**PROJECT R8227 [FTR PART 2]**

**APPENDIX 1: Work conducted in Mozambique**

**1. CBSD-tolerant varieties evaluated in Mozambique**. [Output 2]

[From report by Anabela Zacarias, INIA, Maputo]

The activities are coordinated by INIA staff. The program coordinator is headed by Director of INIA, Maputo. The program is also working closely related with different partners for the purposes of achieving the program objectives. There is a consortium of CBSD activities that was formed in 2001 at the stakeholders meeting. Each partner plays role to facilitate the coverage of the affect area with CBSD. National meetings are held ones a year, were 26 partners are invited.

**Partners invited to Stakeholder Workshop in Nampula**

Director of INIA
SARRNET/IITA
Dept. of Agriculture and Farming Systems of INIA
Dept. of Land and Water of INIA
Deputy Director of DINA
ADRA
SETSAN
Eduardo Mondlane University
DPADRs
Save the Children
DDADRs [District Agricultural officers]
Cooperacao Espanhola
DNER
Umbeluzi Research Station

Institute of Animal Production

Farmers Association – Nampula

SG2000

Concelho Cristao

National Directorate of Agriculture
Care International
ADRA
Nat. Directorate of Rural Extension
INGC
Nutrition Department at Ministry of Health
INIA Monitoring Division
World Vision

*Field days*

Two field days were conducted to disseminate information regarding the varieties tolerant to CBSD. The field days were organized in Mogincual and PAN Station and Sub-station, respectively. At PAN, the partners, World Vision, Save the Children, Care, SARRNET, Provincial and District Directorate of Agriculture, Extension together with Community Farmers from the areas around the Station where present.

At Mogincual, the partners, technical staff of Save the Chidren, World Vision, Distrital Directorate of Agriculture and Community Farmers, were present.

Twelve promising varieties were exhibited in both field days. The partners the technical staff and Community farmers leaders, where able to observe the varieties and make their comments. A leaflet with agronomic and morphological characteristics was available for consultation (see Table A1.1).

**Table A1.1. Tolerant cassava clones to CBSD displayed during INIA field days in Mozambique**

| Descriptor | | MZ89186 | MZ89192 | MZ89001 | MACIA 1 | NIKWAHA | TMS30001 | MACIA 2 | Kigoma Máfia | Likonde | Nachinyaya |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Root | Epiderm texture | Lisa | lisa | Lisa | lisa | Ruguso | Ruguso | Liso | rugosa | rugosa | lisa |
| | Periderm C | white | white | white | white | brown | brown | white | dark brown | dark brown | white |
| | Cortex C | white | white | white | white | white | white | white | rosada | white | white |
| | Polp Color | white | white | white | white | white | white | white | crème | white | white |
| | Forma | cilindric | conic-cilindric | cilindric | conic-cilindric | conic-cilindric | cilindric | cilindric | conic-cilindric | conic-cilindric | irregular |
| | Taste | beeter | beeter | beeter | beeter | sweet | beeter | beeter | sweet | beeter | sweet |
| | Length | long | long | long | long | long | long | long | long | long | intermêdio |
| | Average Yield | 18 | 22 | 17 | 14 | 17 | 16 | 12 | 22 | in study | 12 |
| Stem | C | grey | grey | grey | grey | orange | grey | Marr-light | dourado | grey | grey |
| | Hight 1ª B(cm) | 15 | 20 | 27 | 100 | 100 | 30 | 150 | 90 | 100 | 50 |
| | c terminal stem | green | green | green | green | green | green | purpure | green-purpure | green-purpure | green-purpure |
| | internodo | short | short | medium | medium | medium | medium | medium | medium | medium | medium |
| Leaf | Expanded leaf C | green dark | green dark | green light | green light | green | green | green | green | green | green |
| | Inexpanded leaf C | green dark | green purpure | green dark | green purpure | green dark | green dark | green purpure | purpure | purpure | green dark |
| | Pubescence | absent | absent | absent | absent | present | absent | absent | absent | absent | present |
| | Nº lobuls | 7 | 7 | 9 | 7 | 5 | 7 | 7 | 5 | 7 | 7 |
| | Forma dos lobulos | lanceolat | eliptico lanceolat | eliptico lanceolat | obova-lance | lanceolat | lanceolat | lanceolat | lanceolat | lanceolat | lanceolat |
| | Cor da nervuras | green | green and red | green | green | red | green avermelha | red | red | purpure clara | green-red |
| | Peciol C | green yellow | red green | green yellow | green yellow | red | green yellow | red | red | green purpure | purpure |
| Pest | CGM | 4 | 4 | 4 | 3 | 1 | 4 | 3 | 3 | 2 | 2 |
| | CM | 3 | 3 | 3 | 4 | 2 | 3 | 3 | 4 | 2 | 2 |
| Disease | CM | 2 | 1 | 1 | 2 | 2 | 1 | 2 | 2 | 2 | 2 |
| | CBSD* roots | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 2 |
| | CBSD* leaf | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 |

* Results from trials and surveys

**Field Days and Advanced Clonal Evaluation Trial**

Field evaluations have been conducted to screen for the best cultivars, and tolerant to the CBSD. The establishment of methodology where researchers, extension services, private and public, facilitate the delivery elite clones to the farmers is the key issue for the success for the cassava production at community level. Joint effort is needed to accomplish that.

