Updates of Wheat Improvement Activities in Ethiopia

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CIMMYT
Contents

- Wheat team and activity components
- Wheat in Ethiopia
- 2016 weather condition and disease situation
- Wheat improvement goals
- Wheat breeding objectives/priorities
- Wheat Projects
- Germplasm performance and varieties released
- Highlights of activities by objectives
- Other supports to NARs
- Irrigated wheat in Ethiopia
- Stake holders and partners
Working Team

- HQ GWP staff
- CIMMYT Regional office staff
  - Bekele Abeyo
  - Ayele Badebo
  - Dave Hodson
  - Terefe Fitta
  - Firaol Teressa
Major components of our activities

1. Enhancement of rust surveillance, early warning and phenotyping
2. Fast-track variety testing and pre-release seed multiplication
3. Accelerating seed multiplication
4. Demonstration and scaling up of improved wheat varieties
5. Improving market linkages between small scale durum wheat producers and agro industries
Wheat in Ethiopia

Facts:

- largest producer in SSA
- 4th in area and 3rd in production among cereals

<table>
<thead>
<tr>
<th>Area (Mha)</th>
<th>Production (MMT)</th>
<th>Yield (t/ha)</th>
<th>Demand (MMT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.7</td>
<td>4.2</td>
<td>2.54</td>
<td>1.1</td>
</tr>
</tbody>
</table>

- huge irrigated potential (≈ 3.8 m ha)

CSA, 2015/16
Overall Improvement Goal

- Develop and release high yielding, disease resistant, climate resilient wheat germplasm with nutritious end use and processing quality with NARs
- Better varieties reach farmers faster
Breeding objectives/priorities

- **Core traits**
  - High and stable yield potential
  - Durable resistance to pests
  - Drought tolerance
  - Heat tolerance
  - End-use quality

- **Key diseases**
  - SR, YR and LR
  - Septoria spp.
  - FHB

- **Types of crosses**
  - Simple
  - Single-backcross
  - Top (3-way)

- **Source of germplasm**
  - Indigenous
    - Local collections, Crosses/selections
  - Introductions:
    - Mainly CIMMYT & ICARDA
Wheat Projects (Drought, and Rusts)

1. Maize and wheat emergency seed support for drought affected areas of Ethiopia
   - Duration: 2016 – 2017
   - Objective: To support drought affected smallholder farmers improve food, livelihood and nutritional security of smallholder farm families

2. Seed multiplication and delivery of high yielding rust resistant bread and durum wheat varieties to Ethiopian farmers

3. Mitigating threat from stem rust and stripe rust pathogens through breeding and disseminating durably resistant wheat varieties
   - Objective: To enhance productivity, food security and income for smallholder farmer households in Ethiopia

4. Delivering Genetic Gain in Wheat
   - Duration: 2015 – 2019
   - Objective: Release new varieties replace old cultivars and realize yield gain on farmers' fields
Challenges / Constraints

- Climate Change: Drought
- Emerging new races
  - Yellow rust, and
  - Stem rust
- State of Emergency / Political Unrest which hindered
  - M & E activities
  - Organizing field days and workshops
  - Documentation of progresses
  - Hosting visitors
Maize and wheat emergency seed support for drought affected areas of Ethiopia

Improving food security by supporting drought affected smallholder maize and wheat farmers in Ethiopia through training, awareness creation, and provision of drought tolerant maize and wheat varieties.

The strongest El Niño on record has caused the worst drought in a decade. Harvests across Ethiopia were affected, leaving 10.2 million people – more than 1 in 10 Ethiopians – in need of emergency food assistance.

Using a grant of $3.97 million from USDA-OFDA, CIMMYT is coordinating an emergency response to provide 2,769 tons of seed to 214,840 drought-affected farmers.

Using an additional grant of $1.5 million from the Bill & Melinda Gates Foundation, Ethiopia’s Agricultural Transformation Agency are responsible for transporting the seed to collection points in each woreda.

Development Agents in 74 of the worst-affected woredas identified farmers in need of wheat and maize seed.

CIMMYT staff, partners, and Development Agents supply agronomy advice to provide farmers with a full seed package.

