13th African Crop Science Society Conference

Building Africa's Future

Crop Research and Innovation for Agricultural Transformation, Resilience, and Inclusion

BOOK
OF ABSTRACTS

16th–19th September

Venue: Eduardo Mondlane University Main Campus
Maputo, Mozambique

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UNIVERSIDADE
EDUARDO
MONDLANE

IIAM
Instituto de Investigação Agrária de Moçambique

ISPG
Instituto Superior Politécnico de Gaza

ISPM

13th African Crop Science Society Conference

AFRICAN CROP SCIENCE SOCIETY

República
de Moçambique

EDUARDO MONDLANE UNIVERSITY (UEM)

Rector: Prof. Doutor Manuel Guilherme Júnior
Vice-Rector: Profª. Doutora Amália Alexandre Uamusse
Vice-Rector: Prof. Doutor Joel das Neves Tembe

RECTORATE BUILDING

Julius Nyerere Avenue, 3453, Main University Campus
Maputo, Mozambique
www.uem.mz

13th African Crop Science Society Conference

The Conference is organized by the Faculty of Agronomy and Forestry Engineering, Eduardo Mondlane University, in collaboration with the Agriculture Research Institute of Mozambique (IIAM), the Higher Polytechnic Institute of Gaza (ISPG), The Higher Polytechnic Institute of Manica (ISPM) and the African Crop Science Society (ACSS).

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ACKNOWLEDGEMENTS

MESSAGE FROM THE RECTOR OF EDUARDO MONDLANE UNIVERSITY

Eduardo Mondlane University (UEM), in collaboration with the Institute of Agricultural Research of Mozambique (IIAM), the Higher Polytechnic Institutes of Gaza and Manica and several partner institutions in agriculture, hosts, from the 16th to the 19th of September 2024, the 13th African Crop Science Conference, under the theme "**Building Africa's Future" - Crop Research and Innovation for Agricultural Transformation, Resilience and Inclusion**". This is an international and interdisciplinary event that brings together researchers, students, farmers, entrepreneurs, development agents and policy makers from the national, African and international agricultural sector to share, debate, reflect and dialogue on their research, actions and experiences.

The conference will focus on the contribution of crop research and innovation to agricultural transformation in Africa with emphasis on: (1) Agricultural production systems for sustainable, economically viable and efficient production, from planting to processing, marketing and consumption; (2) Resilience to reduce the impact of climate change, natural hazards and climate-related disasters; and (3) Inclusion for women's and youth participation in agriculture and the market.
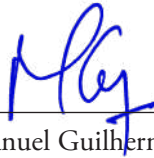
We celebrate the participation of more than 350 actors and the submission of about 150 abstracts, which reflects the contribution of the academy in terms of the promotion and dissemination of knowledge, providing society with useful tools for the progress of science and scientific knowledge to serve as a basis for agriculture development and the well-being of communities across Africa.

I want to express my gratitude to all the presenters who, with their work, as students, researchers, entrepreneurs, farmers, implementers of development projects, make education, science and innovation a central focus for the development of a competitive, sustainable and resilient agriculture and the construction of a society that expands equity and social justice across Africa and around the world as a whole.

As Eduardo Mondlane University, we are fully committed to the development of the food systems and this is reflected in a number of interventions we have been promoting from research, education, extension and outreach. As a matter of fact, the university offers graduate and post graduate courses related to food and nutrition and has food security and nutrition as one of its core research themes, and has just stablished a Centre of Excellence in Agri-food Systems and Nutrition to support our commitments. As

a university, we foresee a future world where zero hunger is possible and NO child across the country, across Africa and across the globe is malnourished. We will continue to support policy development and policy analysis as well as its implementation, that reflects these demands from society.

Maputo, September, 2024

Prof. Manuel Guilherme Júnior

Rector

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WELCOME

The African Crop Science Society (ACSS) was created in 1993 to encourage crop production and food security in the African continent. Over the years, the society's biennial Conference has established itself as an important forum for presenting and discussing a broad range of research results, knowledge and information that impact on agriculture in Africa. Through its organized platforms (such as the African Crop Science Journal and conferences) the society facilitates information sharing, communication, and dissemination of research results from relevant and high-quality research, to foster innovation and African researchers' professional development. From the first ACSS conference held in 1993, twelve (12) African Crop Science Conferences have been held in 8 different African countries (Uganda, Malawi, South Africa, Morocco, Nigeria, Kenya, Egypt and Mozambique). Over the years, the conferences were characterized by significant increases in the number of participants, broadness and relevance of thematic discussions, as well as the scientific value of papers and posters.

Much of Africa has experienced in recent years rapid agricultural and economic growth. At the same time, population growth and demographic change, rural-urban migration, and increasing access to information and communication, have transformed food demand and systems. In many countries, the domestic food market is becoming more attractive for farmers than traditional export cash crops and postharvest activities of the food economy, such as processing, logistics and retail, are developing quickly (FAO, 2016). In addition, a transformation is underway from a subsistence agriculture into one that is more commercialized and integrated into national and international value-chains driven by small and medium private sector enterprises (SMEs). These developments are creating new growth opportunities for Africa agriculture.

However, sustainable agricultural growth in Africa is challenged by several factors. Food insecurity and malnutrition remain a major concern across the continent and without action, will be exacerbated by high population growth. Stagnant and low productivity due mainly to limited inputs use remains one of the major challenges facing African agriculture, as increases in production have mainly been the result of population increase and area expansion. The impact of climate change is another challenge facing agriculture in Africa. Increases in temperature in the continent is being paralleled with increased drought and other extreme events occurrence, which are higher in Africa compared to most other regions in the world. Unfortunately, Africa suffers disproportionately from climate change due to poverty and overreliance on rainfall. Africa has a young population, and family farming will remain the single largest source of employment in the coming decade (WB, 2016). Modernizing and making the agriculture sector attractive to young people is another important challenge facing African agriculture with a high potential

impact on poverty reduction and agricultural growth (FAO, 2016).

These challenges require robust and dynamic innovations that target traditional agriculture and its stressful environments. Crop research and innovation is the backbone of sustainable agricultural growth, bringing new knowledge and practical solutions to the problems faced by farmers and entrepreneurs. African Crop Science Society (ACSS) offers one of the most positioned platforms for sharing of actions, innovations and other developments in crop science and production in Africa.

The overall theme of this 13th ACSS Conference "**Building Africa's Future" - Crop Research and Innovation for Agricultural Transformation, Resilience and Inclusion**, expresses the broad range of opportunities and challenges facing African agriculture today. Research results, innovations and practical solutions across several disciplines, from plant breeding and crop management practices for increased productivity and climate resilience to commodity value chain analysis, technology adoption and inclusion of youth and women, will be shared and discussed.

The conference will focus on the contribution of crop research and innovation to agricultural transformation in Africa across 3 main pillars:

- **Theme 1. Agricultural production systems** for sustainable, viable and efficient production from planting to processing, marketing and consumption. Topics include:
  - ❖ Plant breeding, biotechnology and seed systems.
  - ❖ Food systems and nutritional security.
  - ❖ Agro-processing.
  - ❖ Modern production systems and technologies (digital agriculture, mechanization).
  - ❖ Under researched and emergent crops.
- **Theme 2. Resilience** for reduced impact of climate change, natural hazards and climate-related disasters. Topics include:
  - ❖ Breeding for climate stress-tolerant varieties.
  - ❖ Climate change and agricultural systems resilience.
  - ❖ Soil health, fertility and management.
  - ❖ Sustainable, conservation and regenerative agriculture.
  - ❖ Crop protection, integrated pest management and biosafety.
  - ❖ Water management.
- **Theme 3. Inclusion** for market involvement of women and youth in agriculture. Topics include:

- ❖ Agribusiness, entrepreneurship and inclusive market systems.
- ❖ Smallholder farming and marketing inclusion.
- ❖ Gender inclusive approaches for technology adoption, access to resources, training and market opportunities.
- ❖ Youth engagement in agriculture.
- ❖ Agricultural knowledge systems.
- ❖ Policies for agricultural transformation.

To accomplish its goal the Conference will facilitate a learning, dynamic and interactive environment where opportunities will be created for researchers, innovators, farmers, private entrepreneurs, academics, students and policy makers to share research and innovation results and to discuss strategic recommendations around the themes of the Conference.

The conference will consist of a 4-day program of events and will combine the traditional conference in-person experience with online participation where both groups of attendees can interact with each other. A total of 152 abstracts have been approved for the conference and will be presented across the following events:

- ❖ **Four Symposia** where experts will be invited to present their insights and experiences on how agricultural science and innovation can contribute to facing the main agriculture challenges. Experts' presentations will be followed by a panel discussion in a plenary session.
- ❖ **Four Special Sessions** where a structured and interactive environment will be created to share results experiences around a specific theme and discuss strategies and ways forward to improve research and innovation outputs. Two or three oral presentations may be included.
- ❖ **Eight Thematic scientific sessions** where researchers will present their latest results in their specific field.
- ❖ **Two Posters sessions** where participants will illustrate their work using a poster pinned to a poster board. Presenters will engage with interested participants on a one-to-one basis, providing opportunities for networking, discussion and relationship building.
- ❖ **An Exhibition** where farmers, agribusinesses, education and research institutions will present products and information related to their businesses. Interested participants engage with on a one-to-one basis with each exhibitor.

We dedicated a lot of energy and effort to turn this conference and your stay the best possible and we apologize in advance for any inconvenience and last-minute changes that may occur.

The Local Organising Committee warmly welcomes you to the 13th African Crop Science Conference and hopes that you will enjoy and profit from the very promising conference sessions. We are convinced that the contributions of all of you will result in important progresses for African agriculture and will inspire our research and practices.

Welcome to our country and our capital city Maputo! We hope you will find some time to meet the people and enjoy the friendly and lively atmosphere of Maputo.

The Local Organizing Committee

African Crop Science Society Conference 2024

CONFERENCE PROGRAM

MONDAY, September 16

Activity	Room	Time													
		7am	8am	9am	10am	11am	12am	1pm	2pm	3pm	4pm	5pm	6pm	7pm	8pm
Registration	CPII														
Pre-Conference Symposium (by invitation only) Building Agri-Food Systems & Climate Action in Mozambique (Organized by PASET Rsif, MOZSKILLS)	CPI 1501														
Chairs and moderators meeting															

TUESDAY, September 17

Activity	Room	Time													
		7am	8am	9am	10am	11am	12am	1pm	2pm	3pm	4pm	5pm	6pm	7pm	8pm
Registration	CCMC														
Opening Session	CCMC														
Keynote Address	CCMC														
Cultural Moment	CCMC														
Launch of the The Centre of Excellence in Agri-Food Systems and Nutrition (CE-AFSN)	CCMC														
Group Photo and Coffee Break	CCMC														
Symposium I	CCMC														
Agricultural production systems for a sustainable, viable and efficient production	CCMC														
Lunch Break (self-service)	CPII														

Acronyms

CPI _ Complexo Pedagógico I
CPII _Complexo Pedagógico II
CCMC _ Centro Cultural Moçambique China

Oral Presentations Sessions

Activity	Room														
Time		7am	8am	9am	10am	11am	12am	1pm	2pm	3pm	4pm	5pm	6pm	7pm	8pm
Session 1: Gender, Youth and Market Inclusiveness	CPI 1501								▓	▓					
Session 2: Plant Breeding and Biotechnology	CPI 2501									▓					
Special Session I	CPI 2502									▓					
Opportunities and constraints for the adoption of irrigation as a resiliency enhancing technology (Organized by FTF RESINA)										▓	▓				
Exhibition	CPII 101 & 102							▓	▓	▓	▓	▓			
Coffee Break	CPI										▓	▓			
Poster Session I	CPI														
Welcome Cocktail													▓	▓	

WEDNESDAY, September 18

Activity	Room														
Time		7am	8am	9am	10am	11am	12am	1pm	2pm	3pm	4pm	5pm	6pm	7pm	8pm
Registration	CCMC	▓	▓												
Symposium II	CCMC		▓	▓	▓										
Resilience for reduced impact of climate change, natural hazards and climate related stresses				▓	▓										
Coffee Break	CP II				▓										
						▓	▓								
Oral presentations Sessions															

Activity	Room	7am	8am	9am	10am	11am	12am	1pm	2pm	3pm	4pm	5pm	6pm	7pm	8pm
Session 3: Soil Health, Fertility and Management	CPI 1501														
Session 4: Climate Change and Resilience	CPI 2501														
Special Session II	CPI 2502														
Agricultural Innovations for a Sustainable and Resilient Agri-Food System (Organized by The International Agricultural Research Centers in Partnership with AID-I Mozambique)						█	█								
Lunch Break (self-service)	CPII					█	█	█							
Oral Presentations Sessions									█	█					
Session 5: Agriculture Policies	CPI 1501								█	█					
Session 6: Crop Protection	CPI 2501								█	█					
Special Session III	CPI 2502								█	█					
Resilient and Inclusive Agrifood systems: The work of SOCODEVI with cooperatives in Africa (Organized by SOCODEVI)									█	█					
Exhibition	CPII 101 & 102					█	█	█	█	█	█	█			
Coffee Break	CP II										█				
Poster Session II	CPI										█	█			

THURSDAY, September 19

ACTIVITY	ROOM	7am	8am	9am	10am	11am	12am	1pm	2pm	3pm	4pm	5pm	6pm	7pm	8pm
Registration	CCMC	■													
Symposium III	CCMC		■	■											
Inclusion for market involvement of women and youth in agriculture			■	■	■										
Coffee Break	CPI				■										
Oral Presentations Sessions															
Session 7: Knowledge Systems	CPI 1501					■	■								
Session 8: Food Security and Food Safety	CPI 2501					■	■								
Special Session IV	CPI 2502					■	■								
Agriculture insurance: Ongoing efforts to strengthen rural farmers resilience in local food systems (Organized by FTF RESINA)						■	■								
Special Session V	CPII 202					■	■								
Biotechnology and OFAM-Mozambique (Organized by ATTF)						■	■								
Lunch Break (self-service)	CPII							■							
Closing Keynote address	CCMC								■						
Closing Session	CCMC									■					
Coffee Break															
Exhibition	CPII 101 & 102					■	■								
Gala Dinner	CPI													■	■

MONDAY, September 16
Room: Complexo Pedagógico UEM

11:00 – 16:00	Registration Room: Secretariat Office CPII
08:00 – 17:00	Pre-Conference Symposium (by invitation only) Building Agri-Food Systems & Climate Action in Mozambique (Organized by PASET Rsif, MOZSKILLS) Room: CPI 1501
15:30 – 16:30	Session moderators and workshop organizers meeting Room: CPII 104

PRE-CONFERENCE SYMPOSIUM (BY INVITATION ONLY)
BUILDING AGRI-FOOD SYSTEMS & CLIMATE ACTION IN MOZAMBIQUE
(ORGANIZED BY PASET RSIF)
Room: CPI 1501, Complexo Pedagogico, UEM Main Campus

08:15 – 08:45	**Session 1:** Welcome and Setting the Tone
08:45 – 09:45	**Session 2:** Insights on doctoral programs in Agri- Food Systems & Climate Change from African Universities
09:45 – 10:15	Family photo and coffee break
10:15 – 11:00	**Session 3:** Enhancing doctoral programs in Agr Food Systems & Climate Change (Continued)
11:00 – 11:30	**Session 4:** Perspectives from Emerging Science Leaders
11:30 – 12:30	**Session 5:** Panel Discussion on Strategies for strengthening Doctoral Training Programs in Agri-Food Systems and climate resilience within African Universities
12:30 – 13:00	**Session 6:** Collaborating for resilient agri-food systems in Africa
13:00 – 14:00	Lunch Break
14:00 – 14:30	**Continued-** Group Discussions on potential areas of collaboration: 3 Groups based on the sub- themes

14:30 – 15:15	**Plenary** Feedback of joint areas of collaboration including next steps
15:15 – 15:30	**Session 6:** Closing Statements
15:30 – 16:00	Tea Break
16:00 – 17:00	**Session 7:** Experiential Knowledge Exchange

