REPUBLIC OF NAMIBIA

MINISTRY OF AGRICULTURE, WATER AND LAND REFORM

Development of Cowpea Varieties for Bruchid (*Callosobruchus maculatus*) Resistance using Marker-assisted Selection

African Bean Consortium (ABC) and African Cowpea Programme (ACP)

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Outline

- Introduction
- Problem to Address on Cowpea
- Research Objectives
- Proposed Research Approaches
- Outputs and Impacts
- Future Prospects
- Conclusion

DARD, MAWLR

STRATEGIC PLAN
2017/18-2021/22

MANDATE

"To promote, develop, manage and utilize agriculture, water and forestry resources sustainably"

VISION

"A recognized leading contributor to food and nutrition security, equitable access to agriculture, water and forestry resources and enhanced livelihoods"

MISSION

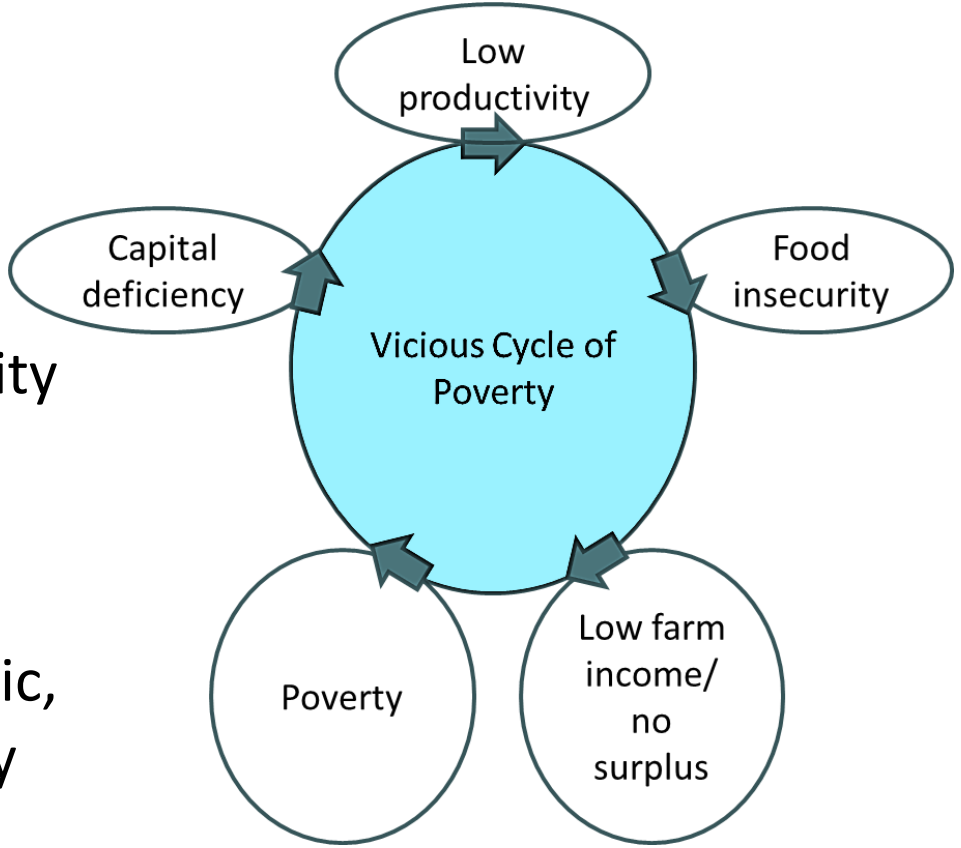
"To create an enabling environment and develop strategies, programmes and projects aimed at enhancing food and nutrition security and improving the livelihoods of Namibians"

Supportive documents:

1) Namibian Constitution; 2) Vision 2030; 3) National Development Plans; 4) Harambee Prosperity Plan; 5) 2014 SWAPO Party Elections Manifesto; 6) Sustainable Development Goals; 7) Growth at Home Strategy; 8) Agenda 2030; 9) Agenda 2063; 10) Paris Agreement of Climate Change; 11) Comprehensive Africa Agriculture Development Programme.