More than 1.13 million people will benefit from increased food security.

Working together today to ensure food security tomorrow.
2016 Cropping Season

- **Weather:**
  - Drought
  - Continuous belg-meher rain

- **Disease:**
  - Early YR detection (Asasa), widespread and aggressive – led to early warning, reasonable control achieved, **samples collected and timely analysed**, new race identified within season
  - **SR:** Low pressure but high susceptibility of DW
  - Early warning efforts (spore dispersal forecasts, surveys (phone and field), regular communications (EIAR, MoANR, ATA…..)) positive response

- **Host:** Resistant varieties become susceptible
Yellow rust situation on experimental fields at Meraro, Bekoji and Kulumsa on the 15th of September 2016
Yellow rust situation on research and farmers’ fields at Asassa, 15th of September 2016
Causes:

- Genetic factor
- Agronomic practices: planting date (early vs late)
- Biotic: early leaf infection by septoria
- Abiotic: humidity, senescence, frost, etc. – altitude- UV light
- Phenology of the crop – maturity (early/late)
- Morphology – spike shape (compact, lax), hairiness, wax, awn, etc.
- Peduncle length, leaf structure, height
**Germplasm Performances**

**Key Location Disease Nursery**

Frequency of BW lines in KLDN to YR leaf and spike infection at Bekoji and Meraro, 2016 (n=202)

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
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<tbody>
<tr>
<td>LR+SR</td>
<td>53</td>
</tr>
<tr>
<td>LR+SS</td>
<td>73</td>
</tr>
<tr>
<td>LS+SR</td>
<td>0</td>
</tr>
<tr>
<td>LS+SS</td>
<td>76</td>
</tr>
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Reaction of Durum wheat entries to stem rust,

4th week of November (25-28), 2016

Rxn to stem rust of entries in IDSN (n=157) at Holetta in 2016

<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
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<tbody>
<tr>
<td>R</td>
<td>16</td>
</tr>
<tr>
<td>RMR</td>
<td>19</td>
</tr>
<tr>
<td>MRMS</td>
<td>23</td>
</tr>
<tr>
<td>MS</td>
<td>14</td>
</tr>
<tr>
<td>MSS</td>
<td>18</td>
</tr>
<tr>
<td>&gt;40</td>
<td>67</td>
</tr>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

(5) R
(5-10] RMR
(10-20] MRMS
(20-30] MS
(30-40] MSS
>40 S
### Septoria situation at Holetta, 2016

**Frequency of Septoria resistant BW lines in CIMMYT nurseries**

<table>
<thead>
<tr>
<th>Varietal Group</th>
<th>Frequency (%)</th>
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<tbody>
<tr>
<td>FHBWSN</td>
<td>2.0</td>
</tr>
<tr>
<td>ISEPTON</td>
<td>0.3</td>
</tr>
<tr>
<td>IBWSN</td>
<td>0.0</td>
</tr>
<tr>
<td>HRWSN</td>
<td>0.1</td>
</tr>
<tr>
<td>ESWYT</td>
<td>0.0</td>
</tr>
<tr>
<td>HRWYT</td>
<td>0.1</td>
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</table>

- **< Murga, 0.05**
- **< LCK, 0.29**

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Frequency of Septoria resistant BW lines in CIMMYT nurseries at Holetta, 2016.
2016/17 KLDSN Njoro SR Data

**BW Advanced Observation Nurseries**

- 0 to 5%: 19
- 5 to 10%: 38
- 10 to 15%: 28
- 15 to 30%: 112
- 30 to 50%: 130
- 50 to 100%: 160

**BW Advanced Yield Trials**

- 0 to 5%: 30
- 5 to 10%: 34
- 10 to 15%: 5
- 15 to 30%: 72
- 30 to 50%: 46
- 50 to 100%: 33

% of disease severity
Objective 1. Enhancement of Early Warning System and Phenotyping Activities

- Early warning
  - Phenotype
    - Seedling test
    - Race nurseries
    - Field test - Njoro
  - Genotype
    - DNA assays
    - G- postulation
- Monitor
- Race analysis
- Capacity building
- Objective 1
- Main season
- Training Supplies
- Phone surveys
- Wind model
- Early season survey