TUESDAY, September 17

7:30-08:30	Registration

OPENING SESSION
Room: CCMC

08:30	Arrival of his Excellency Minister of Science Technology and Higher Education, Mozambique
08:30 - 08:35	**National Anthem**	UEM Choral Group
08:35-08:40	**Objectives and programme of the conference**	Prof. Amélia Sidumo, LOC Coordinator
08:40 – 08:45	**Welcome Remarks**	Prof. Ernesto Uetimane Júnior, Dean of the Faculty of Agronomy and Forestry Engineering
08:45 – 08:50	**ACSS Remarks**	Prof. Luísa Santos, President of ACSS
08:50 – 08:55	**EDUARDO MONDLANE UNIVERSITY ADDRESS** **Prof. Manuel Guilherme Júnior** Rector of Eduardo Mondlane University

08:55 – 09:05	**OFFICIAL OPENING ADDRESS** **Prof. Daniel Nivagara** His Excellence Minister of Science Technology and Higher Education, Mozambique
09:05 – 09:35	**KEYNOTE ADDRESS** **BUILDING AFRICA'S FUTURE: CROP RESEARCH AND INNOVATION FOR AGRICULTURAL TRANSFORMATION, RESILIENCE, AND INCLUSION** **Dr. Canisius Kanangire** Executive Director of African Agricultural Technology Foundation (AATF) Dr Canisius Kanangire is the Executive Director of African Agricultural Technology Foundation (AATF) since 2021. Dr Kanangire has over 20 years' experience in leadership roles across the African continent and over 20 years in Academia including as Dean of the Faculty of Agriculture, University of Rwanda, and Scientific Chairman of the Nile Basin Research Program, a post-doc program at the University of Bergen (Norway). He holds a PhD in Aquatic Sciences, with specialization in Aquaculture, from the University of Namur (Belgium).
09:35 – 09:45	**CULTURAL MOMENT**

LAUNCHING OF THE CENTER OF EXCELLENCE IN AGRI-FOOD SYSTEMS AND NUTRITION (CE-AFSN) Room: CCMC	
09:45 – 10:15	**Presentation about the Center and depoiments** | Prof. Rogério Chiulele, Director of the Center
10:15 – 10:25	**World Bank Adress** | Dr. Iain Shuker, Regional Director for Agriculture, climate Environment, Social Inclusion For Eastern and Southern Africa Region at the World Bank
10:25 – 10:40	**UEM Rector Adress** | Prof. Manuel Guilherme Júnior, zRector of Eduardo Mondlane University
10:40 – 11:00	**Official Launching Address** | Prof. Daniel Nivagara, Hon Minister of Science Technology and Higher Education
11:00-11:03	**Eduardo Mondlane University Anthem** | UEM Choral Group
11:00-11:30	**COFFEE BREAK**

SYMPOSIUM I Room: CCMC		
TIME	AGRICULTURAL PRODUCTION SYSTEMS FOR A SUSTAINABLE, VIABLE AND EFFICIENT PRODUCTION Room: CCMC **Moderator: Dr. Zélia Menete**, Director of the Agricultural Researh Institute of Mozambique	
11:30	Introduction	
	Keynote speakers	
11:40	S1 - 01	**AGROECOLOGICAL INTENSIFICATION OF MIXED CROP LIVESTOCK PRODUCTION SYSTEMS OF SUBSAHARAN AFRICA: THE NEED FOR BIOPHYSICAL AGRONOMY TO ENGAGE MORE INTO INTEGRATED ASSESSMENTS OF AGRICULTURAL SYSTEMS.** **Dr. François Affholder** Principal Investigator and Project coordinator, CIRAD, France Dr. François Affholder developed his career across more than 30 years, mostly as a permanent staff at CIRAD, with long term assignments in partner research institutions of Senegal, Brazil, Vietnam (then as seconded by Cirad to IRRI), and currently Mozambique. His main area of interest is on integrated assessment of sustainability of agricultural systems with special attention to climate-related risks, through interdisciplinary collaborations with social sciences and sciences of the ecosystem.

12:00	S1 - 02	**CROP SCIENCE FOR AGROECOLOGICAL INTENSIFICATION OF AFRICAN AGRICULTURE: LESSONS AND PERSPECTIVES** **Dr. Rachid Serraj** Director of Africa Initiative and Strategy for agriculture, water and climate at Mohammed VI Polytechnic University (UM6P), Morocco Dr. Sarraj has an extensive experience in research and development and occupied several positions in various international research centres and organizations such as IRRI, IAEA, ICRISAT. He is an expert in crop physiology, agronomy, precision farming and agri-food systems innovation. His research has focused on crop stress tolerance, resource use efficiency and adaptation to climate change.
12:20	S1 - 03	**THE ROLE OF AGRICULTURAL SYSTEMS RESEARCH IN MOZAMBIQUE AND THE NEED FOR AN INTEGRATED APPROACH TO GUARANTEE ADOPTION BY SMALL SCALE FARMERS: RESEARCH, EXTENSION, MARKETS** **Dr. Marcos Freire** Mozambique Dr. Marcos Freire works in agriculture since 1982. He has 20 years of experience in teaching and researching at UEM. For 3 years he was the Operations Manager at a Cotton Company (Dunavant Moçambique Lda) and after that worked as an agricultural development expert in several projects/programs (ARD, USAID, WB, MCC, AGRA). Over his professional life he has been contributing to the education and training of farmers and of the new generations of agriculture professionals.
12:40		Discussion
12:55		Closing remarks
13:00 – 14:00		**LUNCH**

SPECIAL SESSION I
Room: CPI 2502

TIME	OPPORTUNITIES AND CONSTRAINTS FOR THE ADOPTION OF IRRIGATION AS A RESILIENCY ENHANCING TECHNOLOGY (ORGANIZED BY FTF RESINA)
14:00 – 16:00	**Justification** The impact of climate change highlights the importance of finding affordable irrigation technologies that can promote water conservation and increase farm production and productivity. They are however numerous constraints and opportunities that must be recognized and addressed in the promotion of irrigation as a resilience enhancing technology for climate adaptation. These factors include the need for appropriate technology demonstration and demand activation, development of inclusive financing mechanisms, promotion of an enabling environment that includes service provision for technology installation, operation, and maintenance. There is need also to strengthen public private partnerships to unlock investments and cooperation between the market actors in this sector. **Objectives** This session will highlight the main constraints and opportunities in the adoption of irrigation as a resilience-enhancing technology in rural communities. Specifically, the session will highlight private sector innovation involving the operationalization of pay as you go facilities as a financing mechanism for irrigation technologies targeting rural entrepreneurs.

Expected Results

The session will provide participants with improved understanding of the structure of the irrigation sector. The opportunities and constraints related to adoption of irrigation technologies in rural communities will be discussed. Lessons learnt from private sector led innovative financing models will also be shared positioning the participants to be able to better design and implement climate adaptation interventions that include promotion of irrigation technologies.

Format

This session will include a special presentation from a private sector actor, followed by a panel discussion with key experts in irrigation both from public and private sectors. A plenary session will be provided to allow participants to add technical inputs and present any issues that require clarification.

ORAL PRESENTATION SESSIONS

TIME		**THEME: INCLUSION** *Session 1 – Gender, Youth and Market Inclusiveness* Room: CPI 1501 Chair: Prof. Nícia Givá	
14:00		Introduction by the Chair	
14:05	01-1	**Mpho Tshikororo,** T. A. Nefale and A. J. Netshipale	Economic Dynamics Shaping Climate Change Adaptation Patterns: Lessons From The Agricultural Market Performance Trends Among Youth Agripreneurs
14:20	01-2	**Edgar Francisco** E. Munda R. Muassabo A. Naico and J. Ricardo	Role of farmer to farmer extension approach in incresing orange fleshed sweet potato productivity and marketing in Massinga districts of Mozambique.
14:35	01-3	**Tomás Sitoe** and C. Vilanculos	Effect Of Contract Farming On Farmers' Income: Empirical Evidence From Smallholder Farmers In Magude District, Southern Mozambique
14:50	01-4	**O. O. Aminu** and B. E. Olanipekun	Gender Analysis Of The Challenges To Rural And Urban Youth Engagement In Agriculture-Based Livelihood Activities In Ondo State, Nigeria
15:05	01-5	**Vilma Tsembane,** N. Givá and J. Bila	"Munasi", The Heart Of Zambezia: Gender Based Impact Of Coconut Lethal Yellowing On Rural Livelihoods

15:20	01-6	**Henry Kamowa**	Can Structured Markets Play A Critical Role In Malawi's Drive For Agricultural Commercialisation? A Case Of Agricultural Commodity Exchange For Africa (Ace)
15:35	01-7	**Dionecleciano C. Alexandre,** A.Tocoloa, H. V. Colial, V. Salegua, S. I. Somueque, B. Divage and M. Donça	Analysis Of Economic And Financial Profitability In The Production And Marketing Of Cowpea [*(Vigna Unguiculata* (L.) Walp.] In Small Farmers Of Mogovolas And Ribaué District.

TIME			THEME: PRODUCTION SYSTEMS *Session 2 – Plant Breeding and Biotechnology* Room: CPI 2501 Chair: Dr. Celestina Jochua and Prof. Custódio Tacarindua
14:00			Introduction by the Chair
14:05	02-1	**Bento Filipe Francisco**, A. Kondwakwenda, J. Sibiya and A. C. Houdegbe	Assessment of genetic diversity using SNPs Markers and marker-trait association studies in local Mozambican cultivated tomatoes
14:20	02-2	**Stella E. C. Nhanala**, Bode A. Olukolub and G. Craig Yenchoc	Identification Of Tas14 As A Candidate Gene For Drought Tolerance By Rna-Seq In Sweet Potato
14:35	02-3	**Bakang K. Kgasudia**, S. Ngwakoa, G. Malambanea, M. Pholo-Taitb And L. Lekgaric	Inheritance Of Seed Coat Colour Patterns And Antioxidant Activity In Cowpea Parental Genotypes And Their F1 Crosses
14:50	02-4	**Lourenco Caunganha**, E. Munda, R. Pereira, J. Ricardo, E. Francisco, P. L. Thumbo, E. Namanja, F. Meireles and L. Enriques	Evaluation Of Adaptability And Stability Of Eight Potato Clones In Niassa Province, Mozambique
15:05	02-5	**Gervancio Covele**, A. Chichango, G. Madroba, H. Joao and G. S. Makunde	Performance of High Iron Sweetpotato Clones from Elite Crosses Across Mozambique Environments

15:20	02-6	**M. P. Maleia,** J. João, S. A. M. Salé, C. M. Domingos, J. O.Teca, A. Raimundo J. Ussene, B. B. Irénio, V. Kimeles, A. F. Chicola, T. A. Perar, H. F. De Sousa, D. B. Guedes, E. C. Jamal, O. Carimo, D. E.Muhala, P.Tebulo and C. C. André	Genotype By Environment Interaction, Adaptability And Stability Analysis Of Cotton (*Gossypium Hirsutum* L. *Race Latifolium* H.) In Northern Mozambique
15:35	02-7	**Aldo Mabureza**	Unlocking The Potential Of Sorghum: A Comparative Study Exploring The Physical, Chemical, Technological, And Digestibility Properties Of New Cultivars From Mozambique
16:00 - 16:30		**COFFEE BREAK**	

POSTER SESSION I

CODE	AUTHORS	TOPIC
P1-01	**Helena Moisés João**	Determinants Of The Use Of Vegetable Production Systems In Kamamota District: Case Study Of The Armando Guebuza Association
P1-02	**Vilma Rosa Tsembane**, N. Givá and J. Bila	Differences In The Level Of Knowledge About Coconut Lethal Yellowing Between Men And Women Coconut Farmers In Zambezia Province.
P1-03	**Michael Olwarotimi Olojugba**, I. Mendy and F. T. Ayodele	Study On Performance Of Cow Manure (CM), Poultry Manure (PM), Tap Water (TW) And Their Efficiency On The Production Of Maize Fodder Under Low Cost Green House Hydroponic Fodder Production System In Westcoast Region, The Gambia.
P1-04	**H.A. Miteca**, E. T. F. Conceição, M. Naimoa, H. M. Baya, O. M. DA Paz, A. Jorge, N.S. Mussá, M. Meneses, P. Hinrichsen, C.Muñoz and L.Prat	Morphological Characterization Of Papaya Germplasm *(Carica papaya L.)* Collected In Different Locations Along The Nacala Corridor, Nampula Province - Mozambique.
P1-05	**Salvado K. M. Mropes**, L. D. Moiana, L. A. Alberto, J. M. Andreque	Morphological characterization of 18 rice varieties
P1-06	**Z. Quadri**, M.T. Abberton, O.J. Oyatomi and O. J. Iawuyi	Variability Studies On Qualitative And Quantitative Characters Of *Phaseolus lunatus* L. (Lima Bean) Accessions

CODE	AUTHORS	TOPIC
P1-07	**Lopes Neves,** H. Malia, R. Afonso, A. Taula and C. Ecole (virtual)	Evaluation Of Different Sowing Dates On The Agronomic Performance Of Onion Varieties (*Allium cepa* L.) At The Umbeluzi Research Station
P1-08	**Cyntia Miguel, I. Victorino,** R. Abobacar, M. Pinho, S. Guilundo, C. Martins, O. Quilambo	Insecticidal Potential Assessment Of Coffee (*Coffea arabica* L.) In Cabbage Cultivation (*Brassica oleracea* L. Var. Acephala D.C
P1-09	**Shelcia Mery Sérgio Nhacudine**	Effect of consociate cultivation of cotton (*Gossypium hirsutum* L.) and cover crops [peanut (*Arachis hypogaea* L.) and labe labe (*Dolichos lab-lab*)] on yield and incidence of cotton pests
P1-10	**Muhamman M. A.,** I. Mohammed and I. H. Lakun	Performance Of Potato (*Solanum tuberosum* L.) Varieties With Different Levels Of Farmyard Manure Under The Cold Harmattan Weather Of Gombe, Sudan Savanna, Nigeria
P1-11	**P. T. Owombo**	Effect Of Integrated Pest Management Technologies On The Yield Of Maize In Nigeria
P1-12	**Cassamo Mahomed Ismail,** Alberto Alaniz Baeza and Carlos Valdivia Prats	Agricultural Land Use Is Increasing Soil Loss In The Lugenda River Basin, Part Of One Of Africa's Largest Conservation Areas: A Multitemporal Analysis
P1-13	**Y. Mustapha,** I. Manu and H. Saleh	Effect Of Different Rates Of Inorganic And Organic Fertilizer On Growth And Yield Of Onion (*Allium cepa* L.) In Gombe, Nigeria

CODE	AUTHORS	TOPIC
P1-14	**Binaissa U. L. Castiano**, Paul K. Kimurtob and Pascal P. O. Ojwang	Stability And Genetic Analyses Of Common Bean (*Phaseolus vulgaris* L.) For Root Traits And Seed Yield In Marginal Environments In Central Mozambique
P1-15	**Jennifer Langa** and A. Sidumo	Evaluation of the efficiency of biopesticides in pest control in sustainable cotton production in regenerative agriculture systems
P1-16	**L. A. Sani**, K. M. Umar, S. R. Babura, M. M. Abdulmalik, I. S. Usman, L. B. Hassan, A. A. Muhammad and A. M Hamza	Molecular Technique For Sex Identification At Early Developmental Stage In Date Palm (*Phoenix dactylifera* L.)
P1-17	**Ogunsusi**, Kayode	Urban Agroforestry: Case Study Of Forest Garden As A Resilient Agricultural System For Food Production
P1-18	**Teresa Mutemba**, A. M. Mondjana, J. Bila, C. Ecole and S. Nhanala	Evaluation Of The Effects Of Potassium Top Dressing Fertilization On Strawberry Yield And Plant Gray Mold (*Botrytis cinerea*) Disease Severity
P1-19	**Lum Ayeoffe** and D. Chikoye	Effect Of Weed Interference On The Performance Of Cabbage (*Brassica oleracea* L.) In Buea, Cameroon
P1-20	**H. S. Hamisu**, M.F. Ishiyaku, S. M. Mohammed, M. M. Abdulmalik., M.M. Umar and A. Usman	Inheritance Studies Of Heat Tolerance Traits In Tomato (*Solanum lycopersicum* Mill.) Genotypes Under Field Condition

