Review Meeting
Dryland Cereals Phase 1 and Extension Phase

Pearl millet for WCA

Malick Ba1, Gangashetty P., Singbo A., Fatondji D., Ajeigbe H.A., Nzungize J., Badolo F., Angarawai I., Tabo R.
Senior-Scientist, Entomology
1ICRISAT Niamey
b.malick@cgiar.org

October 3-5, 2016

http://drylandcereals.cgiar.org

A global alliance for improving food security, nutrition and economic growth for the world’s most vulnerable poor
Background Issue and R4D Challenges

- Pearl millet: dominant cereal and staple food for the Sahelian zone of WCA.
  - 40% of dryland cereal area in the 5 target countries of CRP DC
  - Production only ~ 27% of the three cereals

- Focused on Burkina Faso, Mali, Niger, Nigeria, and Senegal, where >80% of the pearl millet in Africa is produced.

Pearl Millet share compared to sorghum and maize between 2010-2014 in WCA CRP DC countries (Computed from FAOSTAT)
Background Issue and R4D Challenges

- Productivity is still very low (472-862 kg/ha grain yield)

- This is due to several constraints:
  - Abiotic and biotic constraints
    (Drought, Low P, Striga, downy mildew, insect pests)
  - Institutional constraints:
    (poor seed system, poor access to inputs to market)
Objectives

- **Overall Goal**
  Over a 10-year period, an increase in pearl millet production in Burkina Faso, Mali, Niger, Nigeria and Senegal of 3.5 million tons

- **5-Yr Targets**
  - 1.05 million tons increased production
  - 0.91 million ha area targeted
  - 2.05 million smallholder farmer beneficiaries
Research Focus

- Monitoring crop production, use and market trends
- Access of farmers to information
- Research on user needs, especially women
- Strengthened private sector, especially in seed sector
- Partnerships for tangible impacts
- Informing policy makers
- Crop research
  - Improved efficiency of recurrent selection for multiple traits
  - Identifying heterotic pools, generating hybrid parents and experimental hybrids
  - Identifying and using genes for low fertility adaptation and abiotic stress
  - ≥ Threshold levels of grain iron and zinc concentrations
  - Resistance to downy mildew, *Striga* and head miner
RESULTS: Stable future for pearl millet as improved varieties penetrate Niger and Nigeria

- Millet is of high importance in **household diets** in Niger; less so in Nigeria
- **40% of food budget** of poor households in Niger devoted to millet
- Demand for millet is more responsive to income changes in Nigeria than in Niger

- In Niger, **4.6% and 7.3% annual demand growth** is expected for millet in rural and urban areas, respectively

- In Nigeria, **4.3% and 8.0% annual demand growth** is estimated in rural and urban areas, respectively
RESULTS: Stable future for pearl millet as improved varieties penetrate Niger and Nigeria

- In both countries, the unconditional expenditure elasticity for millet is higher in urban areas than rural areas, meaning higher demand growth rate in urban centers.

- Increases in market prices will lead to greater shift away from millet in urban area whereas rural HH food security could be significantly worsen.

- Given the increasing land shortage, additional demand for millet could only be met via higher productivity.

- Therefore, research efforts aiming at developing elite cultivar and improved management practices are highly desirable.
RESULTS: New OPVs and development of Hybrids

- Varietal registration in Niger
  - ICRI-Tabi,
  - Mil de Siaka,
  - ICTP 8203,
  - ICMV 221 WBR
  - Jira Ni in Niger

- Release of two varieties in Nigeria
  - Jira Ni for the Sahelian zone
  - SUPERSOSAT for the Sudanian-Savanna zone
RESULTS: New OPVs and development of Hybrids

- Development and testing of single and top cross hybrids of pearl millet in Niger and Senegal. (ICMH IS 14001 to 14016) and ICMH IS 15001 to 15020)

- The phenotypically distinct superior hybrids yield was about 1.77 t/ha compared to 0.5t/ha for the local check

- Topcross hybrid: Toroniou HTC released by IER in Mali
RESULTS: New OPVs and development of Hybrids

Identification of new restorer inbreds and top cross pollinators derived from West African adapted germplasm
RESULTS: New OPVs and Development of Hybrids