**2.1. Field days**

Two field days were conducted as way for dissemination of information regarding the varieties tolerant to CBSD. The field days were organized in Mogincual and PAN Station and Sub-station, respectively. At PAN, the partners, World Vision, Save the Children, Care, SARRNET, Provincial and Distrital Directorate of Agriculture, Extension and Community Farmers from the areas around the Station where present. At Mogincual, the partners, technical staff of Save the Chidren, World Vision, Distrital Directorate of Agriculture and Community Farmers, were present.

Twelve promising varieties were exhibited in both field days. The partners the technical staff and Community farmers leaders, where able to observe the varieties and make their comments. A leaflet with agronomic and morphological characteristics was available for consultation..

**Advanced Yield Trial (AYT) and Mother and Baby Trials**

Three advanced yield trials were established in the districts with different incidence of CBSD namely: PAN (low incidence zone); Muecate (medium incidence zone) and Mongicual (Medium incidence zone). Trials with randomized complete block design with 3 replications were implemented in all sites. The objective was to evaluate the performance of cassava clones under different level of CBSD and CMD pressure and assess the root yield and damage by CBSD.The trials had 25 clones. The 10 clones exhibited in the field days where part of the advanced yield trial. The clones were local clones, as check, advanced clones from breeding selection, and local varieties claimed by several farmers to be tolerant to CBSD. The field day comments made by the various participants and the agronomic data collected at harvest, where used to select the cultivars so for the advanced stage.

The community farmers at Nampula, Muecati and Mogincual, have participated in the harvest of the AYT. The 25 clones were planted in trial with three replicates. The farmers give their comments for the shoot and root part of the clones. The plant ability to produce good planting material, good leaves production, tolerance to disease and pests, medium to high branching, the absence of root necrosis and low HCN level, were the main characteristics used to select the clones. The disease observed were CBSD, Mosaic (CM) and Bacterial Blight (CBB). The pests were the Casava Mealybug and Cassava Green Mite (CGM) (data not shown).

After the farmer’s selection, the root necrosis was the key for selection. One local variety performed well over 3 locations, Likonde. No symptoms were observed in the leaves and roots. The clones with severity 1 were selected and advanced to the Multilocation Trial using the Mother and Baby approach .

**Table A1.2. Accessions in the gene bank at PAN**

| Nº | Accessions | Origin | Susceptibility to CBSD | |
|---|---|---|---|---|
| | | | Aerial part | Root |
| 1 | IMM (MZ) 30025 | IITA | Under evaluation | Under evaluation |
| 2 | Tomo | Nampula-corrane | Susceptible | Susceptible |
| 3 | Bwana | Nampula | Susceptible | Susceptible |
| 4 | H Melo | Nampula | Under evaluation | Under evaluation |
| 5 | Munamwahula | Nampula | Under evaluation | Under evaluation |
| 6 | Precoce d´Ángola | Angola | Under evaluation | Under evaluation |
| 7 | MZ 89105 | IITA | Susceptible | Susceptible |
| 8 | Nikwaha | Nampula | Susceptible | Tolerant |
| 9 | Fernando Pó | Nampula | Tolerant | Susceptible |
| 10 | MZ 89186 | IITA | Tolerant | Tolerant |
| 11 | Namuhiripwe | Nampula | Under evaluation | Under evaluation |
| 12 | TMS 42025 | IITA | Susceptible | Susceptible |
| 13 | TMS 30001 | IITA | Under evaluation o | Under evaluation o |
| 14 | Macia 1 | Gaza | Under evaluation | Under evaluation |
| 15 | MZ 89192 | IITA | Under evaluation | Under evaluation |
| 16 | TMS 30395 | IITA | Susceptible | Susceptible |
| 17 | Gangassol | Maputo | Susceptible | Susceptible |
| 18 | MZ 89001 | IITA | Tolerant | Tolerant |
| 19 | Chinhembwe | Gaza | Susceptible | Susceptible |
| 20 | Musito | Gaza | Susceptible | Susceptible |
| 21 | Macia 2 | Gaza | Under evaluation | Under evaluation |
| 22 | Kigoma Máfia | Cabo Delgado - Palma | Tolerant | Tolerant |
| 23 | Likonde | Cabo Delgado | Under evaluation | Under evaluation |
| 24 | Xinkole | Cabo Delgado | Under evaluation | Under evaluation |
| 25 | Binte Massute | Cabo Delgado - Palma | Tolerant | Tolerant |
| 26 | Nachinyaia | Cabo Delgado - Palma | Susceptible | Tolerant |
| 27 | Lipemba | Cabo Delgado - Palma | Under evaluation | Under evaluation |
| 28 | N´xinumba | Cabo Delgado - Palma | Under evaluation | Under evaluation |
| 29 | Baadge | Cabo Delgado - Palma | Under evaluation | Under evaluation |
| 30 | Mulaleia | Namacurra – Zambézia | Susceptible | Tolerant |

| | | | | |
|---|---|---|---|---|
| 31 | Mocuba | Zambézia | Under evaluation | Under evaluation |
| 32 | M´parapato | Namacurra - Zambézia | Under evaluation | Under evaluation |
| 33 | Thorola | Alua- Nampula | Under evaluation | Under evaluation |
| 34 | Mukhudo moyeviha | Zambézia | Under evaluation | Under evaluation |
| 35 | Nivalapwa | Alua- Nampula | Under evaluation | Under evaluation |
| 36 | Nottele | Nampula | Under evaluation | Under evaluation |
| 37 | Pwapwa | Caramacha- Nampula | Under evaluation | Under evaluation |
| 38 | Xitaxe | C. Delgado | Under evaluation | Under evaluation |