CODE	AUTHORS	TOPIC
P1-21	**Eliah Munda,** R. Muassabo E. Francisco J. Ricardo and C.Samuel	Effect of the cutting frequency on sweet potato root yield components in southern Mozambique
P1-22	**Orlando Mabureza Tuco-Tuco,** D. Chongo, Z. Menete and R. Brouwer	Combined Effect Of Diferent Levels Of Potassium And Boron On The Yield And Quality Of Orange Fleshed Sweet Potato (*Ipomoea batatas* L.)
P1-23	**Mosamarea Motladi,** T. S. Moroke, Ut. Batlang, B. K. Sebogisi, T. Mathowa	Comparative Effects Of Bioslurry And Chemical Fertilizer On Soil Properties And Perfomance Of Spider Plant (*Cleome gynandra* L.)
P1-24	**M.M. Abdulmalik,** M.L. Umar And L.A. Sani	Biotechnology Strategies For The Conservation Of Plant Genetic Resources
P1-25	**Knowledge Mutodi**	Small-Scale Irrigation: Constraints And Opportunities For Adoption In Mozambique.
P1-26	**M. K. Maduna,** S. S. Thosago, M. P. Bopape-Mabapa M.P And F. R. Kutu	Effect Of Varying Phosphorus Application Rate
P1-27	**E. Joseph,** I. Saifudeen and A. N. Baba-Kutigi	Potentially Toxic Element Pollution Level And Risk Assessment Of Sediments In A Local Fertilizer Blending Plant At Kankara, Katsina – Nigeria
P1-28	**Ronaldo Zunguze,** C. Monjane, M. Mazivele, N. Hogberg, A. Berlin And J. Bila1	First Report Of Banana Bunchy Top Virus Disease Alternate Hosts In Mozambique

CODE	AUTHORS	TOPIC
P1-29	**Hamdino M. I. Ahmed,** Kawther K. Dawa, Mahmoud M. Zaghloul And Khadja M.Hamad	Optimization Of Tomato (*Solanum lycopersicum* L.) Productivity Under Water Stress Conditions Using Some Different Protective Foliar Treatments
P1-30	**N. A Okoli.** and M. C. Nwaemesi	Utilization Of Food Waste-Cow Dung Compost As Substrates For Two Pawpaw Varieties In The Nursery
P1-31	**O. J. Guambe,** M. Andrade, G. Makunde, M. Moyo, D. Ndere and L. Tivana	Relationship between textural and sensory properties of sweet potato [*Ipomea batatas* (L.) LAM] genotypes grown in Mozambique
P1-32	**Tomás Massingue**	Rice seed production and management practices of smallholder farmers in southern Mozambique
P1-33	**Samuel Alves Camilo**	Shoot traits associated with drought stress tolerance in common beans (*Phaseolus vulgar* L.)
P1-34	**Domingos Machava**	Sustainability analysis of fire management in Niassa Province
P1-35	**Ricardo Macia**	Effect Of Different Concentrations Of Sucrose On The In Vitro Growth Of Cassava Cultivars (*Manihot esculenta* Crantz)
P1-36	**Angelo Cumbane,** C. Jorge, G. Braga and H. Malia	Efficiency and selectivity of insecticides and some biopesticides frequently used in the control of *Spodoptera frugiperda* in Manica Cumbane province

CODE	AUTHORS	TOPIC
P1-37	**Alcídio Vilanculos,** C. Jeque, L. Joaquim, T. António, I. Maluleque, T. Alves, D. Chiar, F. Tavares, M. Francisco, F. Mandlate, S. Moiane, V. Cossa, X. João and F. Semba	Syntropic Agroforestry Systems As An Alternative To Climate Change Mitigation And Adaptation
P1-38	**H. Abade,** N. Munguambe, H. Duarte, J. Popisk, B. Casimiro, J. Matimbe, J. Magia, J. Fagema, and M. Langa	Development of Improved Rice Varieties for Rainfed Lowland Ecosystem
P1-39	**O. Chichongue,** J. Mudema, and D. Munguambe	Increasing resilience of smallholder farmers to Climate change through adoption of climate Smart Agriculture practices in Mozambique
P1-40	**Eric Gyasi,** E. Osei Owusu, B. A. Adongo, F. A. Karim, V. Sackey and D. A. Kotey	Antifungal Activity Of Five Botanical Extracts On Storage Rot Fungi Of Taro (Colocasia esculenta (L.) Schott)
P1-41	**Jossias Vilanculo,** A. Chichongue, António A. Nguambe and Herminio Vaso	Low Cost Irrigation System

18:30 – 20:00	**WELCOME COCKTAIL**

WEDNESDAY, September 18

SYMPOSIUM II
Room: CCMC

TIME		RESILIENCE FOR REDUCED IMPACT OF CLIMATE CHANGE, NATURAL HAZARDS AND CLIMATE RELATED STRESSES Room: CCMC **Moderator: Kemal Torcato Vaz** | Universidade Eduardo Mondlane e Verde Azul Consult
08:30		Introduction
		Keynote speakers
08:40	S2 - 01	**AGRICULTURAL CHALLENGES IN THE FACE OF CLIMATE CHANGE IN AFRICA** **Prof. Almeida Sitoe** Eduardo Mondlane University Almeida A. Sitoe is a full Professor of Tropical Forest Ecology and Silviculture at UEM. He is the Chairholder of the Oliver Tambo Africa Research Chair on Ecosystem based Adaptation to climate change in arid and semiarid zones. His research is focused on forest ecosystems, including ecosystem services and the role of forests in climate change adaptation and mitigation. He is a key element in climate change policy development in Mozambique, as he drafted the national strategy for climate change adaptation and mitigation, the national strategy for reduction of emissions from deforestation (REDD+), the national adaptation plan (NAP), and the nationally determined contributions (NDC).

09:00	S2 - 03	**AFRICAN AGRICULTURE IN A CHANGING CLIMATE: CHALLENGES FOR ADAPTATION AND RESILIENCE** (Virtual) **Dr. Makoala Marake** National University of Lesotho Prof. Makoala V. Marake has over 39 years of experience as a teacher and trainer in both academic and community development initiatives. He has researched and consulted broadly in climate change adaptation, natural resource management and transitions in a changing climate entails soil fertility/plant nutrition, conservation agriculture systems, land evaluation and environmental impacts of land use and participatory approaches to resource conservation, environmental management, rural Development, biophysical and ecosystems interactions in relation to people's livelihoods, agro-biodiversity for sustainable agriculture and adaptation to climate change.
09:20	S2 - 03	**WHY BIODIVERSIY IS IMPORTANT** **Dr. Mathew Cassete** Executive Director JRS Biodiversity Foundation Dr. Matthew Cassetta joined JRS in 2021 as the Foundation's third Executive Director. He brings over two decades of diverse experience in international diplomacy and project management, much of it focused in Africa on capacity-building and development partnerships. Matthew's work in Africa began as Regional Environment Officer for Central and West Africa, and later as Facilitator

		of the multilateral Congo Basin Forest Partnership. Matthew has developed collaborations with partners in civil society, academia, the private sector, and national governments for impactful programs to advance development while valuing unique biodiversity and enhancing environmental stewardship.
09:40	S2 - 04	**CARBON TRADING OPPORTUNITIES IN AGRICULTURE: EXPERIENCE FROM TANZANIA** (Virtual) **Prof. Eliakimu Mnkondo Zahabu,** National Carbon Monitoring Centre (NCMC), Sokoine University of Agriculture, Tanzania Prof. Zahabu teaches and carry out research and consultancy services in the areas of Forest Resources Assessment and Management; Climate change and Forestry. He is also a Coordinator of the National Carbon Monitoring Centre (NCMC) since January 2016 to date. NCMC provides technical support to the government on Measuring, Reporting and Verification of GHGs Inventory, REDD+ and Nationally Determined Contributions (NDC). Prof. Zahabu has published a number of scientific articles, book chapters and reports on forestry issues and climate change.
10:00		**Video** – Integrated Resilience in Nutrition and Agriculture, FTF RESINA Organic fertilization as one of the bets to increase the production and productivity of small producers
10:05	Discussion	
10:30	Closing remarks	
10:30 – 11:00	**COFFEE BREAK**	

SPECIAL SESSION II
Room: CPI 2502

TIME	AGRICULTURAL INNOVATIONS FOR A SUSTAINABLE AND RESILIENT AGRI-FOOD SYSTEM Organized by The International Agricultural Research Centers in Partnership with AID-I Mozambique
11:00 – 13:00	**Justification** Rapid population growth has exerted increasing pressure on available agricultural land and in countries such as Mozambique where land is available, the predominate use of human labor on smallholder farms limit opportunities for land expansion. However, there are significant opportunities for improved germplasm, climate smart agriculture and sustainable intensification to increase yields and narrow the yield gaps. The International and National Research partners have developed proven technologies and innovations in the past decades that can be deployed to enable farmers to improve productivity and adaptive capacity. Panelists will discuss some of these innovations, innovation packages and bundling that have the potential to sustainably increase agricultural productivity, profitability and resilience of smallholder households and communities.
	Objectives ⊕ Discuss proven agricultural innovations for sustainable and equitable increase in smallholder productivity, market access and improve consumption of nutritious food ⊕ Discuss ways to increase availability and accessibility of proven agricultural innovations to men, women and young farmers ⊕ Show-case technologies and innovations available and bundling of innovations for climate adaptation

	⊙	Promote platforms and linkages that bring together key stakeholders to enable context-based problem identification, contextualization of solutions, adoption and scaling of feasible technologies

Expected Results
Through the panel discussion and exhibition, participants will learn, share experiences and broaden their knowledge on available technologies and innovations with the greatest potential to reduce the severity of climate change and improve agricultural productivity and profitability of smallholder farmers.

Format
Panel discussion and exhibition of agricultural innovations

Presentations

SSIV - 01	**Stephen K. Boahen**, C.Malita, A. Naico, M. Andrade, J. Mwololo, W. Leonardo And A. Ndayiragije	Agricultural Innovations For A Sustainable And Resilient Agri-Food System
SSIV - 02	**M. I. Andrade**, and A. Naico	Sweetpotato Research And Innovations For A Sustainable And Resilient Food System

ORAL PRESENTATION SESSIONS

TIME	THEME: RESILIENCE Session 3 – Soil health, Fertility and Management Room: CPI 1501 Chair: Prof. Armindo Cambule and Dr. Oscar Chichongue		
11:00	Introduction by the Chair		
11:05	03 - 01	**Winnie Nchoko,** T. Scott Moroke, G. Malambane and U. Batlang	Optimizing Nitrogen Fertilizer Rate For Upland Rice (*Oryza sativa* L.) Varieties In Southeastern Botswana, Gaborone
11:20	03 - 02	**Matias S. Junior,** J. Herrmann, A. Luís and S. Famba	Evaluation Of SPAD Leaf Greenness Index As A Yield Indicator For Leafy Vegetables Grown In Salt-Affected Soil
11:35	03 - 03	**N.C Adikuru,** C.C Nwaugo, O.M Nnebue and R.A Alagba	Influence Of Planting Date And Mulching On African Eggplant (*Solanum macrocarpon* L.) During Early Season In Owerri Nigeria
11:50	03 - 04	**Domingos Feniasse,** R. Borguete, A. Vilanculos, C. Jorge, A. Lumbela, L. Savanguane and V. Massango	Improving Soil Health, Food Security And Income Of Smallholder Farmers In Mozambique Through The Development And Use Of Appropriate Fertilizer Formulations For Maize And Soybean In The Beira Corridor
12:05	03 - 05	**Senewa Kealeboga Pho**	Effects Of Water Deficit Stress On The Physiological Parameters Of Six *Corchorus olitorius* Accessions.

12:20	03 - 06	**D. O. Ogutu,** R. Njoroge, A. N. Otinga, J. Wanjiku, D. Priest and P. Seward	Effect Of Wondergro- A Soil Conditioner-For Enhancing Fertilizer Use Efficiency In Maize Production

TIME	THEME: RESILIENCE **Session 4 – Climate Change and Resilience** Room: CPI 2501 **Chair:** Dr. Nocy Bila and Dr. Samuel Camilo		
11:00	Introduction by the Chair		
11:05	04 - 01	**Sammy Agili,** I. Njagi, E. Munda, E. Kagete, T. Wanyoike, P. N. S. Amboga and G. Muriithi	The effect of spatial arrangement on the yield and cropping efficiency of maize and sweetpotato inter-crop in lower and upper midland agro-ecological zones in Embu, Kenya
11:20	04 - 02	**Mitiku A. Handiso,** Z. Asfaw, B. Glasser, T. Bromm and B. Lemma	Effects Of Canopy Management Of *Terminalia brownii* (Fresen) On Microclimate And Yield Of Maize (*Zea mays* L.) In Parkland Agroforestry Of South Ari District, Southern Ethiopia
11:35	04 - 03	**Robert Mangania,** K. M. Gunnb and N. M. Creuxa	The Predicted Effect Of Climate Change On Planting Date And Cultivar Choice For Maize Production In South Africa
11:50	04 - 04	**Deborah Thayo**	Exploring Common Bean (*Phaseolus vulgaris* L.) Plants Resilience: Screening For Drought And Salinity Stress Tolerance And Optimizing Pre-Treatment Strategies For Enhanced Abiotic Stress Resistance In Different Bean Lines
12:05	04 - 05	**Jaime Pechiço** and R.Brito	Modelling Impacts Of Climate Changes On Yield And Water Requirements Of Sugarcane (*Saccharum officinarum* L.) In Incomati River Basin: Case Of Manhica District

12:20	04 - 06	**Mesfin M. Feleke** , S. G. Gebrehiwot, Z. A. Dejen and T. Derib	Water Availability And Future Demand Dynamics In Awash Basin With Climate Change Projections
12:35	04 - 07	**Ayansina S. Ayangbenro** and O. O. Babalola	Plant-Growth-Promoting, Drought-Tolerant Rhizobacteria

13:00 – 14:00	**LUNCH**

SPECIAL SESSION III
Room: CPI 2502

TIME	RESILIENT AND INCLUSIVE AGRIFOOD SYSTEMS: THE WORK OF SOCODEVI WITH COOPERATIVES IN AFRICA **Organized by:** Josina Nhantumbo, Coordinator for Gender Equality SOCODEVI Mozambique; Andreé-Anne Cotê-St-Laurent, Policy and Advocacy Adviser, SOCODEVI Canada
14:00 – 16:00	**Introduction** SOCODEVI, committed to strengthening cooperatives and community resilience, works in different regions of Africa so that agri-food systems are not only resilient, but also inclusive. Through programs that aim to train and empower women and young people, SOCODEVI contributes significantly to food security and sustainable development on the continent. In Mozambique and other African countries, the organization supports the creation of value throughout the food chain, helping communities to face and overcome current and future challenges. Special attention is given to the differentiated impact of agri-food systems on women, highlighting their crucial role and the need of training for enhancing their resilience and reducing the inequalities. An approach focused on resilient agri-food systems aims to balance economic, social and environmental interests with improved, sustainable food security, thus supporting their effort to adapt to future challenges.
	Objectives With this panel, SOCODEVI seeks to: 🕐 Explore and share strategies (and perspectives) with the public to build (or strengthen) agri-food systems that are not only resilient but also inclusive, ensuring that women, youth and other vulnerable groups are actively engaged and benefited. Together we can build a more sustainable, equitable and prosperous future for everyone.

⊕ Position cooperatives as key actors to generate resilient and inclusive agri-food systems

Expected Results
It is expected that SOCODEVI and the cooperatives will be recognized as relevant interlocutors in the promotion and development of resilient and inclusive agri-food systems

Format
Presentations by project leaders, farmers, district officials will be made regarding the experiences and results followed by discussion. At the end, the main issues arising from the debate and the recommendations that should be followed to consolidate ongoing actions will be globalized.

