WATER EFFICIENT MAIZE FOR AFRICA (WEMA): PROJECT UPDATE
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INTRODUCTION

• Maize is the staple food crop in Africa
• Over 650 million people depend on maize in Sub-Saharan Africa
• In South Africa maize is the staple food crop ➔ Pap, Samp, etc
• For smallholder farmers it is both a food and cash crop
• 40% or 14 million South Africans are food insecure
Africa is drought-prone

Drought is one of the main factors limiting maize production in Africa

Severe droughts occurred every 9 years between 1970 and 2001

Climate change to worsen the problem
  ➢ Shorter seasons with more unreliable rainfall + high temperatures in Southern Africa
Fig 1. Major drought events in Africa occurred approximately every nine years from 1970-2001

Legend: Red = Drought affected country
Source: United Nations World Food Programme and the OFDA/CRED International Disaster Database, de l’Université Catholique de Louvain, Belgium
Kenya: Drought Stress in Maize

- Frequent droughts pose a continuous challenge to maize producers in Africa

Drought stress in maize, Kenya, 2009

Source: James Gethi, 2009
Relevance of Drought-Tolerant Technology to African Agriculture

• In 2003 WFP spent $0.57b on food emergency due to drought in Africa

• Risk of drought prevents investment in best management practices – seed, fertilizer, etc

Recorded droughts between 1971 and 2000, and the number of people affected
• SA is generally not suitable for crop production → less than 15% is arable

• Rainfall: low + varies in amount and distribution

• South Africa is 30th driest country in the world
CHALLENGES FACED BY SMALLHOLDER FARMERS

- Most maize in Africa is produced by smallholder farmers
- Smallholder farmers have no irrigation facilities
- Irrigation: less than 10% of maize crop in SA
- Drought leads to hunger, famine and poverty
- Drought tolerant varieties are required

NB: Poor soil fertility is also a major problem
WEMA Project Objectives

• A public-private partnership to develop drought-tolerant white maize hybrids and deploy them royalty-free to smallholder farmers

• Increase yield stability, protect and promote farmers’ investment in best management practices

• Results in increased maize yields and production → household food security, increased income and improved livelihoods
WEMA Project: Expected Outputs

• Under moderate drought, WEMA DT-hybrids expected to increase yields by 20 – 35% over 2008 commercial hybrids

• Translates into additional 2 million tonnes of maize during drought years; enough to feed about 14 to 21 million people
African Agricultural Technology Foundation
- Non-profit organisation based in Kenya
- Provide smallholder farmers with royalty-free technologies

Monsanto
- World leader in MAB, gene discovery, trait development and trait licensing (e.g., Bt maize)

CIMMYT
- International Maize and Wheat Improvement Center
- Non-profit organization

WEMA
- Kenya, Mozambique, South Africa (ARC), Tanzania and Uganda
- Major maize producers and consumers
- Strong research capacity

AATF
- African Agricultural Technology Foundation
- Non-profit organisation based in Kenya
- Provide smallholder farmers with royalty-free technologies

Funded by BMGF and HGBF
IMPROVED MAIZE FOR AFRICAN SOILS (IMAS)

**Aim:** develop and deploy low nitrogen tolerant varieties, royalty-free

**Target beneficiaries:** smallholder farmers

**P-P-P:** ARC, KARI, CIMMYT & PIONEER

**Funders:** Bill & Melinda Gates Foundation and USAID

**Breeding strategy similar to that of WEMA project**

**Projects complimentary**
WEMA BREEDING STRATEGY

Breeding lines from CIMMYT, NARS and Monsanto

- Conventional
- Biotechnology

Improved DT hybrids & OPVs

Improved & Enhanced DT hybrids

GM

DT gene

MAB
The WMA and WMB codes are Monsanto SSA germplasm

Best entries produced 43 to 61% more yield
Progress in ARC Breeding Under WEMA

To speed up progress:

Summer Nursery at Potchefstroom       Winter Nursery at Makhathini
Progress in ARC Breeding Under WEMA

VARIETY EVALUATION: 2011/12

Potchefstroom: Dryland
Conventional trials at Lutzville

Managed stress + well-watered

Expect to release first conventional DT hybrid(s): 2014
CONVENTIONAL BREEDING IN PARTNER COUNTRIES