**Table A1.3. Disease incidence and root necrosis from trial data collected at Mogincual, 2002/2003 season.**

| Clone N- | Disease incidence (%) | | | CBSD | Clone selected |
|---|---|---|---|---|---|
| | CBB | CBSD | CM | Root necrosis severity | |
| 1. PAN 0176 | 62.5 | 6.25 | 62.5 | 5 | |
| 2. PAN 0171 | 100 | 0 | 25 | 4 | |
| 3. PAN 0136 | 100 | 81.25 | 18.75 | 5 | |
| 4. PAN 01127 | 100 | 12.5 | 0 | 5 | |
| 5. PAN 0114 | 100 | 0 | 0 | 5 | |
| 6. PAN 0144 | 50 | 0 | 0 | 5 | |
| 7. PAN 0140 | 100 | 6.25 | 0 | 3.6 | |
| 8. PAN 0181 | 62.5 | 43.75 | 0 | 3.8 | |
| 9. PAN 0148 | 0 | 18.75 | 0 | 1 | x |
| 10. PAN 01119 | 100 | 0 | 0 | 5 | |
| 11. PAN 013017 | 93.75 | 0 | 25 | 1 | x |
| 12. PAN 01124 | 100 | 12.5 | 0 | 1 | x |
| 13. PAN 0156 | 50 | 31.25 | 0 | 1 | x |
| 14. PAN 012 | 50 | 0 | 18.75 | 1 | x |
| 15. PAN 0178 | 93.75 | 0 | 75 | 1 | x |
| 16. PAN 01122 | 100 | 0 | 31.25 | 5 | |
| 17. PAN 0133 | 12.5 | 0 | 12.5 | 5 | |
| 18. PAN 0191 | 0 | 0 | 18.75 | 1 | x |
| 19. PAN 0132 | 100 | 43.75 | 25 | 3.5 | |
| 20. PAN 0110 | 31.25 | 0 | 0 | 1 | x |
| 21. Likonde | 100 | 0 | 0 | 1 | x |
| 22. TMS30395 | 25 | 6.25 | 0 | 4 | |
| 23. Nikwaha | 87.5 | 0 | 87.5 | 1 | x |
| 24. TMS3001 | 0 | 0 | 0 | 3 | |
| 25. Murwemulhe | 100 | 100 | 50 | 2 | x |

CBB= Cassava Bacterial Blight; CBSD=Cassava Brown Streak Virus; CM= Cassava Mosaic

**Table A1.4: Disease incidence and root necrosis from trial data collected at PAN, 2002/2003 season.**

| Clone Code | Disease incidence (%) | | | CBSD | Clone selected |
|---|---|---|---|---|---|
| | CBB | CBSD | CM | Root necrosis severity | |
| 1. PAN 0116 | 4 | 25 | 6.25 | 4 | |
| 2. PAN 0150 | 14 | 87.5 | 0 | 5 | |
| 3. PAN 0145 | 11 | 68.75 | 31.25 | 1 | x |
| 4. PAN 0187 | 0 | 0 | 0 | 1 | x |
| 5. PAN 01115 | 10 | 62.5 | 6.25 | 1 | x |
| 6. PAN 01119 | 8 | 50 | 25 | 3.33 | |
| 7. PAN 0133 | 13 | 81.25 | 0 | 4.25 | |
| 8. PAN 0179 | 14 | 87.5 | 31.25 | 5 | |
| 9. PAN 0116 | 14 | 87.5 | 0 | 1 | x |
| 10. PAN 0140 | 14 | 87.5 | 0 | 4.75 | |
| 11. PAN 0161 | 13 | 81.25 | 18.75 | 4.5 | |
| 12. PAN 0182 | 8 | 50 | 0 | 3.67 | |
| 13. PAN 0186 | 3 | 18.75 | 37.5 | 1 | x |
| 14. PAN 01114 | 2 | 12.5 | 0 | 1 | x |
| 15. PAN 01117 | 10 | 62.5 | 0 | 1 | x |
| 16. PAN 0188 | 14 | 87.5 | 0 | 1 | x |
| 17. PAN 0196 | 0 | 0 | 0 | 1 | x |
| 18. PAN 0143 | 0 | 0 | 25 | 5 | |
| 19. PAN 01184 | 0 | 0 | 50 | 5 | |
| 20. PAN 0119 | 13 | 81.25 | 25 | 1 | x |
| 21. Likonde | 8 | 50 | 6.25 | 1 | x |
| 22. TMS30395 | 2 | 12.5 | 0 | 3 | |
| 23. Nikwaha | 4 | 25 | 0 | 1 | x |
| 24. TMS30001 | 6 | 37.5 | 0 | 2 | |
| 25. Tomo | 14 | 87.5 | 18.75 | 3 | |

CBB= Cassava Bacterial Blight; CBSD=Cassava Brown Streak Virus; CM= Cassava Mosaic