Strategies for Transforming African Agriculture

- Crop genetic improvement
- Integrated Crop management
- Markets and trade
- Public infrastructure
- Rural vulnerability and insecurity
- Policy and institutions
- Market demand
- Identifying Drivers:
  Social, Technological, Economic, Environmental, Political/Policy (STEEP analysis)



Major Crops in Namibia

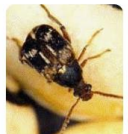
Crops	Land area (ha)	Crops	Land area (ha)	Crops	Land area (ha)
Millet	490,320	Onions, dry	1,461	Dates	136
Roots and tubers	41,772	Tomatoes	1,428	Chillies and peppers, green	96
Maize	35,000	Potatoes	1,187	Carrots and turnips	89
Pulses	20,066	Groundnuts	905	Beans, dry	82
Sorghum	17,842	Watermelons	313	Melons (Other)	71
Grapes	7,753	Oranges	239	Sunflower seed	62
Wheat	2,000	Cabbages and other brassicas	189	Mangoes, mangosteens, guavas	27

FAOSTAT, 2020

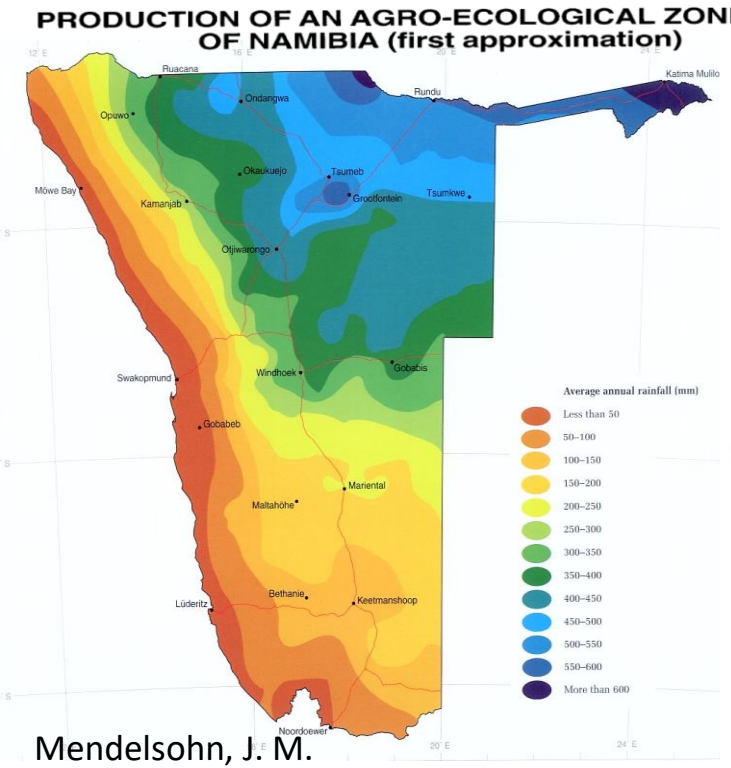






Importance Traits in New Cowpea Varieties



Mendelsohn, J. M. (2002). *Atlas of Namibia: a portrait of the land and its people*. Spearhead Press.

Problem Statement

- Limited varieties to serve the diverse needs of farmers and the market;
- Eight cowpea varieties under seed production program:
  - Nakare (IT81D-985), Shindimba (IT89KD-245-1), and Bira (IT87D-453-2), NKR2P9, NKR8P9, SHR4P1, SHR10P10 and Br4P11
- Limited systematic studies on cowpea bruchid *Callosobruchus maculatus* (F.) (Coleoptera: Bruchidae):
  - Damage and farmer's perceived control strategies;
  - Bruchid resistant genetic resource for breeding;
  - Application of Marker-Assisted Selection (MAS).