ORAL PRESENTATION SESSIONS

TIME	THEME: INCLUSION AND RESILIENCE Session 5 – Agricultural Policies Room: CPI 1501 Chair: Dr. Egas Nhamucho and Prof. Sebastião Famba		
14:00	Introduction by the Chair		
14:05	05 - 01	Wedson Phiri, J. Dzanja, M. Limuwa and H. Phiri	Exploring Incentives And Disincentives Of National Agriculture Policy In Malawi On Value Addition, Job Creation, And Performance Of Smes Within Soybean Value Chain: Evidence From Mchinji, Dowa, Mzimba, And Rumphi
14:20	05 - 02	Rui Benfica, M. Hossain, K. Davis, S. Boukaka and C. Azzarri (IFPRI)	The true costs of food production in Kenya: The role of environmental and social externalities
14:35	05 - 03	Frank Wesonga and F. Keya	Fencing Lands To Enhanced Climate Change Resilience, Promoting Biodiversity Regeneration And Improved Livelihoods Of Climate Change In Makueni County
14:50	05 - 04	Gabriel Viegas, A. Marta-Costa, R. Fragoso and E. Cambaza	Assessing Sugarcane Production Sustainability In Mozambique: Integrating The Sustenagro Approach With The Entropy Weight Method

15:05	05 - 05	**T. Ouma, P.** Agredazywczuk, M. Barthel, A. Otinga, R. Njoroge, S. M. Leitner, Y. Zhu, C. Oduor, F. Perez-Cruz, J. Six and E. Harris	Improving Nitrous Oxide Emissions Accounting In Kenya: Insights And Measurement Results From Fertilizer Practices, Environmental Drivers, And N_2O Isotopic Composition In Uasin Gishu County.
15:20	05 - 06	**Loveline Ndzi**, A. Nkuh, D. Tarla, B. Tatah, E. Ngeh and G. Tanga	Agricultural Cooperative: A Catalyst For Rural Development
15:35	05 - 07	**Constantino T. Senete,** P. Fato, P. S. Chaúque, E. Nhamucho and J. Massitela	Challenges Of Plant Breeding In Mozambique

TIME	THEME: PRODUCTION SYSTEMS AND RESILIENCE **Session 6 – Crop Protection** Room: CPI 2501 Chair: Dra Celsa Macandza and Mr. Emmanuel Malai		
14:00	Introduction by the Chair		
14:05	06 - 01	**K.N. Ntidi** and H. Fourie	Nematode Problems In Subsistence Grain Production Areas Of South Africa
14:20	06 - 02	**Taonga Chasweka**	Identification Of Candidate Microbe For The Development Of Biological Fungicides Against *Phytophthora infestans*
14:35	06 - 03	**Stanlous J. Waswa**, J. W. Waceke and M. Mwangi	Compatibility Of Endophytic Fungus (*Colletotrichum nigrum*) With Velum *(Synthetic Nematicide) Against Root-Knot Nematode (*Meloidogyne* spp.) On Tree Tomato
14:50	06 - 04	**Ali Ussene**, A. Chamuene and F. José	Co-Occurrence And Niche Differentiation Of Lepidopteran Pests And Their Earwig Predator (*Doru luteipes*) In Maize Under Conservation Agriculture In Nampula, Mozambique (virtual)
15:05	06 - 05	**Venâncio A. Salegua**	Grain Yield, Stability And Bacterial Brown Spot Disease Of Dark Red Kidney Dry Bean (*Phaseolus Vulgaris* L.) Genotypes Across Six Environments In South Africa
15:20	06 - 06	**Jamisse Amisse**, E. Chaur, E. Xerinda, E. Zuber and F. Matavele	Screening Of F1 Cassava Population From Two Elite Cassava Varieties (Mokhalana And Colicanana) Using Grafting Inoculation As Rapid And Accurate Method For Field Screening Clone For Cassava Brown Streak Disease Resistance.

| 15:35 | 06 - 07 | Egas Nhamucho, J. Sibiya, S. Mugo | Gene Action And Heritability Controlling Maize Weevil And Larger Grain Borer Resistance In Tropical Maize Germplasm |

POSTER SESSION II

CODE	AUTHORS	TOPIC
P2-01	Abel P. Mataveia Júnior	Analysis of the integration of common bean prices between the markets of Maputo, Maxixe, Angónia, Gurúè and Lichinga
P2-02	Derço Manhice, L. Artur	Socio-economic impact of the Covid-19 pandemic in Boane District, Maputo Province
P2-03	C.R.Bila Mussane and T.F. Chiconela	Adaptability Of The Formosana Banana Variety In The Southern Agroecological Zone
P2-04	Amade Muitia, M. J. Mopecane and V. Salegua	Stability Analysis Of Bambara Groundnut (*Vigna subterranean* Verdc) Gentypes In Northern Mozambique Using Ammi And Gge Biplot
P2-05	Luís Domingos Bota, D. Jequessene, Marc De Meyer, D. R. Cugala and L. Canhanga	Potential Of Waste Brewer's Yeast As Food Based Attractant For Monitoring Of Fruit Flies (*Diptera: Tephritidae*) In Central Mozambique
P2-06	Ângelo José, B. Rachid, L. César, J. Coelho and L. Goulão	Evaluation of sowing dates and wheat genotypes for optimization of rainfed production in the Lichinga Plateau

CODE	AUTHORS	TOPIC
P2-07	**Agisanyang Tautsagae,** M. Mwajita, A. Kavoo and A. Nyende	Evaluation Of Safflower Genotypes As Leafy Vegetable In Two Agro-Ecological Zones In Kenya
P2-08	**M. Mativavarira,** K. Simango, E. Gasura, C. Ziyomo, Paul Kimwemwe, M. Kyallo and D. Savadye	Dartseq SNP-Based Genetic Diversity And Population Structure Of Spider Plant (*Cleome gynandra* L.) Accession Populations From Zimbabwe
P2-09	**Jeje Mangue,** I. Esperança and L. Tivana	Effect Of Different Harvest Ages On The Structure And Chemical Composition Of The Roots Of Six Varieties Of Cassava (*Manihot esculenta* Crantz)
P2-10	**Nyamwamu N. Charles,** P. Jeruto, E. Njenga, P. F. Arama and R. Mwanza Mulwa	Delimitation Of Cassava Germplasm Clusters In Kenya Based On Phenotypic Traits
P2-11	**Kolawole, Opeyemi Saheed** and Bello, Munir Sikiru	Comparative Effectiveness Of Different Animal Manure And The Phytotoxicity Evaluation On The Growth And Yield Of *Abelmoschus esculentus* L. (Okra) Vegetable
P2-12	**Ufuoma Lydia Akpojotor,** Jelili Opabode, Oyatomi Olaniyi and Michael Abberton	Screening Of Winged Bean (*Psophocarpus tetragonolobus* (L.) Dc.) Seedlings For Drought Tolerance
P2-13	**R.A. Alagba,** I.I. Ibeawuchi, N.C. Adikuru, N.A. Okoli and L.C. Emma-Okafor	Influence Of Poultry Manure Mixed With Palm Bunch Ash On Growth And Yield Of *Amaranthus cruentus* In Owerri South Eastern Nigeria.

CODE	AUTHORS	TOPIC
P2-14	**Idris Z. Kiri** and B. Ado	Influence Of Drought Stress On Crop Growth And Development: A Review
P2-15	**Manuel A.Temo,** P. Fato and F. A. Amela	Evaluation of the effectiveness of the use of synthetic and inorganic organic fertilizers in the performance of maize varieties introduced from Spain at the Sussundenga Agricultural Station.
P2-16	**K.N. Ntidi** and Z. Bello	Preliminary Study: Association of Nematode Assemblages on Pigeon Pea with special reference to *Meloidogyne* spp.
P2-17	**Rabiu Sani Shawai**, M. A. Ibrahim, I. M. Bello, Umar Haruna Gaya and Kabiru Dauda Dawaki	Molecular And Morphological Characterization Of Wheat Genotypes Under Drought Condition In Nigerian Sudan Savannah
P2-18	**Dércio Romão,** D. Cugala and L. Canhanga	Evaluation Of The Suitability Of Agro-Ecological Conditions For The Development Of Fall Armyworm (*Spodoptera frugiperda*) In Mozambique
P2-19	**Domingos Feniasse,** R. Borguete, A. Vilanculos, C. Jorge, A. Lumbela, L. Savanguane and V. Massango	Improving soil health, food security and income of smallholder farmers in Mozambique through the development and use of appropriate fertilizer formulations for maize and soybean in the Beira corridor
P2-20	**A. Abdullahi,** M.M. Abdulmalik and M.S. Mohammed	Correlation And Path Coefficient Analysis In Tomato (*Solanum lycopersicum* Mill.) Genotypes Under Water Stress

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P2-21	**Henriques Colial**, M. Chipeta, J. Kampanje, B. Divage, A. Chamuene, V. Salegua, L. António, S. Somueque, D. Alexandre, C. Bambo, C. Pedro, M. Donça, L. Lampião, Y. Langa, and I. Napita	Evaluation Of Cowpea Elite Lines (*Vigna unguiculata*) For Drought Tolerance In Nampula – Mozambique
P2-22	**N. Boodia**, J. Govinden-Soulange and N. Ludidi	Comparative Phenotypic And Physiological Responses Of Pigeon Pea (*Cajanus cajan* L. Millsp.) Genotypes To Water Deficit
P2-23	**N. A. Okoli**, E.S. Udoh and C. M. Lambert	Influence Of Fertilizer Types On Vitamins, Phytochemical And Proximate Contents Of *Ocimum gratissimum* L.
P2-24	**Rhodrick Kusamba**, J. Dzanja, B. Kamwana and D. Chiumia	Are Smallholder Dairy Cooperatives In Malawi Efficient? Examining Dairy Cooperatives Performance In Central Region Of Malawi
P2-25	**Franklin N. Mabe**, Ayuba Dauda and Dominic T. Konja	The Supply Of Labour To Artisanal Small-Scale Mining And Household Food Security In Ghana
P2-26	**E.M. Shikoli**, J.O. Ogweno , M. Saidi And F.W. Obuoro2	Effect Of Bunching Onion Crude Extract Concentrations And Irrigation Levels On Quality Of Tomato
P2-27	**K.C. Oluoch**, A.N. Otinga, R. Njoroge, T. Ouma, P. Agredazywczuk , M. Barthel, J. Six, S. M. Leitner and E. Harris	Fate Of N-Fertilizer In Maize Mono-Crop Systems Of Tropical Highlands

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P2-28	**Victor Vedasto Ngaiza**	Antifungal Potential Of Plant Bioactive Compounds, Sulphur And Copper Formulations Against Alternaria Leaf Spot In Kales, Kenya.
P2-29	**Ihejirika, G. O.,** Ogbedek, K. O., Akalazu, J. N. and Ezenwoke, E. O.	Assessment Of Animal Manure Types And Levels As Protectants Against Field Disease Development And Yield Of Pepper
P2-30	**Hipólito Malia,** A. Cumbane, A. Chamuene, A. Momade, N. Garrine and D. Cugala	Research Into Sustainable Management Methods Of The Fall Armyworm, *Spodoptera frugiperda* In Four Regions Of Mozambique
P2-31	**Elias Secretário Armando Ferreira**	Contributions to the Floristic and Knowledge of Maputo National Park, Mozambique
P2-32	**J. G. Jamisse,** J. Ndunguru, F. Tairo, L. M. Boykin, M. A. Kehoe, E. Ateka, C. Rey and P. Sseruwagi	Population Genetic Analysis Of Cassava Brown Streak Virus In Mozambique, Tanzania And Kenya And Genetic Differentiation Of CBSD Associated Virus Species
P2-33	**Lateiro Salvador de Sousa** and I. A. Chaúquez	Modeling Parameters a, b, c, & d Relevant For Generating Intensive Rain Equations
P2-34	**Carlos Filimone,** A. Humulane And A. Alage	Factors That Influence The Consumption Of Biofortified Yellow Maize Provitamin A
P2-35	**Albertina Alage** and A. A. Humulane	Sustainable Development: Women's Participation And Challenges In Agriculture

CODE	AUTHORS	TOPIC
P2-36	**Tapaça Inocência da P. E.,** L. Mavuque L., J. Pinheiro, I. Maquia, D. Brito, C. Cassamo, C. Tongai, M. Romeiras, J. Ramalho, I Marques and A. Ribeiro-Barros	Genetic Diversity Of Coffea spp. In Mozambique
P2-37	**Luis C. Savanguane,** I. Tokumoto, T. Sato, H. Cho, D. Feniasse, V. L. Massango.	Wood Ash Recycling For Restauration Of Acidic Soil Fertility In Mozambique. A Geochemist's Workbench (Gwb) Predictive Model Use
P2-38	**Dauto Ibramaugy,** E. Mungoi and J. Francisco	Evaluation of the sensory, physical-chemical and microbiological quality of soy milk of the variety Zambone TGZ 19046F
P2-39	**Hailekiros Tadesse Tekla,** Y. Tsehaye, G. Atsbeha, F. A. Abera and R. M. Chiulele	Investigation of genotype x environment interaction for *Hordeum vulgare* L. ssp. vulgare recombinant inbred lines in multi-environments of Tigray, Ethiopia
P2-40	**Melvis C. Vilanculos Cossa,** João P.M. Rocha, Rafael M. Al. de Assis, Jeremias J. F. Leite, L. F. Texeira, Suzan K. V. Bertolucci and José Eduardo B. P. Pinto	Impact Of Photon Flux Density And Light Spectral Quality On Biomass Production And Arbutin Compound Accumulation In Origanum majorana L. Plantlets

THURSDAY, September 19

TIME	**INCLUSION FOR MARKET INVOLVEMENT OF WOMEN AND YOUTH IN AGRICULTURE** Room: CCMC **Moderator:** Prof. João Mosca - OMR
08:30	Introduction
	Keynote speakers

08:40	S3 - 01	**YOUTH IN AGRIFOOD SYSTEMS: MORE THAN THE LEADERS OF TOMORROW** (virtual)

Dr. Geena Tesdall,
Director of Young
Professionals for Agricultural
Development
(YPARD)

Dr. Geena Tesdall is an agriculture systems thinker taking on projects to sustain the environment and people, striving to be a servant-leader in order to foster equality between generations (and all delimiters of privilege). Before joining YPARD, she was the federal agricultural policy officer at the German Rural Youth Association (Bund der Deutschen Landjugend) (2020). She focused on youth involvement in agricultural policy, and was the former president (2013-14) of the International Association of Agriculture and Related Sciences Students (IAAS).

09:00	S3 - 02	**INCLUSION FOR MARKET INVOLVEMENT OF WOMEN AND YOUTH IN AGRICULTURE** **Fatima Dias,** FTF RESINA Dr. Fatima Dias is the, Youth and Social inclusion expert at FTF RESINA. She has over 10 years as a higher education lecturer, teaching courses in Gender Studies, Sexual and Reproductive Health, Life Skills, Scientific Research Methodologies, Marketing and Management, Corporate Social Responsibility, and Public Relations. She also has Extensive experience in coordinating and managing gender and advocacy projects focused on Sexual and Reproductive Health, Economic Empowerment of Women and Girls, and Multisectoral Mechanisms for Women Victims of Violence.
09:20	S4 - 03	**INVESTMENT PRIORITIES FOR DRIVING INCLUSIVE AGRICULTURAL TRANSFORMATION** **Dr. Rui Benfica,** IFPRI Rui Benfica is a Senior Research Fellow at the International Food Policy Research Institute (IFPRI). Prior to joining IFPRI in 2019 he served as Lead Economist at the International Fund for Agricultural Development (IFAD), Associate Professor of International Development at Michigan State University, and Senior Poverty Economist (Africa Region) and Economist with the Gender and Development Group at the World Bank.

09:40	S5-04	**ACTION RESEARCH IN ESTABLISHING LOCAL GOVERNANCE: OPPORTUNITIES AND CHALLENGES BASED ON PROSULI PROJECT EXPERIENCE** **Prof. Nícia Givá,** Eduardo Mondlane University Prof. Nícia Givá is an Assistant Professor at Faculty of Agronomy and Forest Engineering, Eduardo Mondlane University in Mozambique. Her research scope expands from rural sociology, gender and community based participatory rural development to environmental politics of conservation areas, governance of protected areas, environmental communication and sustainable natural resources management in the complex conservation-rural livelihoods nexus.
10:00	Discussion	
10:30	Closing remarks	
10:30 – 11:00	**COFFEE BREAK**	

SPECIAL SESSION IV
Room: CPI 2502

TIME	AGRICULTURE INSURANCE: ONGOING EFFORTS TO STRENGTHEN RURAL FARMERS RESILIENCE IN LOCAL FOOD SYSTEMS (Organized by: FTF RESINA)
11:00 – 13:00	**Justification** Climate-related threats such as droughts, floods, pests and diseases increasingly threaten crop yields and negatively impact productivity. Smallholder farmers are especially vulnerable as they are highly dependent on agriculture and have limited capacity to deal with climate change's impact on their yields or large increases in input prices. Climate change poses a formidable threat to agriculture, leading to unpredictable yields as farmers contend with shifting weather patterns, extreme temperatures, and altered precipitation levels. As a result, they are increasingly struggling with food insecurity and their livelihoods are more at risk than ever. Insurance serves as a crucial tool for farmers, acting as a financial shield that not only safeguards against unforeseen risks such as extreme weather events but also fosters resilience, stability, and long-term prosperity in agricultural communities. Insured farmers are better equipped to withstand shocks, contributing to overall global food security by maintaining stable agricultural production. Insurance is also a low-hanging fruit that can de-risk agricultural transactions, mobilize and secure public investment, and make food systems more resilient by helping smallholders adapt to climate volatility, retain access to inputs from Agri-enterprises, and ensure productivity.
	Objectives This session seeks to provide improved stakeholder understanding of the Area Yield Index Insurance (AYII) as a product that can be operationalized to promote resilience of agri systems actors particularly farmers.