**Table A1.5. Disease incidence and root necrosis from trial data collected at Muecati, 2002/2003 season.**

| Clone Code | Disease incidence (%) | | | CBSD Root necrosis severity | Clone selected |
|---|---|---|---|---|---|
| | CBB | CBSD | CM | | |
| 1. PAN 01101 | 25 | 25 | 1 | 3.67 | |
| 2. PAN 01143 | 18.7 | 100 | 16 | 4.33 | |
| 3. PAN 0175 | 75 | 25 | 4.2 | 1.00 | X |
| 4. PAN 01134 | 25 | 100 | 3 | 3.67 | |
| 5. PAN 0148 | 37.5 | 31.3 | 0 | 1.00 | X |
| 6. PAN 01110 | 18 | 56.5 | 0 | 1.00 | X |
| 7. PAN 01116 | 75 | 100 | 0 | 5.00 | |
| 8. PAN 01124 | 25 | 37.5 | 15 | 5.00 | |
| 9. PAN 0158 | 75 | 100 | 16.7 | 4.33 | |
| 10. PAN 01108 | 31.2 | 75 | 15.2 | 4.33 | |
| 11. PAN 01108 | 81.2 | 18.75 | 18.6 | 3.67 | |
| 12. PAN 01141 | 12.5 | 18.75 | 10 | 1.00 | X |
| 13. PAN 0195 | 25 | 0 | 0 | 5.00 | |
| 14. PAN 0186 | 62.5 | 62.5 | 22.7 | 5.00 | |
| 15. PAN 01121 | 25 | 0 | 0 | 3.67 | |
| 16. PAN 01104 | 31 | 0 | 0 | 5.00 | |
| 17. PAN 0193 | 87.1 | 0 | 10 | 4.33 | |
| 18. PAN 0189 | 25 | 50 | 16 | 5.00 | |
| 19. PAN 01119 | 37.5 | 81.2 | 15 | 4.33 | |
| 20. PAN 0121 | 75 | 31.2 | 16.7 | 4.33 | |
| 21. Likonde | 25 | 0 | 0 | 1.00 | X |
| 22. TMS30395 | 75 | 62.5 | 0 | 3.67 | |
| 23. Nikwaha | 22.5 | 25 | 12.3 | 1.00 | X |
| 24. TMS30001 | 0 | 0 | 0 | 1.00 | |
| 25. Tomo | 100 | 100 | 15.7 | 1.00 | X |

CBB= Cassava Bacterial Blight; CBSD=Cassava Brown Streak Virus; CM= Cassava Mosaic

**Table A1.6 Cultivars selected at AYT for M&B trials in 3 Districts in Nampula Province, season 2003/2004.**

| Clone Code | Muecati | Clone Code | Mogincual | Clone Code | Nampula |
|---|---|---|---|---|---|
| 1. PAN 01101 | | 1. PAN 0176 | | 1. PAN 0116 | |
| 2. PAN 01143 | | 2. PAN 0171 | | 2. PAN 0150 | |
| 3. PAN 0175 | X | 3. PAN 0136 | | 3. PAN 0145 | x |
| 4. PAN 01134 | | 4. PAN 01127 | | 4. PAN 0187 | x |
| 5. PAN 0148 | X | 5. PAN 0114 | | 5. PAN 01115 | x |
| 6. PAN 01110 | X | 6. PAN 0144 | | 6. PAN 01119 | |
| 7. PAN 01116 | | 7. PAN 0140 | | 7. PAN 0133 | |
| 8. PAN 01124 | | 8. PAN 0181 | | 8. PAN 0179 | |
| 9. PAN 0158 | | 9. PAN 0148 | x | 9. PAN 0116 | x |
| 10. PAN 01108 | | 10. PAN 01119 | | 10. PAN 0140 | |
| 11. PAN 01108 | | 11. PAN 013017 | x | 11. PAN 0161 | |
| 12. PAN 01141 | X | 12. PAN 01124 | x | 12. PAN 0182 | |
| 13. PAN 0195 | | 13. PAN 0156 | x | 13. PAN 0186 | x |
| 14. PAN 0186 | | 14. PAN 012 | x | 14. PAN 01114 | x |
| 15. PAN 01121 | | 15. PAN 0178 | x | 15. PAN 01117 | x |
| 16. PAN 01104 | | 16. PAN 01122 | | 16. PAN 0188 | x |
| 17. PAN 0193 | | 17. PAN 0133 | | 17. PAN 0196 | x |
| 18. PAN 0189 | | 18. PAN 0191 | x | 18. PAN 0143 | |
| 19. PAN 01119 | | 19. PAN 0132 | | 19. PAN 01184 | |
| 20. PAN 0121 | | 20. PAN 0110 | x | 20. PAN 0119 | x |
| 21. Likonde | X | 21. Likonde | x | 21. Likonde | x |
| 22. TMS30395 | | 22. TMS30395 | | 22. TMS30395 | |
| 23. Nikwaha | X | 23. Nikwaha | x | 23. Nikwaha | x |
| 24. TMS3001 | | 24. TMS3001 | | 24. TMS3001 | |
| 25. Tomo | X | 25. Murwemulhe | x | 25. Tomo | |
| **Total selected** | **8** | | **11** | | **12** |

**Table A1.7 Cassava Mosaic and Brown Streak Diseases incidence and severity and number of samples per Districts during 2002/03 season and partners involved.**