- Completed resequencing of 300 inbreds by GBS
- In progress: Development of heterotic pools in West African adapted pearl millet accessions
- In progress: Development of association mapping population (PMiGAP-WCA) from diverse germplasm accessions from WCA.
- Testing of high Fe OPVs of pearl millet in Niger, Mali, Senegal, Ghana and Burkina Faso.
  - GB 8735 and ICTP 8203 were found to be highest in Fe and ready for fast track commercialization and release
- In progress: Characterization of *maiwa* type of pearl millet genotypes with contrasting *Striga* response for bi-parental QTL mapping (Nigeria)
RESULTS: Integrated management of soil fertility and major pests and diseases

Hill-placed mineral + organic fertilizer enhances pearl millet grain yield (Niger, 2013 and 2014)

- Marked increase in grain yield when manure was added to fertilizer micro-dosing treatments (2 g DAP hill⁻¹ or 6 g NPK hill⁻¹)

- Manure + mineral fertilizer micro-dose increased millet grain yields on average by 59%-113% for 100g-300g per hill application of manure
RESULTS: Integrated management of soil fertility and major pests and diseases

Fertilizer Micro-dosing, Nigeria

- Micro-dose 100-150 gm poultry manure/hill yielded up to 793 kg/ha while control (no fertilizer) produced yield 188 kg/ha.

- Yields as high as 2500 kg/ha can be obtained by using improved varieties + applying NPK fertilizer under microdose in combination + higher hill population.
RESULTS: Integrated management of soil fertility and major pests and diseases

Seed Treatment and Integrated *Striga* Management

- **26% more harvested hills** with seed treatment using Apron Star 42 WS
- **53% yield advantage** in treated plots over non-treated checks.
- **1250 kg/ha grain yield** with seed treatment versus 875 kg/ha with no treatment.
- **60% yield increase** and an estimated **40% marketable surplus** with integrated *Striga* management for pearl millet in Mali
Sustainable biological control of millet head miner with parasitoid wasp, *H. hebetor* field tested in Niger and upscaled in Mali.

- Up to 80% larval mortality of millet head miner with release of parasitoid *H. hebetor* adults

- Promising egg parasitoids of the head miner, *Trichogrammatoidae armigera*, identified for further improving the control of this pest.

RESULTS: Integrated management of soil fertility and major pests and diseases
RESULTS: Towards development of formal and private seed sector

- **3 seed processing units** created (all managed by women)
- **25,000 mini bags** of 200g sold in 40 villages in 2015
- **> 4110 metric tons** of seeds produced and **4085 metric tons** distributed
- **4.2 t of foundation seed** purchased by GIZ in 840 kits for vulnerable households in Niger in 2016
- **2000 demonstration trials** in farmers fields in Niger with NARS, NGO’s and seed company partners.
- **5000 brochures and 1000 posters** distributed
RESULTS: Towards development of formal and private seed sector

- Five pearl millet OPV (ICMV IS 89305, SOSAT-C88, GB 8735, ICMV IS 94222 and ICMV IS 94206) have got local farmer names

- Training farmer seed units on post-harvest operations and seed processing (packaging, labeling) and marketing

- Use of rural radio to create awareness

- Establishment of points of sale for seeds in 50 villages in 2015

- Seed sales points associated with PVS demonstrations.
RESULTS: Supply marketing of pearl millet in WCA

- Analysis of the supply marketing shows that only **25% to 30%** of quantity produced by farmers in the dryland areas of WCA are sold into spot markets.

- Millet is sold to buyers once farmers have determined the quantity necessary for their own consumption.

- The marketing system is vertically integrated and consists of five categories of actors:
  - farmers,
  - collectors,
  - wholesalers,
  - retailers
  - and consumers.
RESULTS: Supply marketing of pearl millet in WCA

- Marketable surpluses of pearl millet and sorghum are the lowest in target countries, compared to crops like rice, maize and groundnut.

- This implies that in the dryland areas of WCA, millet and sorghum are grown by farmers for their own household food consumption.

- Results of millet marketing studies imply that in order to increase the productivity value of these crops, potential new market is important to increase the value added and the gain to producer.
## IMPACT

<table>
<thead>
<tr>
<th></th>
<th>Niger</th>
<th>Nigeria</th>
<th>Mali</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of new OPVs released</td>
<td>7</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Number of new <strong>Hybrids</strong> released</td>
<td>0</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Seed produced (metric tons)</td>
<td>3,870</td>
<td>215</td>
<td>26</td>
</tr>
<tr>
<td>Seed distributed (metric tons)</td>
<td>3,870</td>
<td>200</td>
<td>15</td>
</tr>
<tr>
<td>Number of farmers growing improved</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>varieties released before the CRP</td>
<td>6% nation wide adoption</td>
<td>68,686</td>
<td>7,200</td>
</tr>
<tr>
<td>period</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of farmers growing improved</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>varieties released during the CRP</td>
<td>432,900</td>
<td>89,956</td>
<td>11,780</td>
</tr>
<tr>
<td>period (<strong>ICRISAT bred material</strong>)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Area covered by improved varieties</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>released before the CRP period</td>
<td>NA</td>
<td>137,371ha</td>
<td>6100</td>
</tr>
<tr>
<td>Area covered by improved varieties</td>
<td>865,800</td>
<td>42,540</td>
<td>9,262</td>
</tr>
<tr>
<td>released during the CRP period (ha)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### IMPACT