Expected Results

The session will promote networking by actors interested in agri-insurance and provide opportunities for the replication and scaling of the pilot intervention that is being implemented by PULA in partnership with FTF RESINA in northern Mozambique

Format

This session will include a special presentation from PULA, followed by a panel discussion with key experts in the insurance industry. A plenary session will be provided to allow participants to add technical inputs and present any issues that require clarification.

SPECIAL SESSION V
Room: CPII 202

TIME	**Biotechnology and OFAM-Mozambique** Organized by: African Agricultural Technology Foundation (AATF) and IIAM
11:00 – 13:00	**Justification** Agricultural biotechnology is still a relatively little explored science, and its benefits are little utilized, especially in Africa. For greater advocacy on Biotechnology, the Open Forum on Agricultural Biotechnology in Africa (OFAB) Project was established, which facilitates the conduct of constructive dialogues between key actors and decision-makers on agricultural biotechnology. For both policymakers and the general public, OFAB facilitates quality commitments on the safety and benefits of modern biotechnology. OFAB is an African Agricultural Technology Foundation (AATF) project funded by the Bill and Melinda Gates Foundation that is being implemented in ten African countries – Kenya, Uganda, Tanzania, Nigeria, Ghana, Burkina Faso, Ethiopia, Mozambique, Malawi and Rwanda. AATF is a leading non-profit organization that provides farmers in Sub-Saharan Africa (SSA) with practical technology solutions to overcome constraints to agricultural productivity.
	Objectives The objective of the Side Event on Biotechnology and OFAM-Mozambique at the conference is to share the importance of biotechnology in agriculture with scientists, innovators, farmers, agribusiness entrepreneurs and operators, educators and policymakers involved in agriculture-related value chains who will participate in the conference, including sharing the research carried out and results achieved using biotechnology.

Expected results

- Improved knowledge and understanding about biotechnology and its benefits in development, especially for agriculture;
- Contribution to more constructive dialogues on Biotechnology;
- Shared the path of research on agricultural biotechnology conducted by IIAM in Mozambique and shared some regulatory instruments, and
- The OFAB-Mozambique network was publicized and greater awareness was created for the participation of various actors in the discussion, dissemination for the consolidation of information and the use of Biotechnology in the country

Format

Presentations and discussion will be made around the topics presented. Space will also be created for clarifications on questions presented. At the end, the main issues arising from the debate and the recommendations that should be followed to consolidate ongoing actions will be globalized

ORAL PRESENTATION SESSIONS

TIME	THEME: INCLUSION *Session 7 –Knowledge Systems* Room: CPI 1501 Chair: Prof. Eunice Cavane and Dr. Arsénio Jorge		
11:00			
11:05	07 - 01	**Arsénio Jorge,** L. Artur and A. Pinto	Sharing Information And Knowledge With Urban Farmers To Build Agricultural Practices: The Case Of The Infulene Valley, Mozambique
11:20	07 - 02	**Meshack Oriama**	Investigation Of Information Assymetry In Agricultural Extension Services In The Wake Of Agriculture Digitization In Kenya: Case Study Of Kirinyaga County
11:35	07 - 03	**Martin P. Moyo,** **A. Magaisa** and F. Dube	Assessing The Differential Impact Of Conservation Agriculture Techniques On Crop Productivity, Adoption Levels And Farmer Preferences
11:50	07 - 04	**João Bila,** C. Mucuamule, A. Bombe, M. I. Ribeiro, A. Venâncio, S. Afonso and P. Rodrigues	Assessment Of Farmer's Knowledge About Fungi And Mycotoxin In Southern Mozambique

12:05	07 - 05	**Mathews L. Kambani,** Christopher O. Gor and Monica A. Ayieko	Traditional Knowledge, Beliefs And Practices On Collection Of Lake Flies (*Chaoborus sp.* And *Chironomus sp.*) And Their Implications On Food Security
12:20	07 - 06	**Wafula Carolyne Khalayi,** L. E. Chimoita, J. M. Kinama, P. M. Nyangweso and S. Gudu	Evaluation Of Sorghum Seed Systems And Sources Of Agricultural Knowledge In Farmer Research Networks In Homabay And Tharaka Nithi Counties, Kenya Counties, Kenya
12:35	07 - 07	**Amade Muitia,** M. J. Mopecane and V. Salegua	Understanding Bambara Groundnut (*Vigna subterranean* Verdc) Crop In The Northern Region Of Mozambique: Production, Uses And Myths

TIME	THEME: PRODUCTION SYSTEMS Session 8 – Food Security and Food safety Room: CPI 2501 Chair: Prof. João Bila and Dra Sandra Inguane		
11:00			
11:05	08 - 01	**Zecas C. Gomate**	Factors That Contribute To The Food And Nutritional Security Of Households In The District OfMeconta, Nampula Province
11:20	08 - 02	**Paula Rodrigues,** C. Matusse, A. Tolentino, Z. Lucamba, S. Afonso, A. Venâncio, J. Bila and C. Macuamule	Occurrence Of Aflatoxins In Food Commodities Produced And Consumed In Angola And Mozambique
11:35	08 - 03	**Tariro Munyaria,** N. Nleyab, K. Chitindinguc and M. Ndemeraa	Effect Of Biofertilizers On Productivity And Aflatoxin Production In Groundnuts (Arachis hypogaea)
11:50	08 - 04	**Theoneste Hagenimana,** Joseph O. Anyango, Patrick S. Muliro and Clement Bitwayiki	Processing Practices And Acrylamide Levels Of French Fries From Commercial Food Service Establishments In Rwanda (virtual)
12:05	08 - 05	**C. O. Echereobia**, E. F. Asawalam, K.C. Emeasor and K. Sahayaraj	Efficacy Of Ultraviolet (Uv) Irradiation On The Postharvest Control Of Cowpea Bruchid
12:20	08 - 06	**Tamara T. Chirambo** and A. Mwangwela	Physical, Cooking Characteristics And Consumer Acceptance Of Whole And Dehulled Pigeon Peas (Cajanus cajan L) Cultivars Grown In Malawi

12:35	08 - 07	**Edson C. Bambo,** Yanick L. Langa, A. S. Hassane, J. Atanásio, C. R. J. C. Pastola, Henriques V. Colial, Porfírio A. N. Rosa and F. J. Tanleque-Alberto	Evaluation of the Nutritional Quality of sunflower (*Helianthus annuus* l.) genotypes of different colors of achene produced at IIAM – Nampula
13:00 – 14:00		**LUNCH**	

CLOSING SESSION
Room: CCMC
Moderator: Prof. Amélia Sidumo

14:00 – 14:30

CLOSING KEYNOTE ADDRESS

INVESTING IN QUALITY TO POTENTIATE RESEARCH AND INNOVATION AND NETWORKS OF EXCELLENCE ACROSS THE REGION

Roberta Malee Bassettis Global Lead for Tertiary Education and Senior Education Specialist at the World Bank, where she provides coordinated support to the World Bank's $7b global lending and analytical efforts supporting post-secondary education reforms. She leads operational teams implementing projects across a variety of tertiary and higher

Roberta Malee Bassett,
The World Bank

education projects, addressing issues such as finance and quality assurance reform, internationalization, equity and access, research and competitiveness, and skills development. Prior to joining the World Bank, Dr. Bassett held several positions in university administration, teaching, and research at institutions in the US and UK. She is the author/editor of numerous publications on topics related to international higher education.

14:30 – 14:45

Conference Final Communiqué |
Prof. Luis Artur, Local Organizing Committee

14:45 – 14:55	**CLOSING ADRRESS** **Prof. Manuel Guilherme Júnior** Rector of Eduardo Mondlane University
14:55 - 15:00	**African anthem** | UEM Choral Group
15:00 – 15:30	**COFFEE BREAK**
19:00 – 21:00	**DINNER GALA**

LIST OF EXHIBITORS

Higer Education Institutions
1. Superior Politechnic Institute of Gaza (ISPG)
2. Centre of Excellence in Agri-food Systems and Nutrition (CE-AFSN), Eduardo Mondlane University
3. Faculty of Agronomy and Forestry Engeneering, Eduardo Mondlane University (FAEF, UEM)
4. University of Save (UniSave)

Research institutions
5. Agrarian Research Institute of Mozambique (IIAM)
6. International Agricultural Research Centers in Partnership with AID-I Mozambique

Development projects
7. PASET Rsif
8. Feed The Future - Resilience Integrated In Nutrition And Agriculture (FTF RESINA)
9. Socodevi

Private companies
10. BIOCHEM-Biológicos, Medicamentos & Químicos, Lda
11. Vellsam
12. AQI
13. Government institutions
14. Instituto Oleaginosas
15. SeedCo Mozambique
16. NUTAGRI, Lda
17. Tecap - Tecnologia e Consultoria Agro Pecuaria, Lda
18. ETGWorld

Others
19. Better Cotton Initiative

ABSTRACTS

Theme: Inclusion

Theme: Production Systems

Theme: Resilience

THEME: INCLUSION

GENDER ANALYSIS OF THE CHALLENGES TO RURAL AND URBAN YOUTH ENGAGEMENT IN AGRICULTURE-BASED LIVELIHOOD ACTIVITIES IN ONDO STATE, NIGERIA

Aminu O. O. | funmiaminu83@gmail.com

Olanipekun B. E.

Department of Agricultural Economics and Extension, Olusegun Agagu University of Science and Technology, Okitipupa, Ondo State, Nigeria

Agriculture plays a significant role in the Nigerian economy and has the potential to create livelihood opportunities for youth. However, there are challenges limiting youth engagement in agriculture in rural and urban areas. Hence, this study examines the gender dynamics underlying these challenges in Ondo State, Nigeria. The study's objective is to assessed gender analysis of challenges to rural and urban youths' engagement in Agriculture-based Livelihood Activities (AbLAs) in Ondo State, Nigeria. Perceived benefits accruing from AbLAs involvement were also examined. Using simple random sampling, three local government areas and three communities per local government area were sampled. A structured questionnaire was used to collect data from 151 youths aged 18-35 years. Descriptive statistics and t-test at $\alpha_{0.05}$ were used for data analysis. The majority in rural (males, 63.2%; females, 54.3%) and urban (males, 70.5%; females, 50.0%) indicated engagement in AbLAs. In rural, the average monthly income from AbLAs was 119,478.26±161,534.65 for males and 94580.95±98909.59 for females, while in urban, the average monthly income from AbLAs was 97142.86±81987.67 for males and 83,511.11±53074.96 for females. The major AbLAs engaged in in rural (males, 63.2%; females, 54.3%) and urban (males, 56.8%; females, 55.9%) was crop farming. Engagement in livestock farming was more in rural (males, 50.0%; females, 48.6%) compared to urban (males, 34.1%; females, 38.2%). Engagement in AbLAs was for income generation in rural (males, 39.5%; females, 40.0%) and urban (males, 56.8%; females, 35.3%). Major benefit from AbLAs was income generation and financial stability for rural males (=1.95) and females (=1.77), and urban males (=1.82) and females (=1.94). The prominent challenge to youth engagement in AbLAs was the lack of access to capacity building and funding for rural males (=1.95) and females (=1.83), and urban males (=1.82) and females (=1.94). Urban females were most challenged by pests/diseases (=1.91) and the fear of incurring losses (=1.88). Urban youths (=1.81) were more challenged by environmental factors compared to rural (=1.51). Perceived benefits (t=2.042) and challenges (t=3.928) to AbLAs significantly differed between

rural and urban. In urban, challenges to AbLAs significantly differed between males and females (t=2.037). The study suggests that addressing the gender-specific challenges to youth engagement in agriculture can unlock the full potential of young men and women as drivers of sustainable agricultural development, thereby promoting inclusive and equitable agricultural development. The study recommends the establishment of youth-friendly financial institutions that provide access to affordable credit and financial resources for agricultural investments.

Keywords: Youths, Gender, Livelihood activities, Rural, Urban.

CAN STRUCTURED MARKETS PLAY A CRITICAL ROLE IN MALAWI'S DRIVE FOR AGRICULTURAL COMMERCIALISATION? A CASE OF AGRICULTURAL COMMODITY EXCHANGE FOR AFRICA (ACE)

Henry Kamowa | hkamowa@luanar.ac.mw

Agriculture remains the mainstay of Malawi's economy as it generates around 80% of export proceeds. Tobacco has been the main cash crop and forex earner for Malawi as it alone generates 60% of total export proceeds for the economy. However, Malawi is trying hard to wean itself from heavy reliance on tobacco due to worldwide anti-smoking lobbies which are negatively impacting on forex revenues. The country is therefore turning to other crops in the same agricultural sector to spur its economic growth. Agricultural commercialization has been earmarked as the best strategy to move the crops from subsistence level to a level where they can replace tobacco as a foreign exchange earner. Further to that, it has been suggested that structured markets for the crops have to be in place to replicate what has worked for the country on the tobacco market over the years. The study was aiming at exploring whether structured markets for commodities can spur agricultural commercialization to the level that Malawi wants in order to eventually replace tobacco as a foreign exchange earner. The study's objectives were to assess activities of structured markets in Malawi and their level of use (volume) as well as examining the effect of structured markets on agricultural commercialization which eventually has an effect on Malawi's economy. The study took an action research approach and the intervention that was considered in this study was the use of structured markets by farmers. Time series data was collected on farmers and traders who utilise ACE as a structured market as well as other time series data available to meet the study objectives. Cross sectional surveys were done on stakeholders who are not ACE members. A baseline survey was conducted to assess the status quo of farmers and traders before rolling out the intervention, and then an endline survey to assess any changes that had occurred after the intervention. Economic data was also collected on how the country has performed over the years against the interventions on the agricultural front. The research has concluded that the commodities structured markets are not yet vibrant in Malawi where low volumes are traded on them. The structured markets would do a lot to impact on agricultural commercialization for the country and even improve the country's economy through foreign exchange earnings, the way tobacco markets were doing for the country.

Keywords: Agriculture commercialization, Malawi, markets.

EFFECT OF CONTRACT FARMING ON FARMERS' INCOME: EMPIRICAL EVIDENCE FROM SMALLHOLDER FARMERS IN MAGUDE DISTRICT, SOUTHERN MOZAMBIQUE

Tomás Adriano Sitoe[1] | sitoetoms@yahoo.com

Carlos Vilanculos[2]

[1]Agricultural Research Institute of Mozambique

[2]Eduardo Mondlane University Faculty of Faculty of Arts and Social Sciences, Mozambique

One popular policy proposal among donors and multilateral agencies is for recipient governments to facilitate the expansion of contract farming (Eaton & Shepherd, 2001; Bellemare & Bloem, 2018) wherein firms support farmers during the production and/or marketing process by providing inputs, technical support, and secured output markets. Findings regarding contract farming are mixed with studies pointing towards both positive and negative effects, which highlights the diversity that exists in terms of commodities involved, contracts offered, and regions studied. The purpose of this study is to analyse the effect of contract farming on farmer's income in Magude district, southern Mozambique. The contract farming model analysed in this study is the nuclear state model (Eaton and Shepherd, 2001) practiced by Xinavane mill as the contractor that not only buy sugar cane from independent producers, but also it has its own production fields. This research was based on interpretivist research philosophy and constructivist paradigm implemented by a case study, combining quantitative and qualitative research approaches. The empirical analysis is based on non-probabilistic sample survey of 100 household heads (50 with contracts with Xinavane mill, and 50 without contracts) selected by convenience or accessibility in 4 farmers' associations in Magude district for interviews. Collected data and information include farmer's sources of income, agricultural production, livestock, and quantities of goods, sold and/or provided services and they cost. Semi-structured interviews were also meant to capture farmers' and Xinavane mill manager's perceptions about contract farming. Semi structured interviews were performed between September and December 2017. Quantitative data was systematized using the Microsoft Office Excel software package and analysed using STATA computer package comparing farmers 'income (with contract farming with Xinavane mill and those without contracts in 2105 and 2016). There were significant differences on farmer's income of household's heads with contract farming and households without a contract (p = 0.0000), the trend continued in

2016, where the two groups income difference is about 36%, suggesting that farmer's integration in contract farming may be one of the factors that contribute to income increase. The observed improvement in farmer's income in this study is consistent with empirical observations by Mosca (2014) who indicates that there are social mobility's for the benefit of smallholder farmers under outgrower schemes, which are reflected by increase of cultivated areas, wage earning, increased incomes and use of more productive techniques. Farmer's integration in contract farming may improve farmer's income. However, statistic results are not enough for making final and complete inferences regarding the influences of contract farming and other variables on farmers' income as the simple comparison of mean differences does not account for different factors and their relations. The observed increase on farmers' incomes may be associated to three factors, namely assured access to the market, and the stability of income source, and the reduction of production and marketing risks.