| Nampula Province | | | | | | |
|---|---|---|---|---|---|---|
| District | Disease incidence on leaves (%) | | % of Root necrosis (>2) | Samples observed | *Zone* | Partner (data collection) |
| | ACMV | CBSD | | | | |
| Angoche | 54.2 | 57.8 | 46.6 | 500 | C | Care |
| Erati | 52.5 | 42.3 | 27.25 | 500 | I | Care |
| Malema | 21.5 | 1.3 | 2.0 | 500 | I | Care |
| Meconta | 46.5 | 49.6 | 45.2 | 500 | I | Care |
| Mecuburi | 4.2 | 52.4 | 12.8 | 500 | I | Care |
| Mogincual | 0.25 | NA | 41.0 | 400 | C | INIA |
| Moma | 5.58 | 9.8 | 21.6 | 500 | C | Care |
| Mussuril | 1.75 | 30.8 | 29.0 | 400 | C | INIA |
| Muecati | 43 | 32.6 | 37.6 | 500 | I | Care |
| Mogovolas | 8.9 | NA | 10.6 | 500 | I | Care |
| Murrupula | 38 | 14 | 6.2 | 500 | I | Care |
| Nacala-A-Velha | 2.25 | 32.5 | 55.25 | 400 | C | INIA |
| Nacaroa | 28 | 32.5 | 16 | 500 | I | Care |
| Nampula | 6 | 2 | 7.5 | 500 | I | Care |
| Rapale | 3.5 | 7 | 3.0 | 500 | I | Care |
| Total | | | | 7200 | | |
| **Cabo Delgado Province** | | | | | | |
| District | Disease incidence on leaves (%) | | % of Root necrosis (>2) | Samples observed | *Zone* | Partner (data collection) |
| | ACMV | CBSD | | | | |
| Balama | NA | NA | 13.25 | 400 | I | C.E |
| Macomia | 48.5 | 40 | 19 | 400 | C | A.K |
| Moc da praia | 1 | 5.25 | 8.25 | 400 | C | INIA |
| Montepuez | 0 | 0 | 12.75 | 400 | I | C.E |
| Mueda | 5.25 | 0 | 15.75 | 400 | M | C.E |
| Namuno | NA | 20 | 0 | 400 | I | C.E |
| Palma | 7 | 3.75 | 8.75 | 400 | C | INIA |
| Metuge | 75 | 40.5 | 8.75 | 400 | C | Umokadzi |
| Quissanga | NA | NA | 28.76 | 400 | C | A.K |
| Total | | | | 3600 | | |
| **Zambezia Province** | | | | | | |
| District | sease on leaves (%) | | % of Root necrosis (>2) | Samples observed | *Zone* | Partner (data collection) |
| | ACMV | CBSD | | | | |
| Ile | 16.5 | 10 | 12.0 | 400 | I | ADRA |
| Maganja da Costa | 6 | NA | 2.85 | 400 | C | ADRA |
| Milange | NA | 0.2 | 0.26 | 400 | I | INIA |
| Mocuba | 74 | 10.3 | 53.83 | 400 | I | ADRA |
| Morrumbala | 0.5 | 1 | 3.75 | 400 | I | INIA |
| Nicoadala | 1.4 | 32.14 | 15.75 | 400 | C | INIA |
| Total | | | | 2400 | | |

C=Coastal; I=Interior; C.E= Cooperacao Espanhola; A.K=AGA KHAN

Summary of Varieties

About 15% of varieties found in the districts surveyed showed a CBSD severity below 2. The varieties Kigoma Mafia, N'maputo, Mulunga, Mutope, Manga, Panema, Chincaci, Ntimbuca, Puanapur, Suruma, in Cabo Delgado Province, showed no symptoms in the leaves and roots. For Nampula Province, the varieties Nroquia, Nroro, Vintecinco and Bwana, showed no symptoms on leaves or roots. These varieties were collected for germplasm maintenance at INIA.

**2. Survey of impact of CBSD in Mozambique [conducted with Save the Children]**

At the beginning of the project we continued to provide technical support to Save the Children. With Television Trust for the Environment, NRI and STC filmed a documentary on the impact of CBSD on food security in Mozambique for the BBC World Service. STC provided the Portuguese translation of the CBSD poster. We also conducted a survey in 2003, with Steve McSween and Chande Osufo of STC, to assess the various ways in which CBSD impacted on household food security [see below].

Method

A list of key questions was prepared and used to guide discussions with groups of cassava farmers. The groups were assembled informally in a total of nine villages in three coastal districts of Nampula Province: Nacala Velha, Memba and Mossaril between 29 September and 02 October 2003. Farmers responses to the questions and discussions prompted by the questions were noted and are summarised in this report. Group sizes differed at each village but the total number of cassava growers who participated in the survey was 79 men and 75 women.

Survey results

*Where do you normally obtain your planting material?*

The most common answer was that planting material was obtained from friends and relatives within the village. Some people used barter to obtain cuttings from nearby villages. In the past, some villages had received planting material from the Catholic mission. At present there was an acute shortage of planting material and Save the Children/SAARNET were currently the only external source.

*Which varieties do you grow?*

The main varieties grown were, Namuishe, Nlapa, Calamidade, Gerue,Carita, Muniacola. Some villages were only growing one or two varieties, although they mentioned other varieties that they used to have but had lost. Calamidade is highly susceptible to root necrosis.

With the exception of Nikwaha that is being distributed by Save the Children, the groups were not aware of any varieties resistant to root rot. All the local varieties mentioned were considered to be susceptible.

*What pest and disease problems do you have on your cassava?*

More or less the same pests came up in all nine villages, with some variation in the order of precedence:

Mealy bug

Rats

Monkeys
Only one group mentioned root rot without prompting. In each case when we asked why they had not mentioned root rot, the response was the same: 'Yes, root rot is our main problem, but when we talk about mealy bug, this includes root rot because it is caused by mealy bug'.

*When do you normally plant and harvest your cassava?*
Most groups said at first that they planted in November/December and harvested in August/September. However, when individuals were asked the question, it became apparent that,

a) Some had harvested much earlier, even one farmer who had harvested in April, but harvesting in July was common.
b) Several who had left their crop in the field until September and opted not to bother harvesting after examining some of the roots and finding them rotted.
c) Some people in each of the village said they had not planted cassava at all this year due to lack of planting material.

*Why did you harvest early?*
The universal response was that early harvesting was an attempt to avoid root rot. If on examining the roots in June or July they were a reasonable size and free of root rot, then they would harvest immediately, rather than leave them to increase in size but run the risk that they will be rotted.