<table>
<thead>
<tr>
<th></th>
<th>Niger</th>
<th>Nigeria</th>
<th>Mali</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of management practices</td>
<td>6</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Number of farmers currently</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>adopting recommended management</td>
<td>6</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>practices.</td>
<td>10%</td>
<td>400</td>
<td>44.68% of the farmers</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>have planted at least one</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>improved variety</td>
</tr>
<tr>
<td>Number of publications in ISI</td>
<td>11</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>journals during the CRP period</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of farmers at farmer field</td>
<td>3,062</td>
<td>-</td>
<td>2,100</td>
</tr>
<tr>
<td>days</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of trainees in short-</td>
<td>304</td>
<td>-</td>
<td>10,116</td>
</tr>
<tr>
<td>duration training programs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of students who</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>completed Masters training</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of students who</td>
<td>4</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>completed PhD training</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Lessons Learned

- Farmers utilize ICRISAT millet varieties once they are exposed to demonstrations in their villages
- Spill over is still limited
- The major problem remains accessibility to seeds
- Availability/cost of Apron® Star 42 WS seed treatment remains a challenge
- Strategic partnerships missing in pearl millet is in processing in most of the target countries
- Hybrids are about to make their way in WCA
- Very limited activities in Senegal
Areas suggested for continued R4D

- Development of OPVs (drought, diseases and insect pests resistance)
- Continue efforts on hybrids (targeting elite farmers)
- Dual purpose pearl millet
- Nutritious pearl millet
- Integrated crop management practices
- Value Chain development (with emphasis on processing and seed sector)
Contributing Bilateral Projects

- HOPE phase I and supplemental phase (BMGF)
- Africa RISING’s large-scale diffusion of technologies for sorghum and millet systems (ARDT_SMS) (USAID)
- Bringing the benefits of heterosis to smallholder sorghum and pearl millet farmers in West Africa: Establishing a solid foundation for hybrid development (BMZ)
- Large-Scale Diffusion for Sorghum and Millet Systems (ARDT_SMS) (USAID)
- Genetically enhanced pearl millet with high grain iron density for improved human nutrition in West & Central Africa (HarvestPlus)
- Seed project for pearl millet and legumes in Niger (Mcknight)
- CRS/ICRISAT DFAP (PASAM-TAI) USAID funded project
- Biological control of the millet head miner in Niger and Senegal (SMIL)
- Biological control of the millet head worm in Burkina Faso, Mali and Niger (Mcknight)
Summary

- Rate of adoption of improved varieties range from **13% to 35%**, with higher rate of adoption in Nigeria.
- **14 promising** phenotypically distinct hybrids identified, with grain yield up to **2.7 t/ha** compared to 0.5 t/ha for the local land race.
- **113% and 321%** grain yield increase with hill micro-dosing with manure and mineral fertilizers in Niger and Nigeria, respectively.
- **Multi-stakeholder consortia** in Mali to enhance awareness and access to new technologies for millet production
- Supply marketing analysis reveals that increase of productivity can only be reached when farmers had higher market gain.
List of Posters

- Adoption of improved varieties of millet and sorghum in WCA: current situation and perspectives—(Singbo et al)
- Preliminary yield testing of pearl millet single cross hybrids and high yielding OPVs in Niger and Senegal— (Gangashetty et al)
- On-farm augmentative releases of parasitoid wasps for biological control of the millet head miner in WCA— (Ba et al)
- Delivery of farmer preferred participatory selected varieties of pearl millet in Niger— (Gangashetty et al)
- Supply marketing of dryland cereals in WCA— (Singbo et al)
- Research development partnerships for large-scale utilization of priority proven technologies— (Nzungize et al)
Thank you for your attention

Farmer Organizations
NGO’s

http://drylandcereals.cgiar.org

A global alliance for improving food security, nutrition and economic growth for the world’s most vulnerable poor