Keywords: Agriculture, Sugar cane, Xinavane.

EXPLORING INCENTIVES AND DISINCENTIVES OF NATIONAL AGRICULTURE POLICY IN MALAWI ON VALUE ADDITION, JOB CREATION, AND PERFORMANCE OF SMES WITHIN SOYBEAN VALUE CHAIN: EVIDENCE FROM MCHINJI, DOWA, MZIMBA, AND RUMPHI

Wedson Phiri| wedsonbphiri@gmail.com

J. Dzanja, M. Limuwa, H. Phiri

LiIlongwe University of Agriculture and Natural Resources, Lilongwe, Malawi

The soybean industry in Malawi has significant potential for economic growth through value addition, job creation, and the enhancement of small and medium-sized enterprises (SMEs). Despite this potential, the impact of the National Agriculture Policy (NAP) on these areas within the soybean value chain remains inadequately explored. This research aims aimed to address this gap by examining the incentives and disincentives within the NAP and their effects on the soybean value chain in Mchinji, Dowa, Mzimba, and Rumphi districts. The primary objectives of this research are: 1) To examine the effects of NAP on the performance of SMEs within the soybean value chain, 2) To analyze the effects of NAP on employment within the soybean value chains, 3) To investigate the effects of NAP on the adoption of value addition activities within the soybean value chain, 4) To determine the fidelity of NAP implementation on soybean value chains. A mixed-methods approach will bewas adopted, combining qualitative and quantitative data collection techniques. Primary data will bewere gathered through surveys and in-depth interviews with key stakeholders, including farmers, SME owners, policymakers, and industry experts in the selected districts known for their significant soybean production and processing activities. Secondary data will bewere sourced from government reports, agricultural databases, and existing literature. Qualitative data will bewere analyzed using thematic analysis to identify key themes and patterns, while quantitative data will bewere subjected to statistical analysis using PSM and double hurdle models to uncover trends and correlations. The expected results of this research include comprehensive insights into how NAP incentives, such as subsidies and access to credit, positively impact SME performance, job creation, and value addition within the soybean value chain. The study also anticipates identifying significant disincentives, such as bureaucratic hurdles and inconsistent policy implementation, which hinder sectoral growth. Additionally, the research will evaluate the fidelity of policy implementation, providing insights into the alignment between actual practices and the intended policy

framework. In conclusion, the findings are expected to demonstrate the critical role that well-implemented agricultural policies play in fostering value addition, job creation, and SME performance within the soybean value chain. The research will highlight the importance of balancing incentives with the elimination of disincentives to achieve sustainable sector growth. Recommendations will guide policymakers in creating more effective strategies that align with Malawi's agricultural landscape, ultimately contributing to the country's economic development and food security.

Keywords: National Agriculture Policy, propensity score matching, SMEs performance.

ARE SMALLHOLDER DAIRY COOPERATIVES IN MALAWI EFFICIENT? EXAMINING DAIRY COOPERATIVES PERFORMANCE IN CENTRAL REGION OF MALAWI

Rhodrick Kusamba | rkusamba@gmail.com

J. Dzanja, B. Kamwana and D. Chiumia

Lilongwe University of Agriculture and Natural Resources, Lilongwe, Malawi

The agriculture sector is extremely significant in many developing countries and serves as the backbone of several countries' food supply, employment, and Gross Domestic Product (GDP). Livestock production, including dairy farming, is one of the major agricultural sectors that contribute greatly to the welfare and health of rural populations in most of the low-middle-income countries (LMICs). However, most of the people engaged in dairy production are rural smallholder farmers who face several challenges, including poor transportation of dairy products, lack of inputs and storage facilities, and selling their products through informal markets that fetch low prices. As one way of combating the aforementioned challenges, Government ministries particularly responsible for agriculture, in partnership with relevant Stakeholders and development partners introduced the idea of 'Agricultural Cooperatives', including dairy cooperatives. Dairy cooperatives in developing countries can play a very integral role in poverty eradication and economic stimulation of the developing countries. This proposal aims to examine the efficiency of smallholder dairy cooperatives in central region of Malawi. The study seeks to identify key factors influencing their operational success and sustainability by analyzing the performance metrics of these dairy cooperatives through examining dairy cooperatives performance in central region of Malawi as the main objective by evaluating the governance structure of dairy cooperatives in central region of Malawi, assessing the conduct of dairy cooperatives in central region of Malawi and assess the social and economic performance of dairy cooperatives in central region of Malawi. The research will employ the mixed-methods approach, combining quantitative data on dairy cooperatives production, sales, and profitability with qualitative insights from dairy cooperative members and stakeholders. This study will use rigorous quantitative and qualitative approaches in an effort to give evidence-based suggestions and data-driven insights for improving the competitiveness, sustainability, and efficiency of Malawi's Dairy cooperatives. It is expected that the findings will provide a comprehensive understanding of the challenges and opportunities faced by smallholder dairy cooperatives in Malawi, offering policy recommendations to enhance their efficiency and contribution to rural livelihoods and the broader dairy sector.

Keywords: Efficient and dairy cooperatives, Performance.

DIFFERENCES IN THE LEVEL OF KNOWLEDGE ABOUT COCONUT LETHAL YELLOWING BETWEEN MEN AND WOMEN COCONUT FARMERS IN ZAMBEZIA PROVINCE

Vilma Rosa Tsembane[1] | Vilma.tsembane84@gmail.com

João Bila [1,2] and Nícia Givá[1]

[1]Faculdade de Agronomia e Engenharia Florestal, Universidade Eduardo Mondlane, Maputo, Mozambique

[2]Centre of Excellence in Agri-food Systems and Nutrition – CE-AFSN, Universidade Eduardo Mondlane, Maputo, Mozambique

The coconut palm (Cocos nucifera) is a plant of great economic and social importance in several tropical regions, including Mozambique. The coconut lethal yellowing disease (CLY) is one of the most devastating factor for this crop, causing the death of infected plants and significant losses in production. The knowledge about the causes, symptoms, dissemination and mitigation measures of CLY is crucial for the implementation of effective management practices that can prevent and control the disease, thus ensuring food security and the livelihood of coconut palm-dependent communities. This study assesses the gender-based level of knowledge of coconut farmers about CLY in the communities of Muibe, Evile and Corrine, in Maganja da Costa, Zambezia, applying combined qualitative and quantitative methods. Results from a survey with 134 farmers (60.74% women) indicated that women, in general, had little knowledge about the disease. Data reveals that 99% had never received technical assistance, 37.8% never went to school and the remained percentage had only studied up to a maximum of 3rd grade. However, one case drew attention: a 25-year-old woman who demonstrated in-depth knowledge about the disease had watched an educational film at school during her childhood, highlighting the importance of awareness and technical education about the disease. In addition, about 49% of the interviewees confused the CLY with the Oryctes pest, evidencing an urgent need for adequate training and technical assistance programs. These results underline the disparity in knowledge between men and women and the positive influence of early and continuing education, suggesting that educational interventions are essential to mitigate the spread of CLY. Investments in such programs could be crucial to improve the future prospects of disease management and coconut productivity in the region.

Keywords: Coconut palm, coconut lethal yellowing, rural knowledge, technical assistance.

INVESTIGATION OF INFORMATION ASSYMETRY IN AGRICULTURAL EXTENSION SERVICES IN THE WAKE OF AGRICULTURE DIGITIZATION IN KENYA: CASE STUDY OF KIRINYAGA COUNTY

Meshack Emakunat Oriama

Faculty of Agriculture and Vertinary Sciences

Department of Agricultural Economics, University of Nairobi, Kenya

Agricultural extension services in modern Kenyan society have been subject to commercialization. In the past two decades, the capitalization of agricultural information by knowledge workers has been on the rise. The economic recovery strategy for wealth and employment creation policy of 2002 set the impetus for the transnationalization of agricultural information through the gist of "demand-driven agricultural extension" that knowledge workers would have to profile information and guidance to farmers where it fit through demand. Agriculture extension mutated as E-extension to a quid pro quo cultural norm among agricultural technology and service providers, who capitalize on the opportunity by leveraging the need for information to improve productivity. Agro-dealers trade this information as they market products to farmers irrespective of quality assurance guarantee to farmers faulting food safety and productivity. These endeavors are proliferated by the digitization of agriculture coupled with the emergence of various agri-digital tools to support production. We seek to investigate the information asymmetry in the digitized agricultural extension to the farmers in Kirinyaga County Kenya, hence enhance our understanding of the utilization of e-extension services among farmers. This will prompt us to understand the existing framework for information standardization in agri-digital extension services in Kenya by investigating the existing regulatory frameworks and gaps to food safety regulations. A probit logistical model will be used alongside descriptive statistics to analyze and present the outcome of the study. This study will go a long way in helping policymakers look at the perspective of digitalization in food production with standardization of agricultural information to improve productivity and food safety.

Keywords: Agriculture extension, agriculture information.

ASSESSMENT OF FARMER'S KNOWLEDGE ABOUT FUNGI AND MYCOTOXIN IN SOUTHERN MOZAMBIQUE

João Bila[1,2*] | jbilay@gmail.com

Custódia Mucuamule[3], Amina Bombe[1], Maria Isabel Ribeiro[4], Armando Venâncio[5,6]

Sandra Afonso[7] and Paula Rodrigues[4,8]

[1]UEM-Universidade Eduardo Modlane, Faculdade de Agronomia e Engenharia Florestal, Maputo, Mozambique

[2]Centre of Excellence in Agri-food Systems and Nutrition (CE-AFSN), UEM, Maputo, Mozambique

[3]UEM-Universidade Eduardo Modlane, Faculdade de Veterinária, Maputo, Mozambique

[4]Centro de Investigação de Montanha (CIMO), Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5300-253 Bragança, Portugal

[5]CEB - Centre of Biological Engineering, University of Minho, 4710-057 Braga, Portugal;

[6]LABBELS – Associate Laboratory, Braga/Guimarães, Portugal; [7] Instituto Superior Politécnico de Cuanza Sul, Angola

[8]Laboratório Associado para a Sustentabilidade e Tecnologia em Regiões de Montanha (SusTEC), Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5300-253, Bragança, Portugal

Mycotoxins find their way into the human and animal body through the consumption of mycotoxin contaminated foods, which may result in acute or chronic intoxication. This study aimed to assess knowledge about fungi and mycotoxins among farmers in the provinces of Gaza and Inhambane, in southern Mozambique. Data were collected using quantitative study based on non-probabilistic questionnaire, covering 180 farmers from Gaza (90) and Inhambane (90) Provinces, from October to November 2022. Data were subjected to descriptive and statistical analysis. The majority of farmers were aged 36 or over (75.0%), were female (75.2%), had no education or only had primary education (80.6%) and had been a farmer for longer 15 years old (64.4%). The level of knowledge about fungi and mycotoxins is mainly explained by the province of residence, followed by the level of education, age and gender, with producers with higher levels of education and of male gender recording a higher level of knowledge. Regarding mycotoxins, most farmers have never heard about these toxic compounds. Likewise, regardless of the province, a significant number of farmers did not know or have never accounted

for production losses or income losses due to fungal and mycotoxin contamination. The number of farmers who knew the consequences of consuming food contaminated by mycotoxins is residual. Hence, there is a significant proportion of farmers who use contaminated products for animal feed. Concerning knowledge about the conditions that promote fungal contamination after harvest, 33.3% and 23.3% of farmers in Gaza and Inhambane respectively, reported that did not know. However, the majority assumes that they knew, pointing out as the main causes are humidity, storage of harvest with high moisture content or recently harvested for long periods, existence of insects, rodents and birds, and the lack of ventilation in the storage area. Sociodemographic and geographic variables were predictors of the level of knowledge about fungi and mycotoxins. The low level of knowledge about fungi and mycotoxins, including the consequences of consuming mycotoxin-contaminated food to human and animal reported, increase the vulnerability and risk-exposure of producers and consumers for mycotoxin intoxication, which call for increased awareness campaigns.

Keywords: Fungi, farmers, farmer's Knowledge, mycotoxins.

ANALYSIS OF THE INTEGRATION OF COMMON BEAN PRICES IN THE MARKETS OF MAPUTO, MAXIXE, ANGÓNIA, GURÚÈ AND LICHINGA

Abel Pedro Mataveia Júnior

Common beans have a great socio-economic importance in Mozambique. However, there are deficiencies in the flow of distribution, from producer, markets to consumers. Therefore, the present study was necessary to analyze and understand the market dynamics and propose solutions. The objective was to analyze the integration of common bean prices in the markets of Maputo, Maxixe, Angónia, Gurúè and Lichinga. For this purpose, the VEC model was used to analyze the short and long-term relationships between the common bean markets complemented by Johansen cointegration tests, Engle-Granger causality tests, and the impulse-response function. The results identified two equations that explain long-term relationships significant in all markets. However, it cannot be said that markets are perfectly integrated, because prices do not completely influence each other in the long run. No causal relationship was verified, that is, no market explains the future prices of the other in the short term. In the long term, Maputo and Angónia prices can be used to predict the future prices of Maxixe, Gurúè and Lichinga. As for the degree of integration, the shocks (price changes which cause imbalance) that occurred in Maputo and Angónia, have little significant responses in the prices of the Maxixe, Gurúè and Lichinga markets. Thus, it was concluded that there is a weak degree of integration between the Mozambican common bean markets.

Keywords: Common bean, error correction vector, impulse-response, Market integration.

VEGETABLE PRODUCTION SYSTEMS DETERMINANTS IN THE DISTRICT OF KAMAVOTA: CASE STUDY OF THE ARMANDO GUEBUZA ASSOCIATION

Helena Moisés João | helenamoisesj@gmail.com

The present work was carried out with the objective of evaluating vegetable production systems determinants in the Armando Guebuza association. Specific objectives were to describe the socioeconomic profile of vegetable producers; to describe vegetable production systems; and to estimate the factors that most explain the use of vegetable production systems. The data for the study was collected through the survey, carried out with ninety-four (94) farmers, through convenience sampling. Data analysis was performed using descriptive statistics and binary logistic regression. The results show that of the producers surveyed, 65 are female, most of the producers have primary education, on average the families of the respondents are composed of 5 members and most of these families are headed by men. The vegetable production system practiced by most of the respondents is small-scale, as for production and income, producers in the commercial production system are more likely to prosper in agricultural activity when compared to small-scale producers, due to the fact that they have relatively larger areas, higher productions (kg/ha), high selling prices of products, higher yields (MZN), high levels of use of agrochemical inputs and high level of use of certified seeds. The most relevant factors driving the use of the production system by farmers are: educational level and the sale of vegetables as the only source of income. It is recommended that the government should create policies that facilitate the granting of credits to producers, especially young people and women.

Keywords: Determinants of the use of production and horticultural systems.

SHARING OF INFORMATION AND KNOWLEDGE WITH URBAN FARMERS TO BUILD AGRICULTURAL PRACTICES: THE CASE OF THE INFULENE VALLEY, MOZAMBIQUE

Jorge, A.[1] | arseniojorge12@gmail.com

Artur, L.[2] and Ardila Pinto, A.[3]

[1, 2]Universidade Eduardo Mondlane, Faculdade de Agronomia e Engenharia Florestal, Moçambique

[3]Universidade Federal de Minas Gerais, Departamento de Sociologia, Brasil

For decades, the sharing of information and knowledge has been indispensable to boost the growth of agricultural production and productivity. The objective of this research was to understand the process of sharing information and knowledge for the construction of agricultural practices to urban farmers in the Infulene Valley. In methodological terms, quantitative analyses (descriptive statistics, t-test, correlations and logistic regression) and qualitative analyses (coincidence of patterns and textual statistical analysis) were performed. To select the participants, stratified random sampling (farmers), non-probabilistic convenience sampling (technicians) and census sampling (association leaders) were used. The results reveal that access to technical assistance is unequal among groups of farmers. On the other hand, the pedagogical contents are guided by a linear approach (centered on the technical) and the exchange of information and knowledge occurs largely by horizontal alternative means, that is, between farmers by the degree of kinship and proximity.