*How does present harvesting practice compare with 10 - 20 years ago?*
The older members of the groups said that planting in November with the main harvesting period in September/October, was the standard practice in the past. It was also common to begin harvesting as early as April, but to take only a few roots, as they were needed, with some cassava being left in the field into the second and sometimes into a third season. Nowadays, due to root rot and food shortage, most of their cassava is harvested early [commonly June - August]. Several women said that their crop had already been harvested and consumed.

*Do you leave any cassava in the field for more than 12 months?*
No one interviewed in any of the villages left their cassava for a second season. When asked why this was the answer was always the same - because of root rot.

*Why have you lost your planting material?*
Part is lost in the field due to disease and the rest is lost during storage of planting material before the planting rains arrive. One group said that mealy bug also attacks the cuttings during storage. In ordere to avoid root rot they harvest early. This then means they have to leave the cuttings for several months before planting and viability is partly or even totally lost.

*Do women cut out the rotten parts of the root when they prepare chips for drying?*
Some said they did try to cut out the worst affected parts, but many said they were forced to use the rotten parts due to food shortage, only the most rotted roots were discarded. Even unrotted portions of a root affected by CBSD do not produce good quality flour.

*How much of your cassava is rotted?*
Women responded to this question similarly in all villages - the rotten portion was the majority in all their harvested roots. This was why they could not remove the rotten parts. They went on to say that affected [by CBSD necrosis] roots did not dry properly and produced a poor quality flour that their children were reluctant to eat.

The four tasted bitter and could not be eaten with fish. It could be eaten with a bean stew that helped to disguise the bitter taste.

*If cassava production has gone down so much due to root rot, how do you feed your families?*
The most common response was that they had to sell their labour to farmers who planted a lot of land. It had always been traditional for some people to work as labourers for some of the year - usually beginning around February/March when food became scarce but now, they had to begin labouring much earlier; some said they were already looking for work.

Another common response was that they had to spend much of their day collecting food from wild plants, such as the buffalo bean and some made small amounts of money from selling these in local markets. Others sold firewood, charcoal or local beer. Money obtained from these enterprises was used to buy maize flour.

In terms of alternative crops, sorghum, maize, cowpea and bambara nut were the only crops mentioned but the groups all emphasised that cassava was their food crop of choice and that these other crops often failed due to drought and poor soil fertility.

*When did the root rot problem first begin?*
In almost all cases the answer was 1994, and many people said it was at the time of the cyclone. Most of the groups said that root rot was not seen before then, but some individuals said that they remembered seeing similar symptoms before 1994 but it was rare. In discussions around this question some people mentioned again the link with mealy bug and one group brought an affected plant to show us. Some of the women were adamant that if they saw a plant with mealy bug it would certainly have root rot, and only those free of mealy bug could be expected to be free of root rot.

Discussion
The survey results emphasise reports by NRI, Save the Children, World Vision and other organisations, that there is an acute food shortage in some of the coastal districts of northern Mozambique that rely heavily on cassava for their food security. The food shortage is due to the prevalence of CBSD. Although I have worked on CBSD in Tanzania for many years, I was surprised by the seriousness of the problem in the three districts of Mozambique that we visited. The survey has revealed two important aspects of the impact of CBSD that were not fully appreciated before. Firstly, that the main harvest period is on average one - two months earlier than was the case before 1994. Some households harvest as much 3 - 4 months earlier than the optimum date of September/October. In these districts the practice of leaving cassava in the field for two or even three season has been lost due to the increased severity of root rot the longer the crop remains in the field. This has a major impact on food security in the lean months of February/March, before the short season crops are harvested. Secondly, and related to the first point, planting material has become very scarce in some villages, as cassava is increasingly harvested early, requiring longer storage before planting. Longer storage leads to loss of viability that might be exacerbated by mealy bug infestation of the cuttings. It was interesting that the belief that mealy bug was the cause of root rot was common in all nine villages. There does not seem to be any scientific basis for this and CBSD was first reported long before CMB arrived in Africa.

Given that cassava is the staple food in the survey area, it is a worrying situation when some people in several of the villages we visited said that they had not planted cassava this year. This is due it seems, to a combination of having lost their planting

material and lack of incentive to find more, on the basis that the crop would inevitably be affected by CBSD.

Conclusions
1. In the districts of Nacala Velha, Memba and Mossuril, the amount of cassava being harvested has gone down dramatically since 1994.

2. The decrease in cassava production is due directly and indirectly, to CBSD-induced root necrosis.

3. CBSD has decreased cassava production in three ways:

a) Through direct loss of root due to rotting, that increases the longer the crop is left in the field.
b) Through early harvesting before roots reach their optimum size.
c) Through loss of planting material.

4. There is an additional impact on food security as farmers no longer leave cassava in the field into the second season.

5. Planting material is lost due to early harvesting and the consequent need to store cuttings for 4 - 5 months before the rains arrive.

**3. Surveys of CBSD incidence conducted by INIA**

The original surveys that reported CBSD in Mozambique for the first time were conducetd by NRI under CPP funding in 1999. Methods used have become standard practice and have been adopted by INIA. With funding from the present project INIA undertook further surveys in Nampula and Zambezia Provinces and in Cabo Delgado Province which was surveyed for the first time for cassava virus diseases. All districts in these Provinces have now been surveyed and CBSD has been found in all of them.

Cassava is considered one the most important food security crops in Mozambique, and is the main source of calories and carbohydrates in the rural areas. Cassava is well known for its ability to produce reasonable yields even under conditions of poor soil fertility and low rainfall. In spite of being considered a net carbohydrate producer, this crop is also a very important source of protein if leaves are considered.

