</tr>
<tr>
<td>Durum</td>
<td>Pre-bas</td>
<td>9</td>
<td>0.07</td>
<td>440</td>
<td>5.8</td>
</tr>
<tr>
<td></td>
<td>Breeder</td>
<td>7</td>
<td>0.01</td>
<td>25</td>
<td>3</td>
</tr>
<tr>
<td>Chickpea</td>
<td>Basic</td>
<td>9</td>
<td>0.3</td>
<td>710</td>
<td>2.3</td>
</tr>
<tr>
<td>Lentil</td>
<td>Basic</td>
<td>6</td>
<td>0.2</td>
<td>210</td>
<td>1.0</td>
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<tr>
<td>Faba bean</td>
<td>Basic</td>
<td>15</td>
<td>0.2</td>
<td>380</td>
<td>2.0</td>
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<td></td>
<td></td>
<td>60</td>
<td>0.89</td>
<td>2540</td>
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</table>
# Seed distribution

Number of sets and lines for international nurseries in 2017/18

<table>
<thead>
<tr>
<th>Crop</th>
<th>Nurseries</th>
<th>Genotypes</th>
<th>Sets</th>
<th>Countries</th>
<th>Cooperators</th>
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<tbody>
<tr>
<td>Chickpea</td>
<td>11</td>
<td>393</td>
<td>363</td>
<td>25</td>
<td>47</td>
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<tr>
<td>Lentil</td>
<td>12</td>
<td>487</td>
<td>318</td>
<td>22</td>
<td>38</td>
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<tr>
<td>Faba Bean</td>
<td>11</td>
<td>298</td>
<td>153</td>
<td>19</td>
<td>27</td>
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<tr>
<td>Grass Pea</td>
<td>4</td>
<td>107</td>
<td>51</td>
<td>14</td>
<td>19</td>
</tr>
<tr>
<td>S. Barley</td>
<td>4</td>
<td>316</td>
<td>200</td>
<td>25</td>
<td>39</td>
</tr>
<tr>
<td>W. Barley</td>
<td>2</td>
<td>71</td>
<td>52</td>
<td>11</td>
<td>20</td>
</tr>
<tr>
<td>Durum Wheat</td>
<td>3</td>
<td>882</td>
<td>159</td>
<td>34</td>
<td>65</td>
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<tr>
<td>S. Bread</td>
<td>5</td>
<td>550</td>
<td>215</td>
<td>24</td>
<td>49</td>
</tr>
<tr>
<td>Wheat</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Winter Wheat</td>
<td>1</td>
<td>335</td>
<td>10</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Grand Total</td>
<td>53</td>
<td>3439</td>
<td>1521</td>
<td>44</td>
<td>135</td>
</tr>
</tbody>
</table>
Seed packaging for dispatch to 50 countries
Rates of data recovery

Percentage of data recovered from different crops for the period of 2012-13 to 2017-18

In progress
Uses of germplasm

- Both developing (47) and developed (11) countries
- Both public (106) and private (19) collaborators
Achievements in Variety Release

Number of varieties released from germplasm of ICARDA origin: 1977-2017 - All crops

Uses of germplasm

• Direct releases or as parents for crossing
• Both developing and developed countries
• Both public and private breeding programs
International Nurseries ...

Reporting and data management (recovery, processing and sharing)

- Database developed for receiving and uploading the performance of nurseries across countries
- Data is shared with breeders and the community of breeders (INDMS) to inform future work
- IN distribution are reported to ITGPRFA as per the requirements
- Variety release database with key traits, pedigree and selection history maintained
Improvements in IN handling

Production arrangements
• Staggering IN production to overcome delay

Introduction of automatic packaging
• Reduced cost and labor by 90%
• Helped overcome delay in IN distribution

Introducing IN and data management systems
• Developed online ordering reduced work load & error
• Improved IN shipping management
Current challenges

• Low data recovery rate at 13% of the total sets distributed

• A professional database and biometrics support particularly on data base maintenance and automation of the tedious International Nurseries preparation, data compilation and sharing processes is urgently required (BMS?)

• Winter barley, Facultative winter wheat and Global Durum Program, durum and bread are to be harvested, processed, tested, prepared and dispatched within one and half month

• Increased water scarcity with expanding GRS and breeding activities at AREC

• Demoralized technical staff due to poor compensation package. U$D 500 is far below the salaries of technicians at LARI
The Way forward

- **Automatic data collection and entry**

- **Annual IN data analysis workshops to boost data recovery**

- **Georeferencing for better targeting to reduce test sites and costs and increase efficiency**

Thank You