Keywords: Extension services, knowledge, sharing, information, urban agriculture.

THE SUPPLY OF LABOUR TO ARTISANAL SMALL-SCALE MINING AND HOUSEHOLD FOOD SECURITY IN GHANA

Franklin N. Mabe | mfnantui@uds.edu.gh

Ayuba Dauda and Dominic Tasila Konja

Faculty of Agriculture, Food and Consumer Sciences, Centre for Agricultural Productivity and Policy Studies

Department of Agricultural and Food Economics, University for Development Studies, Nyankpala Campus

Institute of Food Economics and Consumer Studies, Department of Food Economics and Food Policy, Kiel

Artisanal small-scale mining (ASM) activities are on the rise wit several concerns. However, farm households in the mining communities in northern Ghana have over the years engaging in ASM during off season to invest in their farming operation as well as to boost their welfare. This study investigates the impact of farm households provision of labour service to ASM on household food security. Multi-stage sampling technique was employed to collect cross-sectional data from 200 farm households in two districts in northern Ghana. Endogenous Switching Regression model was used to estimate the welfare effects of supply of labour services to ASM. From the estimates of food security, it was found that ASM has a positive significant incremental effect on households who provide labour services to ASM. Thus, households who engage in ASM are more food secured. It is therefore recommended that community mining which has been promoted in the south should be promoted in Northern Ghana. Also, agriculture extension service should be intensified to quick farmers' enthusiasm to enter into farming. Farmers should be sensitized to invest moneys obtained from mining into their farming activities to expand their welfare net.

Keywords: Farm households, mining communities, Switching Regression model.

ANALYSIS OF ECONOMIC AND FINANCIAL PROFITABILITY IN THE PRODUCTION AND MARKETING OF COWPEA [(*Vigna unguiculata* (L.) WALP.) IN OF SMALL FARMERS OF IN MOGOVOLAS AND RIBAUÉ DISTRICTS

Diocleciano Calton Alexandre[1] | dioameli@gmail.com

Alexandre Tocoloa[2] Henriques V. Colial[1], Venâncio Salegua[1], Salva I. Somueque[1], Belarmino Divage[1] and Marques Donça[1]

[1]Mozambique Agricultural Research Institute Institute of Agrarian Research of Mozambique (IIAM)

[2] Lúrio University, Mozambique

The cowpea [Vigna unguiculata (L) Walp], is a legume that providesthe main source of protein, minerals, and fiber of smallholders farmers. In Mozambique, it is produced by the family sector in small areas with an average yield of 253 kgKg/ha. Despite of being a very important crop, its production, productivity, marketing, and profitability are affected by biotic and abiotic factors. Another predominant factor for of small farmers is the perception of the economic and financial profitability of this crop. The purpose of this study was to analyze the economic and financial profitability of cowpea [Vigna unguiculata (L.) Walp] for of small farmers in the Mogovolas and Ribaué Districts in the 2021/2022 growing season. The research was conducted in a mixed, explanatory manner where the data were collected was through interviews and questionnaires. The study had a totalhandled a sample of 145 participants, with 4 district representatives interviewed and 141 small farmers questioned, inferred through a non-probabilistic convenience sample. The data was were analyzed using content analysis and the chi-square test using SPSS V28 softwareversion and the CONAB, IEA, and IIAM methodology. The results showed differences in the forms and strategies of production, marketing, and economic and financial profitability between small farmers in the two Districts. The highest economic and financial profitability was obtained by small farmers with high incomes in the Ribaué District with an average of 14,746.20MT, compared to those with high incomes in the Mogovolas District who had 1,534.35MT. On the other hand, low-income smallholders in the two Districts recorded negative and unsustainable economic and financial profitability of around -6,106.20 MT for Mogovolas and, -2,907.00 MT for Ribaué. Therefore, the smallholder farmers of lowest income group should focus on adoption of improved technologies, that are used by the highest income group, or should allocate their labor to highest income group that could afford the labor of low income group.

Keywords: Cowpea, economic and financial profitability, production, small farmers.

GENDER ASSESSMENT OF RURAL FARMERS' PREFERENCE FOR TRAINING LOGISTICS ON IMPROVED AGRICULTURAL INNOVATIONS

Adeyemi, M. A.[1] | ade_maxwell@yahoo.com

Faborode, H. F. B.[2]

[1]Department of Animal Production and Health, Olusegun Agagu University of Science and Technology, Okitipupa, Nigeria

[2]Department of Agricultural Extension and Rural Development, Obafemi Awolowo University, Ile-Ife, Nigeria

The importance of culture on gender has continue to diminish the attainment of national food security among sub-Saharan countries particularly Nigeria through denial of equal access to information on developed technologies on crop and animal improvement, innovations on best agricultural practices and use of such by farmers to improve yield. The research was conducted to ascertain farmers' preference for training logistics on common agricultural innovations and improved practices available in national research institutes. It determined the levels of awareness by gender, and discussed farmers' training constraints. Purposive sampling technique was used to select six States and four Local Government Areas based on the preponderance of agricultural research institutes and development of improved crop and animal varieties/strains. Structured interview schedule was administered on 1,200 mixed (crop and livestock) farmers and 90 key informants identified through snow ball sampling technique. Data were subjected to descriptive and inferential statistics. Results include cost advantages of growing/rearing improved crop/livestock as the time to maturity reduced with improved yields, over 80 % of both gender in their active ages, both gender had high level of awareness in improved crops/livestock varieties/strains and similarities in preferences for training methods, mode and facilitator. They differ in preferences for training venue, duration, day and time. Results of ANOVA revealed that male and female farmers' preferences for training logistics differ significantly ($p < 0.05$). In conclusion, farmers' preference for training logistics was largely determined by cultural diversity in gender relations which if not considered could widen gender gap in access to information on agricultural innovations, hinder improved food production and contribute to widening rural poverty among populations.

Keywords: Agricultural production, culture, farmers' preference, gender, Training logistics.

TRADITIONAL KNOWLEDGE, BELIEFS AND PRACTICES ON COLLECTION OF LAKE FLIES (*Chaoborus* and *Chironomus sp.*) AND THEIR IMPLICATIONS ON FOOD SECURITY

Mathews L. Kambani | kambanimathews@gmail.com

Christopher O. Gor and Monica A. Ayieko

Jaramogi Oginga Odinga University of Science and Technology, School of Agricultural and Food Science, Bondo, Kenya

Lake Flies are edible insects with the potential of contributing to food security in that they are an alternative protein and micronutrient food source in freshwater lake regions. The main challenge in exploiting the lake flies is difficult in the collection. This study was conducted to identify sustainable traditional collection practices and forecasting techniques of lake flies and was implemented in Rusinga and Mfangano Island in Kenya. The ethnographic study employed multiple methods of data collection: focus group discussion (FGD), observations and interview schedules. 5 (3 female and 2 male) key informants were selected for interview schedules aged above 60 years. 48 (19 female and 29 male) participants took part in FGDs they were divided into 8 sets each containing 6 participants and an age range between 18 to 40 years. Open data kit (ODK) software was used for data collection while analysis was conducted via thematic analysis framework using Nvivo version 10 software. Questions were administered on traditional lake-flies emergence forecasting, collection techniques and devices. The emergence of lake flies is determined by moon sightings, the presence of strong winds and the rainy season. Lake flies can be collected: mid-air flight mode, bushes along the shore and night operations using a light source (bulb, touch). Lake flies are collected using traditional tools: a woven basket with a stick handle, pots, a plastic basin and a woven basket with a stick attached. Cultural myths associated with lake flies included: marriage partner/business customers' attraction. Uses include libido enhancement, remedy for sickness and good fish harvest indicator. In conclusion, lake flies have the potential to contribute to food and nutrition security as affordable and locally available alternative protein and micronutrient source.

Keywords: Food security, Lake-flies, Practices, Beliefs, Traditional knowledge.

"MUNASI", THE HEART OF ZAMBEZIA: GENDER BASED IMPACT OF COCONUT LETHAL YELLOWING ON RURAL LIVELIHOODS

Vilma Rosa Tsembane1 | Vilma.tsembane84@gmail.com

Nícia Givá1and João Bila [1,2]

[1]Faculdade de Agronomia e Engenharia Florestal, Universidade Eduardo Mondlane, Maputo, Mozambique

[2]Centre of Excellence in Agri-food Systems and Nutrition - CEAFSN, Maputo, Mozambique

The coconut tree, known as the "tree of life," is vital for rural communities, providing food, drink, oil, fiber, and building materials. Its multiple uses ensure food security, income, and environmental sustainability. In regions such as Zambezia, where agriculture sustains the local economy, the coconut tree is essential for the survival and well-being of families. However, the emergence of the Coconut Lethal Yellowing (CLY) disease threatens to devastate this crucial source of livelihoods, jeopardizing the food security, income, and communities' social cohesion, putting the resilience and survival of these rural populations at risk. This study assesses the damage caused by CLY on the livelihoods of rural communities in Maganja da Costa, Zambezia. For this study, we conducted nine focus group discussions (FGD), three FGD with women, men, and community leaders from different communities respectively. We also carried out seven semi-structured interviews with coconut farmers' over 20 years of experience in the industry and a survey with 134 male and female coconut farmers. The results shows that 82.96% of respondents suffered a significant reduction in coconut production in the last five years. This decrease in production resulted in a sharp drop of household's income and food security. Additionally, data confirm the decrease of the average annual income generated from the sale of coconuts and coconut products by 60% during the same period. Consequently, there is an increasing of men migration by 45% seeking for alternative livelihoods outside the community, leaving behind women and children, who play a key role in agricultural activities, but often with limited knowledge about the disease and its mitigation measures. Thus, the study underlines the need to put women and youth at the forefront to fight against CLY by providing them with adequate training and resources. It also argues that without a coordinated and effective response, communities will increasingly face challenges to maintain their livelihoods and quality of life. The study highlights the importance of inclusive and sustainable public policies to address this agricultural crisis. This includes the need for urgent interventions, such as the replanting varieties of coconut palms that are resistance or tolerant to CLY, ensure that women and youth are equipped to lead efforts to mitigate and adapt to CLY and financial support to mitigate the climate related adverse effects.

Keywords: Coconut Lethal Yellowing, Women Empowerment, Youth Engagement, Zambezia.

ECONOMIC DYNAMICS SHAPING CLIMATE CHANGE ADAPTATION PATTERNS: lessons from the agricultural market performance trends among youth agripreneurs

Mpho Tshikororo| Mpho.tshikororo@univen.ac.za

Tshimangadzo Ashely Nefale and Avhafunani Justice Netshipale

University of Venda, Faculty of Science, Engineering & Agriculture, Department of Agricultural Economics and Agribusiness, South Africa

Globally, the agricultural industry has severely suffered from the impacts of climate change, with Africa being the most affected. Climate change adaptation enhances farmers' viability and competitiveness in the market but is costly. With tailored efforts to assist youth participation in agriculture, the study sought to investigate the economic dynamics that climate change has on agricultural marketing performance among youth agripreneurs. The study was conducted in the emerging economic zone, the Vhembe district of Limpopo province, where agricultural activities dominate. The study used purposive sampling to select 125 young agripreneurs. Structured questionnaires were handed to the participants during the in-person interview sessions. The discriminant analysis method was utilized to draw insights on market participation and performance between youth agripreneurs who adapt to climate change and those who do not. The study further revealed that there is a distinct difference in marketing performance between the two groups. The study findings show that adapting to climate change enhances one's participation in the market. However, the agribusinesses collapse within the first five years of establishment. The results also indicate that adapting to climate change secures a market share but not necessarily the edge. Moreover, results further show that young agripreneurs who do not adapt to climate change generate low revenues compared to their counterparts. The study recommends early climate change potential impact detection for tailored adaptation as it may significantly minimize adaptation costs. The study further recommends improved tailored institutional support for climate change, particularly for emerging young agripreneurs. The study further recommends future studies to assess the economic viability of various climate change adaptation strategies to enhance the selection of such strategies.

Keywords: Climate Change, Market performance, Youth.

SOCIO-ECONOMIC IMPACT OF THE COVID-19 PANDEMIC IN THE DISTRICT OF BOANE, MAPUTO PROVINCE

Derço Manhice | dercojosesendela@gmail.com

Luis Artur | lartur2000@yahoo.com

Faculdade de Agronomia e Engenharia Florestal, Universidade Eduardo Mondlane, Maputo, Mozambique

The Covid-19 pandemic represented one of the great threats of the present century. It has produced negative impacts in several parts of the world, including Mozambique. The present research work aimed at evaluating the socio-economic impact of the Covid-19 Pandemic in the district of Boane. The methodological procedure used in the study was the combination of qualitative and quantitative methods. 151 heads of households were surveyed using systematic random sampling. Unsystematic observations and semi-structured interviews were also conducted with key informants. The results show that most of the households surveyed were male and, in general, the heads of households have an average age of 51 years and a low level of education (EP1 and EP2). The respondents were aware of the existence of Covid-19, whose main sources of information were television and health units. Most respondents are aware of prevention measures, of which the most adopted were constant hand washing and the use of masks. The main sources of income reported in Boane are: formal employment, agriculture, informal trade, self-employment outside the field, pension and remittances. Overall, earnings through the main sources of income reduced with Covid-19; The survey shows that in general it reduced the average annual income by 12.2%, the minimum income reduced by 80%. And, the source of income that suffered the most was informal trade. On the other hand, the results show that women had a greater decline in their average incomes, which were already low, having fallen by about 23% when compared to men who had a reduction of about 10%. As for changes in networks, respondents perceive that crime and the prices of basic necessities have increased; Solidarity within communities and domestic violence within households was similar to previous levels.

Keywords: Boane, Households, Income, Impact, Covid-19.

ASSESSING THE DEVELOPMENT IMPACTS OF BIO-INNOVATIONS: the case of genetically modified maize and cassava in Tanzania

Rui Benfica | rmsbenfica@gmail.com

Tanzania's agriculture is characterized by low productivity due to unpredictable rainfall and the prevalence of pests and diseases. Genetically modified (GM) maize offering protection against drought and insects are being developed. Likewise, GM varieties resistant to cassava brown streak disease were developed. Building on prior crop-based analyses, we use the Rural Investment and Policy Analysis (RIAPA) CGE model to assess the impacts of the adoption of those GM crops. GM maize and cassava have positive effects on the economy, the Agri-Food System (AFS), and poverty. Given its stronger linkages in the AFS, the effects of the GM maize are stronger, especially in higher adoption and high yield scenarios. Likewise, the effects on the poorest and rural households are greater. The high variation across scenarios, and the significant effect of the high adoption/high yield scenarios, suggests a high return to investments and policies that realize these adoption rates and yield potential.

Keywords: Bio-innovations, cassava, GMO, maize.