The use of low yielding varieties and highly susceptible to major diseases and pests are among others the most important constrains. Cassava Brown Streak Disease (CBSD) has recently become the most important factor that is threatening the cassava production particularly in Northern Mozambique where more than 50% of cassava is produced.

According to data collected from 1999 from surveys on CBSD incidence and studies on disease assessment, the areas affected are classified as areas with low (<25%), medium (25-49%) and high incidence (>50%) of plants with symptoms of CBSD (annex 8).

The Promotion and Control Measures for Cassava Brown Streak Disease Project aims at:

Conduct effective trials and assessment of advanced cassava cultivars on-station and on-farm in Nampula, Zambezia and Cabo Delgado Provinces.
Conduct CBSD surveys for disease monitoring in three provinces.
To provide technical guidance, information and recommendation to partners in terms of disease spread and control measures.

This report gives an overview of the main activities and achievements carried with Project funds during the 2002/03 cropping season.

Importance and Cultivation of Cassava in Mozambique

Cassava is a hardy crop that manages to give a good yield in areas where most other crops do not thrive. It occupies over one quarter of the total cultivated land area annually, thus engaging many farmers in farm employment. As an energy crop, its overall production of 5.4 million metric tonnes could provide an equivalent of all the daily calorie needs of about 2200 calories per head per day for 5.275 million persons, or 30.5 percent of the national population in 1999-2000. It is clear that directly or indirectly the crop is very important for sustaining food security and preventing food shortages across many areas of the country.

The distribution of production of cassava in the country show that the four major producing provinces (Nampula, Zambezia, Cabo Delgado, and Inhambane) account for over 90 percent of the total annual output of the country. It is significant to note that the three northern provinces account for 88.1 percent. Cassava has relative importance compared to all other crops in this northern parts of the country is in the 1997/98 season the cassava occupied 50% of the cultivated area in Cabo Delgado and Nampula, followed by sorghum (15%), maize (13%), beans (10%), groundnuts (8%), rice (3%), and millet (1%). In all, it is clear that the recent rise of the diseases in this dominantly cassava growing areas will spell hardships to the populace, if no action is taken as soon as possible.

Of a total of 5,361,974 metric tonnes of cassava roots produced from all provinces in 1999-2000, some 70 percent of the roots were used for human food and the rest for other uses. This was however variant for the three regions as follows:

| Region | Cassava use kg/head/day | Population on 1 July in 99-00 | Cassava output (tonne) | Percent of cassava output used for human food |
|---|---|---|---|---|
| North | 1.161 | 5,601,935 | 3,390,281 | 70.0 |
| Center | 0.402 | 7,227,983 | 1,515,610 | 70.0 |
| South | 0.198 | 4,412,322 | 456,083 | 70.0 |
| National | 0.596 | 17,242,240 | 5,361,974 | 70.0 |

Source: Sistema Nacional de Aviso Previo (1999-2000) and Instituto Nacional de Estatistica, Maputo. Note that the national urban population was 4,601,100 with a rural population of 11,498,100 and Maputo city had 898,400 people in 1997.

Constraints to the Production of Cassava in Mozambique

The cassava crop is very productive if grown on fertile soils and well watered by rain or through irrigation using disease resistant varieties following the right agronomic practices. The farming environments in Mozambique have not been so favorable. The farming systems in use create conditions that make the crop produce below its potential. Yields of tuberous roots after 12 months of growth are about 4-6 tonnes per hectare compared to potentials of 40 tonnes per hectare. The chief constraints of the cassava crop in the country are:

a) Use of varieties that are susceptible to the major diseases and pests.
b) Little use of fertilizers/manures to improve fertility of soils on which the crop is grown.
c) Planting of poor quality stems without chemical treatment against pests and diseases.
d) Lack of application of the best agronomic practices (planting dates, land preparation, weeding, etc.) suitable for each of the agro-ecological zones where the crop is grown
e) The attack of the cassava crop by many pests and diseases some of the most important being: cassava mosaic (CM), cassava brown streak (CBSD), cassava green mite (CGM), and mealy bug (CM).

Dispite the importance of cassava in the northern region the CBSD, is the most threatening factor, where can cause a potential root yield losses of about 52 percent in the coastal districts. This problem disease affects the roots that are used for food has increasingly threaten the food supplies to farmers and consumers in districts of the northern parts of Mozambique. The surveys conducted from 1999 to 2002 have shown that the CMD and CBSD incidence by district is high, averaging more than 70 percent in the coastal districts for CBSD and 14-26 percent for CMD. Based in this surveys map of CBSD incidence was produced showing three levels on incidence, where low varies from 0 to 25, meduim from 25 to 50 percent and high up to 50 percent of incidence (annex ).

A total of 30 Districts and 126 Villages were surveyed in Zambezia, Nampula and Cabo Delgado Provinces. At Village level, 20 farm fields were inspected and 20 to 25 plants harvested and the root uprooted. Data records were on cultivar name, taste, Mosaic and CBSD incidence, CBSD root necrosis and severity using the scale (1=no necrosis and 5=severe necrosis), root weight per plant with and without necrosis and ziz-zag stem characteristic.

## Disease incidence

A total of 13200 plants were inspected the leaves and roots in the villages studied. The results preliminary showed that the acmv vary from 1.75% to 54.2% infestation and 2% to 57.8% in nampula province. The coastal districts had higher disease infestation compared with interior ones. The districts that registered root severity more than 3 in the scale (1 to 5) were nacala-a-velha and angoche with 55.25% and 46.6% of roots necrotic respectively. Malema had the lowest percentage of root necrotic (2%).