PPRC - stem rust
CDL - stem rust
GRRC - yellow rust
Objective 2. Fast Track Variety Testing and Pre-Release Seed Multiplication

- Introductions
- Locs
  - Variety trials
- Prerelease seed multiplication
  - Off-season & Main season
    - Bread wheat
      - 2-3 t
    - Durum wheat
      - 2-3 t
  - Variety release
    - Bread wheat
      - 11 (2)
    - Durum wheat
      - 4 (1)
- Information Exchange
- Capacity building
- Adaptation trials
Objective 3. Accelerated Seed Multiplication

Early Generation

10 Research Centers (Off-season and main season)

Formal

- Public
- Private
- FUCs

Intermediate (Emerging)

- FSAs
- FCUs
- Primary cooperatives

Informal

- Community based
- Farmer to farmer (sale, exchange, etc)
### Objective 3. Accelerated seed multiplication

<table>
<thead>
<tr>
<th>Center</th>
<th>Area (ha)</th>
<th>Actual production (Qt)</th>
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<tbody>
<tr>
<td></td>
<td>Breeder</td>
<td>Pre-basic</td>
</tr>
<tr>
<td>Kulumsa</td>
<td>14.3</td>
<td>66.9</td>
</tr>
<tr>
<td>Sinana</td>
<td>0.3</td>
<td>1.3</td>
</tr>
<tr>
<td>Bako</td>
<td>0.5</td>
<td>3</td>
</tr>
<tr>
<td>Debre Zeit</td>
<td>3.5</td>
<td>7</td>
</tr>
<tr>
<td>Holetta</td>
<td>0.5</td>
<td>3.5</td>
</tr>
<tr>
<td>Adet</td>
<td>0.5</td>
<td>4.5</td>
</tr>
<tr>
<td>Total</td>
<td>19.6</td>
<td>86.2</td>
</tr>
</tbody>
</table>
Objective 3. Accelerated Seed Multiplication, Demonstration, and Scaling up

- **661 tons** of EGS of **20 BW** and **9 DW** varieties produced
- **10 BW** and **2 DW** varieties under production on **21 ha** under irrigation in 2017 off-season
- **Lemu and Wane** in 2016, more than 500 demonstrations in 51 woredas across four regions.
- **412 tons** of seeds of 3 DW and 12 BW varieties were distributed to **10,317 HHs** (19% female) in 53 woredas.
- **Farmers are expecting about 50% more yield** than the national wheat average
CIMMYT Nurseries