Promising DT Hybrid – Optimum moisture: Embu, Kenya, Aug 6, 2010

Promising DT hybrid: Chókwé, Mozambique, Mar 2011
TRANSGENIC DT TECHNOLOGY FOR WEMA

• Monsanto donated DT gene → royalty-free for SHF
• Gene helps plants cope with drought stress
• *Gene approved for commercial maize production in USA in 2011*
• Gene currently being tested in regulated trials in South Africa since 2007
• Testing done under strict permit conditions
• Regular inspections conducted by DAFF
2. REGULATED TRIALS

(1) South Africa

- **ARC CFT site developed at Lutzville (WC)**
  - No summer rain → managed drought
  - withdraw water at critical flowering stage: two weeks before flowering and re-water two weeks after flowering

- **Monsanto CFT sites developed at Orania, Hopetown and Delareyville**

(i) September 2009: First permit approval to conduct WEMA CFT
  - 2009/10: CFTs planted at four sites in South Africa November/December 2009

(ii) September 2010: A permit extension was obtained
  - 2010/11: Second round of CFTs planted in South Africa at four sites in December 2010

(iii) Permit extension granted: 18 October 2011
  - Planted: December 2011/January 2012
ARC’s Confined Field Trial (CFT) Site at Lutzville (Western Cape)
### 2009/10 WEMA Testing Locations in RSA

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Irrigation Applied (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic stress</td>
<td>401</td>
</tr>
<tr>
<td>Well watered</td>
<td>589</td>
</tr>
<tr>
<td>Rainfall</td>
<td>3.05</td>
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</tbody>
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![Map of South Africa with locations marked: Delareyville and Hopetown Orania. WW and CS are indicated on the map.]
Results of DT Trials in Lutzville

Yield reduction at Lutzville

| Yield (Q/ha) | CS | WW |
|--------------|默 | 147.59 |
| 60%          |默 | 默 |

Chronic stress block

Well-watered block

Chronic stress

Well-watered
Regulatory Compliance

- **Plant destruction using Silage maker and Rotavator**

- **Seed destruction using hammer mill**

- **Compliance inspections** by DAFF: after planting + before flowering + harvesting and processing + seed destruction + equipment cleaning + post-harvest monitoring

- **In-house compliance training and audits** by WEMA-SA Regulatory team

- **Post-harvest monitoring**: 12 mths
Late maturity hybrids showing benefit:

Other traits

Kernel #/row

Kernel weight

P= 0.03**

P= 0.014**

P= 0.01***

P= 0.02**

P= 0.014**

Representative 10 ear sub-sample

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KEY POINTS

- DT gene is effective in hybrids grown in SA
- Yield benefits of 12 to 17% obtained
- No yield penalty under good moisture conditions
Regulated trials in Kenya and Uganda

(i) Uganda
- CFT site at Kasese
- Approval to conduct WEMA CFTs obtained in June 2010
- Transgenic seed was imported and trials planted in November 2010
- Trials planted 3 times

(ii) Kenya
- CFT site at Kiboko (2 ha +1 ha)
- Approval to conduct WEMA CFTs obtained in July 2010
- Transgenic seed was imported and trials planted on 1 December 2010
- Trials planted 3 times
Drought Tolerance Transgene (DT)
Confined Field Testing in Kenya, April 2011

Paired comparisons of mean yields (t/ha) of sub-tropical test hybrids under managed drought stress conditions. Green line is mean yield of commercial checks (3.14 t/ha)
SUMMARY FIELD TESTING OF DT GENE

- First trials in Kenya and Uganda showed no positive effect of gene → varieties not adapted
- Second set in Uganda was rained out
- Second set in Kenya showed promising results
- Third set of trials currently growing in RSA, Kenya and Uganda
COMMUNICATION AND OUTREACH

Community outreach meeting, March 2011, Lutzville + SPP

Lessons learnt:
1. Community outreach activities essential to maintain support of local community
2. Anti-GM activists exploiting plight of poor community

Community outreach meeting 22 November 2011, Ebenheizer

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CONCLUDING REMARKS

1. WEMA project (P-P-P) on course
2. It is hoped that conventional WEMA DT white hybrids will be available to farmers from 2013
3. Transgenic white maize hybrids will be available to farmers from 2015 subject to Biosafety approvals
4. WEMA partnership has been invited to submit a full proposal for Phase 2 (Project extension by another 5 years), by Bill and Melinda Gates Foundation (BMGF)
My Vision…  

Yes We Can!!