In cabo delgado, three districts had completely lost the leaves at time of data collection. However, pemba metuge had the highest acmv incidence followed by

macomia. The some was registered with cbsd. In terms of root necrosis quissanga district had the highest percentage (28.76). The root necrosis was not observed at namuno, but had 20% of incidence on cbsd.

Total of 2400 samples were collected in zambezia province. Nicodala had the highest of leaf incidence (32.14%). In terms of root necrosis mocuba had 53.83% of root necrotic observed.

In general there is a variation between coastal and interior in terms of disease infestation and necrosis observed in the roots.

Mocimboa da praia and palma ar e coastal districts. The disease incidence for both acmv, cbsd and root necrosis was very low. Palma is the districts main areas were is recommended to collect clean cassava stock for multiplication.

## Varieties

About 14.6% of varieties found in the districts had potential severity below than 2. Kigoma mafia, N'maputo, Mulunga, Mutope, Manga, Panema, Chincaci, Ntimbuca, Puanapur, Suruma, in Cabo Delgado Province, showed no symptoms in the leaves and roots. For Nampula Province, the varieties Nroquia, Nroro, Vintecinco, Bwana no symptoms on leaves and roots were observed in during the survey.

The continuous search updating of varieties tolerant to CBSD is important issue for germoplasm collection at country level and to the cassava breeding programs (annex 1).

## Conclusion

- There is high perception by farmers for selection of new cultivars tolerant to disease and pest and their phenotypic features are also important for selection.
- The farmer's field day are best way for technology delivery and experience exchange for both sides, farmer to farmers and farmer to scientist.
- Both disease ACMV and CBSD are still threatening the Northern part of the country.
- The collection of varieties claimed by farmers to be tolerant to CBSD is continuous activity.
- Study on morphology study
- The surveys have to be conducted at right time to avoid missing data on leaves and twice a year.
- Palma Districts is the best one for clean stock collection according to the data collected so far.

**Table A1.8: Cassava Mosaic and Brown Streak Diseases incidence and severity and number of samples per Districts during 2002/03 season and partners involved.**

| Nampula Province | | | | | | |
|---|---|---|---|---|---|---|
| District | Disease incidence on leaves (%) | | % of Root necrosis (>2) | Samples observed | *Zone* | Partner (data collection) |
| | ACMV | CBSD | | | | |
| Angoche | 54.2 | 57.8 | 46.6 | 500 | C | Care |
| Erati | 52.5 | 42.3 | 27.25 | 500 | I | Care |
| Malema | 21.5 | 1.3 | 2.0 | 500 | I | Care |
| Meconta | 46.5 | 49.6 | 45.2 | 500 | I | Care |
| Mecuburi | 4.2 | 52.4 | 12.8 | 500 | I | Care |
| Mogincual | 0.25 | NA | 41.0 | 400 | C | INIA |
| Moma | 5.58 | 9.8 | 21.6 | 500 | C | Care |
| Mussuril | 1.75 | 30.8 | 29.0 | 400 | C | INIA |
| Muecati | 43 | 32.6 | 37.6 | 500 | I | Care |
| Mogovolas | 8.9 | NA | 10.6 | 500 | I | Care |
| Murrupula | 38 | 14 | 6.2 | 500 | I | Care |
| Nacala-A-Velha | 2.25 | 32.5 | 55.25 | 400 | C | INIA |
| Nacaroa | 28 | 32.5 | 16 | 500 | I | Care |
| Nampula | 6 | 2 | 7.5 | 500 | I | Care |
| Rapale | 3.5 | 7 | 3.0 | 500 | I | Care |
| Total | | | | 7200 | | |
| **Cabo Delgado Province** | | | | | | |
| District | Disease incidence on leaves (%) | | % of Root necrosis (>2) | Samples observed | *Zone* | Partner (data collection) |
| | ACMV | CBSD | | | | |
| Balama | NA | NA | 13.25 | 400 | I | C.E |
| Macomia | 48.5 | 40 | 19 | 400 | C | A.K |
| Moc da praia | 1 | 5.25 | 8.25 | 400 | C | INIA |
| Montepuez | 0 | 0 | 12.75 | 400 | I | C.E |
| Mueda | 5.25 | 0 | 15.75 | 400 | M | C.E |
| Namuno | NA | 20 | 0 | 400 | I | C.E |
| Palma | 7 | 3.75 | 8.75 | 400 | C | INIA |
| Metuge | 75 | 40.5 | 8.75 | 400 | C | Umokadzi |
| Quissanga | NA | NA | 28.76 | 400 | C | A.K |
| Total | | | | 3600 | | |
| **Zambezia Province** | | | | | | |
| District | sease on leaves (%) | | % of Root necrosis (>2) | Samples observed | *Zone* | Partner (data collection) |
| | ACMV | CBSD | | | | |
| Ile | 16.5 | 10 | 12.0 | 400 | I | ADRA |
| Maganja da Costa | 6 | NA | 2.85 | 400 | C | ADRA |
| Milange | NA | 0.2 | 0.26 | 400 | I | INIA |
| Mocuba | 74 | 10.3 | 53.83 | 400 | I | ADRA |
| Morrumbala | 0.5 | 1 | 3.75 | 400 | I | INIA |
| Nicoadala | 1.4 | 32.14 | 15.75 | 400 | C | INIA |
| Total | | | | 2400 | | |

C=Coastal; I=Interior; C.E= Cooperacao Espanhola; A.K=AGA KHAN

# Fig. 1: Incidence of CBSD in Mozambique