- **Objectives:** Identify locally adapted HYWV with superior quality
- In 2016, CIMMYT INs consisting of 4029 (45% BW and 55% DW) entries were evaluated from which seeds of lines with combined resistance identified, harvested and promoted.
- Of the 1007 BW advanced lines (68% CIMMYT) in national trials evaluated at “hot spots” 17.5% and 24.1% exhibited high level of resistance for SR and YR respectively.
- Among the 154 Advanced DW lines tested 53 were promoted to the next stage.
- Lemu and Wane varieties Released
<table>
<thead>
<tr>
<th>No.</th>
<th>Nursery Name</th>
<th># of entries tested</th>
<th># of reps</th>
<th># of genotypes &lt;30 SR/YR severity</th>
<th># of genotypes ≥ 30 SR/YR severity</th>
<th>% of Resistant lines selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10th STEMRRSN</td>
<td>0</td>
<td>1</td>
<td>34</td>
<td>174</td>
<td>16</td>
</tr>
<tr>
<td>2</td>
<td>14th HTWYT</td>
<td>50</td>
<td>2</td>
<td>33</td>
<td>17</td>
<td>66</td>
</tr>
<tr>
<td>3</td>
<td>18th FHBSN</td>
<td>52</td>
<td>1</td>
<td>25</td>
<td>27</td>
<td>48</td>
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<tr>
<td>4</td>
<td>1st RAVEN</td>
<td>12</td>
<td>2</td>
<td>5</td>
<td>7</td>
<td>42</td>
</tr>
<tr>
<td>5</td>
<td>15th RHTLONG</td>
<td>72</td>
<td>1</td>
<td>25</td>
<td>47</td>
<td>35</td>
</tr>
<tr>
<td>6</td>
<td>SATYT</td>
<td>45</td>
<td>2</td>
<td>15</td>
<td>30</td>
<td>33</td>
</tr>
<tr>
<td>7</td>
<td>23rd SAWYT</td>
<td>50</td>
<td>2</td>
<td>33</td>
<td>17</td>
<td>66</td>
</tr>
<tr>
<td>8</td>
<td>24th HRWYT</td>
<td>50</td>
<td>2</td>
<td>18</td>
<td>32</td>
<td>36</td>
</tr>
<tr>
<td>9</td>
<td>26th ISEPTON</td>
<td>52</td>
<td>1</td>
<td>31</td>
<td>21</td>
<td>60</td>
</tr>
<tr>
<td>10</td>
<td>27th HRWSN</td>
<td>116</td>
<td>1</td>
<td>26</td>
<td>90</td>
<td>22</td>
</tr>
<tr>
<td>11</td>
<td>34th SAWSN</td>
<td>272</td>
<td>1</td>
<td>119</td>
<td>153</td>
<td>44</td>
</tr>
<tr>
<td>12</td>
<td>36th ESWYT</td>
<td>50</td>
<td>2</td>
<td>31</td>
<td>19</td>
<td>62</td>
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<tr>
<td>13</td>
<td>3rd WYCYT</td>
<td>43</td>
<td>2</td>
<td>12</td>
<td>31</td>
<td>28</td>
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<tr>
<td>14</td>
<td>48th IDSN</td>
<td>164</td>
<td>1</td>
<td>13</td>
<td>151</td>
<td>8</td>
</tr>
<tr>
<td>15</td>
<td>48th IDYN</td>
<td>50</td>
<td>2</td>
<td>13</td>
<td>37</td>
<td>26</td>
</tr>
<tr>
<td>16</td>
<td>49th IBWSN</td>
<td>294</td>
<td>1</td>
<td>38</td>
<td>256</td>
<td>13</td>
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<tr>
<td>17</td>
<td>6th HPYT</td>
<td>50</td>
<td>2</td>
<td>23</td>
<td>27</td>
<td>46</td>
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<tr>
<td>18</td>
<td>7th HLBSN</td>
<td>52</td>
<td>1</td>
<td>9</td>
<td>43</td>
<td>17</td>
</tr>
<tr>
<td>19</td>
<td>7th HPAN</td>
<td>100</td>
<td>1</td>
<td>44</td>
<td>56</td>
<td>44</td>
</tr>
<tr>
<td>20</td>
<td>Elite Lines for ETH</td>
<td>100</td>
<td>1</td>
<td>72</td>
<td>28</td>
<td>72</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>1882</td>
<td></td>
<td>619</td>
<td>1263</td>
<td>37</td>
</tr>
</tbody>
</table>
Objective 4: Demonstration and scaling up of improved varieties

Variety release

National

Regional

Adaptation

Demonstration

Scaling up

Mechanisms:
- Technical planning
- Regional planning
- Field days

RCs, FTCs

Model Farmers
FTCs

Field days

Model farmers Clustering Revolving
## Number of demonstrations plots per variety and Region