Research Objectives

- To determine farmers' perceived damage and control strategies for cowpea bruchid;
- To select brichid resistant cowpea genotypes for breeding;
- To develop institutional capacity in phenotypic and genotypic data analysis for MAS;
- To use diagnostic simple sequence repeat (SSR) and Single Nucleotide Polymorphism (SNP) markers to develop cowpea brichid resistant varieties.




Proposed Research Approaches

- Carry out a Participatory Rural Appraisal (PRA) on farmers' perceived damage and control strategies for cowpea bruchid;
- Source and screen cowpea genotypes to select genetic resources for brichid resistance;
- Collect and analyse phenotypic and genotypic data for MAS;
- Identify SSRs and SNPs use in breeding varieties resistant to cowpea brichid.






PRA - Damage and Control Strategies

- To be conducted in eight selected constituencies sampled from four regions in northern Namibia,
- Multistage purposive sampling will be used to collect data in the selected constituencies.
- A total of 320 cowpea farming households will be randomly sampled in 32 villages across eight constituencies in four regions.
- The extension officials from DAPEES and the Directorate of Agricultural Research and Development (DARD) will facilitated group discussions with farmers and seed growers to collect the data.

Source and Select Resistant Genotypes

- Seed increase and field screening
- IITA genotypes
  - Six Bruchid resistant (Tvu-2027, IT84S-2246, IT90K-76, IT95K-207-15, IT97K-499-35, and T189KD-391),
  - Three Maruca resistant (Tvu-1, Tvu-17354, and Tvu-946)
- RCBD experimental design with three replication was used to layout field experiment consisting of nine sourced genotypes and nine local genotypes.
- Seed increase was planted under field and pot in shade net conditions.

Screening for Bruchid Resistance

- Review and select Bruchid screening method:
  - Vial in laboratory
  - Hand-held Raman spectrometer - to detect chemical signatures of bruchid larvae and excrements inside the intact seeds during its development within intact cowpeas.
  - Chemometric – to distinguished healthy from infested seeds hosting developing larvae.
  - ‘Free choice’ and ‘no choice’ tests
- Storage strategies
  - Hermetic bag: Purdue Improved Cowpea Storage (PICS)

SSRs and SNPs for MAS

- Review and select:
  - SSRS
  - SNPs
  - Genome-Wide Association Studies (GWAS)
- Marker Assisted Breeding:
  - Crossing
  - Multi-parent advanced generation inter-cross (MAGIC)
  - Back-crossing

Outputs and Impacts

- Bruchid resistant cowpea seed;
  - ✓ Cheapest input in crop production and key to agriculture progress,
  - ✓ Crop status largely depends on the seed materials used;
  - ✓ Response of other inputs in crop production depends on seed material used;
  - ✓ Reduced post-harvest loses.
- The seed required for raising crop is quite small and its cost is so less compared to other inputs.
- Quality seeds of improved varieties can contribute to 20-25% increase in yield.

Future Prospects

- Institutional Capacity:
  - Enhanced phenotypic and genotypic data collection approaches;
  - Improved quality data collection, processing and analysis;
  - Publication of research finding;
  - Integrate genomics, speed breeding, high-throughput phenotyping, and digital tools;
  - Harmonization of research resources.
- Personnel Capacity:
  - Co-development of varieties;
  - Multidisciplinary research approach to develop cowpea value chain;
  - Plant breeders' reward and incentive.

Conclusions and recommendation

- Subsistence farming = Low-input farming systems + Low Return on Investment (ROI);
- Post-Harvest loses (50%) = Poor logistics + Poor processing facilities
- Bruchid resistant cowpea varieties can improve food and income generation for farmers;
- Improved breeding program can improve cowpea value chain;
- Improved seed system;
- Harmonization of research resources.

Thank you

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