<table>
<thead>
<tr>
<th>Region</th>
<th>Utuba</th>
<th>Bekalcha</th>
<th>Obsa</th>
<th>Mangudo</th>
<th>Lemmu</th>
<th>Wane</th>
<th>Hobora</th>
<th>Bulluq</th>
<th>Liben</th>
<th>Alidoro</th>
<th>Ogolcho</th>
<th>Hoggena</th>
<th>Shorima</th>
<th>Hulluka</th>
<th>Total(14)</th>
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<tbody>
<tr>
<td><strong>Amhara (11)</strong></td>
<td>10</td>
<td>12</td>
<td>12</td>
<td>0</td>
<td>55</td>
<td>55</td>
<td>0</td>
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<td>0</td>
<td>55</td>
<td>110</td>
<td>110</td>
<td>110</td>
<td>110</td>
<td>639</td>
</tr>
<tr>
<td><strong>Oromia (25)</strong></td>
<td>22</td>
<td>22</td>
<td>30</td>
<td>30</td>
<td>6</td>
<td>125</td>
<td>125</td>
<td>50</td>
<td>85</td>
<td>85</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>558</td>
</tr>
<tr>
<td><strong>SNNPR (9)</strong></td>
<td>18</td>
<td>18</td>
<td>18</td>
<td>18</td>
<td>6</td>
<td>45</td>
<td>45</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>150</td>
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<tr>
<td><strong>Tigray (6)</strong></td>
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<td>18</td>
<td>18</td>
<td>6</td>
<td>30</td>
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<td>0</td>
<td>25</td>
<td>30</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>169</td>
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<tr>
<td><strong>Total</strong></td>
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<td>78</td>
<td>78</td>
<td>18</td>
<td>255</td>
<td>255</td>
<td>50</td>
<td>85</td>
<td>85</td>
<td>80</td>
<td>140</td>
<td>110</td>
<td>110</td>
<td>110</td>
<td>1516</td>
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</table>
Quantity of seed (qt) distributed for scaling up activities

<table>
<thead>
<tr>
<th>Region</th>
<th>Mangudo</th>
<th>Ude</th>
<th>Dire</th>
<th>Danda'a</th>
<th>Hidase</th>
<th>Kakaba</th>
<th>Kingbird</th>
<th>Ogolcho</th>
<th>M. wolabu</th>
<th>Sofumer</th>
<th>Pavon-76</th>
<th>Alidoro</th>
<th>Huluka</th>
<th>Hoggana</th>
<th>Shorima</th>
<th>total (qt)</th>
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<td>Oromia (28)</td>
<td>200</td>
<td>160</td>
<td>60</td>
<td>10</td>
<td>390</td>
<td>110</td>
<td>15</td>
<td>155</td>
<td>125</td>
<td>0</td>
<td>260</td>
<td>85</td>
<td>375</td>
<td>0</td>
<td>60</td>
<td>2,005</td>
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<tr>
<td>Amhara (11)</td>
<td>80</td>
<td>150</td>
<td>130</td>
<td>390</td>
<td>100</td>
<td>30</td>
<td></td>
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<td></td>
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<td>880</td>
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<td>SNNPR (9)</td>
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<td>0</td>
<td>95</td>
<td>135</td>
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<td>720</td>
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<td>140</td>
<td>170</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>0</td>
<td>480</td>
</tr>
<tr>
<td>Total</td>
<td>300</td>
<td>160</td>
<td>60</td>
<td>255</td>
<td>715</td>
<td>760</td>
<td>335</td>
<td>415</td>
<td>195</td>
<td>0</td>
<td>260</td>
<td>100</td>
<td>435</td>
<td>35</td>
<td>60</td>
<td>4,085</td>
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</tbody>
</table>
Objective 5. Improving linkages between small scale durum wheat producers and agro industries

- Variety release
  - Capacity building (Training, grain analyzer)
  - Socio-economics surveys along the durum wheat value chain
  - Stakeholders’ planning and consultation workshops
  - Facilitate contractual agreement
- Seed multiplication
- Adaptation
- Demonstration
- Scaling up
Other Support to NARs

- Information and data sharing
- Project development – Eth, Rwn, Zam, Nig. Tan
- Capacity building:
  - Several trainings – Researchers, ToTs, SMSs, Model farmers
  - Procurement of research supplies and equipment/machineries
- Joint initiative - make better varieties reach farmer faster
Irrigated wheat in Ethiopia - the untapped resource
Partners and stakeholders

**Objective 1**
CDL-UMN (USA)
- WSU (USA)
- Cambridge U (UK)
- Cornell U (USA)
- Aarhus U (Denmark)

**Objective 2**
- NARs
- ICARDA

**Objective 3**
- Private farms
- FCUs
- Public seed enterprises
- FSAs
- NARs/RCs

**Objective 4**
- MoANR
- BoANR
- Farmers

**Objective 5**
- ATA
- MoANR
- Farmers

**Partners and stakeholders**

- ATA
- MoANR