EVALUATION OF SORGHUM SEED SYSTEMS AND SOURCES OF AGRICULTURAL KNOWLEDGE IN FARMER RESEARCH NETWORKS IN HOMABAY AND THARAKA NITHI COUNTIES, KENYA COUNTIES, KENYA

Wafula Carolyne Khalayi[1] | ckhalayi@yahoo.com

Chimoita L.E.[2], Kinama J.M.[2], Nyangweso P.M.[3] and S. Gudu[4]

[1]Kenya Agricultural and Livestock Research Organization - The Agricultural Mechanization Research Institute, Machakos, Kenya

[2]University of Nairobi, Kenya

[3]Moi University, Kenya

[4]Rongo University, Kenya

Sorghum production in Kenya is an important agricultural activity to many smallholder farmers. The distribution of improved quality varieties and efficient seed production can contribute a lot to increased agricultural production, food and nutrition security in Kenya. The success of crop productivity and stability is determined by the farmer seed channels, hence understanding where farmers acquire seed is crucial for assessing the accessibility and availability of seeds within communities. However, the challenge has been delivery of improved varieties to smallholder farmers through reliable seed channels on a regular basis. Notably, social networks contribute to seed dissemination and the functioning of seed systems, while their importance varies by crop varieties and seed sources. Despite the successful interventions by Farmer Research Networks, the sorghum seed system in Kenya is constrained unsuitable communication structures between linkage partners, poor methods of seed distribution especially improved varieties, reducing the ability to reach smallholder farmers. The aim of the study was to evaluate the role of farmer research networks in sorghum seed systems and sources of agricultural knowledge among smallholders in Homabay and Tharaka Nithi counties, Kenya. Three hundred and fifty four sorghum growing households were randomly sampled and interviewed using a structured questionnaire. The collected data was analysed using the Python programming language. Python provided a versatile and efficient platform for data manipulation and visualization. The study indicated that the most popular main source of agricultural knowledge in both study regions is Farmer to Farmer research networks. This suggests a strong reliance on peer-to-peer knowledge exchange within the farming community and decentralized approach to knowledge sharing, emphasizing the collaborative nature of these networks. The study revealed that

social networks through the farmer research networks, farmer to farmer seed networks, community based seed groups were found to be important to the performance of sorghum seed system. For instance in Tharaka Nithi County the study indicated that farmer research networks were the main source of sorghum seed at the beginning of the season. It was noted that a good percentage community based seed groups; research institutes, government extension and FRN-NGO give seed to farmers before the beginning of the season. In both regions, commercial outlets like local markets and Agrovet/Input dealers play significant roles in seed acquisition. However, differences exist in the reliance on informal networks, engagement with external organizations, and preferences for government extensions. Understanding these differences is crucial for developing targeted interventions to improve seed accessibility and promote sustainable agricultural practices within the regions.

Keywords: Agricultural knowledge, Farmer Research Networks, Seed System, Seed channels, Seed Sources.

AGRICULTURAL COOPERATIVE: a catalyst for rural development

Loveline Ndzi[1] | ndziloveline2017@gmail.com

Assan Nkuh[1,2], Divine Tarla[1,3], Basilius Tatah[1], Ernestilia Ngeh[1,4], Germaine Tanga[1,5]

[1]CAWDEV
[2]University of Dschang, Cameroon
[3]Fulbright Association, North Dakota, USA
[4]Univversity of Bamenda, Cameroon
[5]GBHS Mabanda, Douala, Cameroon

Farming groups in Cameroon, provide numerous benefits that enhance the livelihoods of farmers and foster economic development. These groups enable farmers to pool resources, allowing them to purchase agricultural inputs like seeds, fertilizers, and equipment at lower prices, thereby achieving economies of scale. They also improve access to credit, as financial institutions are more inclined to provide loans to organized groups. This access empowers farmers to invest in advanced technologies and practices, boosting productivity and yields. By collectively marketing their produce, farming groups enhance farmers' bargaining power, allowing them to negotiate better prices and access larger markets, including export opportunities. This results in increased income and financial stability for farmers and their families. Additionally, farming groups facilitate knowledge sharing among members, enabling the exchange of best practices and innovative techniques. Many groups offer training programs in partnership with NGOs and governmental organizations, focusing on areas such as crop management and climate resilience, which enhance farmers' skills and knowledge. Beyond economic advantages, farming groups foster community cooperation, leading to stronger social networks and support systems. They often engage in community development projects, contributing to the overall well-being of rural areas. Furthermore, farming groups empower marginalized groups, particularly women, by providing access to resources and decision-making processes, promoting gender equality, and enabling women to assume leadership roles. Overall, farming groups in Africa play a crucial role in enhancing agricultural productivity, improving livelihoods, and contributing to social and economic development across the continent. My presentation would centered on the case of CAWDEV.

Keywords: Agricultural cooperatives, CAWDEV, farming groups, farmer associations.

SUSTAINABLE DEVELOPMENT: women's participation and challenges in agriculture

Albertina Alage | <u>albertinaalage@yahoo.co.uk</u>

Américo António Humulane

Instituto de Investigação Agrária de Moçambique, Maputo, Moçambique

Women participate in agriculture, but there is limited knowledge about the extent of their contribution. The UN 2030 Agenda, which defines the Sustainable Development Goals, advocates integrated and inclusive development, encouraging the participation of all actors, paying attention to vulnerable groups, including women. This work aims to identify and analyze the role that women play in agriculture in the context of sustainable development, including the challenges for its strengthening. It is a bibliographic review whose object of analysis was the results resulting from several studies worldwide, privileging the experiences of Southern Africa, highlighting Mozambique. The work will contribute to consolidating information about women in sustainable agriculture by trying to envision the visibility of their work, presenting options to improve interventions. The results allow us to understand that women actively participate in sustainable agriculture, participating in a varied way in the various segments, and their performance may vary depending on the crop practiced. The analysis showed that women are versatile, performing domestic and agrarian activities, revealing an organizational capacity in the redistribution of tasks throughout the year. Meanwhile, his work is invisible, especially in terms of statistics. On a social level, it appears as a "helper" of man even in tasks where it is a precursor. The lack of recognition of women's work aggravates the differential treatment that they are victims of in agriculture, in relation to men in similar circumstances. This is reflected in its exclusion from accessing resources and making decisions about the tasks it performs. The study concluded that women play a key role in food and nutrition security and in the family economy. They participate and contribute to the use of sustainability practices in production, post-harvest and agro-processing, marketing, on-farm research and the dissemination of information and agricultural technologies. This work of women is not always visible by the way it is interpreted and documented. There are limitations that affect women's performance in sustainable agriculture, combined with the status of subordination and exclusion that society has cultivated, with the consequent exclusion in access to resources and decision-making. Thus, a change in vision and strategy on women's work as a path to sustainable development is required.

Keywords: Sustainability, Sustainable Development, Women and Sustainable Agriculture.

ROLE OF FARMER-TO-FARMER EXTENSION APPROACH IN INCREASING ORANGE FLESHED SWEETPOTATO PRODUCTIVITY AND MARKETING IN MASSINGA DISTRICTS OF MOZAMBIQUE.

Eliah Munda | E.Munda@cgiar.org

Edgar Francisco, Riquito Muassabo, Abdul Naico, Jose Ricardo

International Potato Center, Maputo, Mozambique

Many smallholder farmers in Mozambique lack access to modern technologies, technical skills, and knowledge partly due to poor public extension coverage resulting in low crop productivity and reduced income opportunities. A study was conducted to explore the role of farmer-to-farmer extension approach in sweetpotato production and marketing in Massinga district in Mozambique from 2020/21 to 22/23 cropping seasons. Six lead farmers were identified and trained. Two farmer groups were identified, one receiving advisory service through farmer-to-farmer extension and another one only receiving technical support directly from extension workers. Trained lead farmers received backstopping from extension workers and monitored once per month by their local extension officers. Each lead farmer provided extension support to 20 follower farmers and each extension worker supporting many farmers in the community as their normal practice. About 110 follower farmers receiving advisory service from lead farmers and 110 farmers receiving advisory service from extension workers were interviewed using predetermined questionnaires. and the ODK was used to create and collect the data Data analysis was done using Stata version 14.2. Farmers who went through farmer-to-farmer extension had higher sweetpotato yield of 12 t/ ha and earned a higher average gross profit of 258,372.00 Meticais/ha compared to a yield of 8. 9 t/ha and 203,331.00 Meticais/ha average gross profit achieved by farmers who received support from extension workers. Additionally, 79% of the farmers who received advisory service through farmer-to-farmer extension (follower farmers) sold sweetpotato compared to only 33% of farmers who received advisory service through public extension workers only who sold sweetpotato. About 39% of public extension worker assisted farmers conserve vines for more than two cropping seasons for use as planting material compared to only 25% of farmers who received advisory support through farmer-to-farmer extension indicating differences in farmer groups' knowledge of possible contamination and degeneration of vegetatively propagated material that is recycled for many seasons. Farmer-to-farmer extension approach improve productivity, incomes and complements inadequate and poorly resourced public extension service. Therefore, this approach it should be encouraged for knowledge and skills transfer in Mozambique.

Keywords: Extension, follower farmer, lead farmer, trained.

THEME: PRODUCTION SYSTEMS

CHALLENGES OF PLANT BREEDING IN MOZAMBIQUE

Constantino Tomás Senete| senetecosta@gmail.com

Pedro Fato, Pedro Silvestre Chaúque, Egas Nhamucho and João Massitela

Instituto de Investigação Agrária de Moçambique, Maputo, Moçambique

Crop improvement programs have been established over years focusing on agronomic trait improvement. Currently, plant breeding programs are focused on major production challenges, addressing the production constraints to respond to the increasing population growth in food demand, market needs and environmental quality. According to Francisco (2010), in the last 100 years from 1891, Mozambican population doubled twice from 7.6 million in 1961 and 15.8 million in 1995. Based on the statistics, the actual population in Mozambique has reached the third duplication. Other major consequences of high population growth rate include: environmental related issues, such as a soil degradation, global warming with all related affects. Increase of population was more reported from urban centers where primary food production is limited. Therefore, use of robust and modern technologies in crop production is needed. Other challenges faced by crop breeding programs are low use of input and adoption of new technologies by famers. In Mozambique, the use of improved seed is bellow to 10%, inorganic fertilizer is 8%, pesticides are 7% and herbicides is 3% (MADER, 2021). All these production limitations affect negatively the impact of breeding programs. The strategies for successful crop improvement program are based on three major pillars: The land, as physical support and vehicle for water, air and nutrients for plants; the manpower, responsible for management in the field; and the seed that can contribute significantly for higher yield (Penido, Reis, Carvalho, & Reis, 2020). Therefore, apart from all these challenges, crop improvement programs can be structured to respond to commercial needs by increasing genetic diversity promoted by greater exchange of information between plant breeders, use of molecular markers to increase the probability of success and rapid integration of biotechnology in elite products. Therefore, the expectation is to develop robust and productive varieties, adapted to different agricultural systems, an increase in new private seed companies, an even greater reduction in public sector involvement in seed production.

Keywords: Environmental, Population, Technology.

STABILITY ANALYSIS OF BAMBARA GROUNDNUT [*Vigna subterranean* (L.) VerdcERDC]) GENOTYPES IN NORTHERN MOZAMBIQUE USING AMMI AND GGE BIPLOT

Amade Muitia| amuitia@gmail.com

Maria Jacinta Mopecane

Posto Agronómico de Nampula, Nampula, Moçambique

Bambara groundnut is a potential cash crop and a great source of food and nutrition for resource poor farmers living in rural areas and without access to agricultural inputs. However, the crop has been neglected when it comes to allocate research funds. This study aimed at identyding high yielding genotypes with a wide range adaptability. Six bambara groundnut were evaluation including 6 lines introduced from Tanzania and 2 2 lines collected in Mozambique. These genotypes were teste during 3 consecutive cropping seasons, and 3 locations (Nampula, Namapa and Montepuez) in experiments set up in randomized complete block design with 4 replicationse. Rach plot was 6 m long plot and 6 rows, with a spacing of 0.5 m between rows and 0.20 m between plants. Data collected during the study included plant height, primary grain color, pod shape, pod maturity, shelling percentage, number of pods per plant, total pod weight, weight of 100 seed weight s, and grain yield. These data were subjected to analysis of variance (ANOVA) and correlations. Stability analysis for yield was carried out using regression tools, AMMI and GGE biplot approaches. The results showed that the tested genotypes performed differently (P<0.05) in several evaluated parameters analyses. Stability analysis indicated that the Chiure 3 and Chiure 4 genotypes, in addition to high yield presented better stability in most of the environments. Based on the results of this study Chiure 3 and Chiure 4 genotypes were selected for registration and release within the testing environments.

Keywords: Bambara groundnut, Mozambique, stability analysis.

UNDERSTANDING BAMBARA GROUNDNUT [(*Vigna subterranean* (L.) Verdc]) CROP IN THE NORTHERN REGION OF MOZAMBIQUE: production, uses and myths

Amade Muitia | amuitia@gmail.com

Maria Jacinta Mopecane and Venancio Salegua

Posto Agronómico de Nampula, Nampula, Moçambique

In Mozambique, Bambara groundnut is a neglected and underutilized crop even despite its high nutritional value. Consequently, there is limited information on agronomic management practices, production constraints, farmers' preferred traits, seed and improved varieties. To understand the major production constraint and uses of Bambara groundnut crop in Mozambique, a participatory rural appraisal (PRA) was conducted. The objectives of the survey were to: 1) identify major constraints limiting bambara production; and 2) identify the main uses of the crop. The study was carried out in three districts of northern Mozambique, namely Chiure and Memba (in Cabo Delgado and Nampula provinces respectively), and Mulevala (in Zambezia province). Survey tools included a semi-structured questionnaire, transect walk, problem listing, and focused group discussions. Additionally, interviews were also carried out with key informants comprising community leaders and local extension officers, and these data were triangulated with the data gathered from transect walk, problem listing and focused group discussion and used to support and validate the information obtained from the semi-structured questionnaire. Other supporting information was obtained through reports from other sources such as the Ministry of Agriculture and National Institute of Statistics. Key informants, community leaders and local extension officers were contacted in the process to validate the data. Analysis performed included association, frequencies and descriptive statistics using the statistical software SPSS. Results indicate that drought was considered the major limiting factor for bambara production in all districts villages. Also, diseases and insect pests were indicated as a prominent fact that explains the low bambara yields. Additionally, seed unavailability and lack of improved varieties were also reported as an important constraint responsible for the low yields. Farmers indicated that the purpose of bambara production include household income, by selling either in town or at village market, home consumption and seed for the following season. This study revealed that farmers are aware of the major constraints that affect bambara production production in Cabo Delgado, Nampula and Zambezia provinces.

Keywords: Bambara groundnut, Mozambique, neglected crops, underutilized crops.

PHYSICAL, COOKING CHARACTERISTICS AND CONSUMER ACCEPTANCE OF WHOLE AND DEHULLED PIGEON PEAS (*Cajanus cajan L.*) CULTIVARS GROWN IN MALAWI

Tamara Tumasile Chirambo[1] | tamarachirambo.tc@gmail.com

Agness Mwangwela[2] | agnesmwangwela@yahoo.com

[1]Eduardo Mondlane University, Maputo, Mozambique

[2]Lilongwe University of Agriculture and Natural Resources, Bunda Campus, Malawi

Pigeon pea is an important pulse crop in Malawi particularly in the southern region since it provides valuable source of vegetable protein. Seed coat affects physicochemical properties of pigeon pea which affect cooking quality and acceptability of pigeon peas. The study was done to evaluate the effect of seed coat thickness and variety on cooking qualities and consumer acceptability of six varieties of pigeon pea which are Kachangu (00040) Mwaiwathualimi (ICEAP00557) Chitedze 1(ICEAP 01514/15), Mthawajuni, Sauma (ICP 9145) and ICPL 93026. The pigeon pea samples were obtained from ICRISAT and Chitedze Research Station. Physicochemical properties, descriptive sensory evaluation and consumer preference were determined. Varietal difference had significant difference on cooking time (p< 0.001), water absorption during soaking (p< 0.001), water absorption during cooking (p < 0.001) and splitting (p<0.001). Cooking time ranged from 97 to 193 minutes for Kachangu and Mthawajuni, respectively. for whole pigeon peas while for dehulled samples, cooking time ranged from 28 to 54 minutes Sauma and ICEAP 01514/15 respectively. There was no significant difference in cooking time for Kachangu, Mwaiwathualimi, ICPL 93026 and ICEAP 01514/15. Seedcoat thickness did not have any effects on physical characteristics, water absorption during soaking as well as cooking, cooking time and consumer preference. Seed coat removal had an effect on water absorption during soaking and during cooking. This also led to reduced cooking time by average of 66%. Variety Kachangu and Mwaiwathualimi had intense splits during cooking. There was no significant difference in terms of protein content for whole and dehulled pigeon peas. The protein ranged from 21g/100g to 29.45g/100g. Calcium content for whole pigeon peas was significantly higher that that of dehulled pigeon peas. Seedcoat calcium ranged from 16% to 56% for Kachangu and Mthawajuni respectively. Pigeon pea varieties with thin seedcoat had high aromatic character which is associated with undercooking. PCA showed variation in whole and dehulled pigeon peas varieties in terms of raw aroma, mushiness, nutty aroma,

cooked taste and nutty flavour. On consumer acceptability, whole ICEAP 01514/15 was acceptable due to nutty aroma and cooked taste. Dehulled ICEAP 01514/15 was preferred than all varieties and nutty aroma was the driver of liking. Variety differences had the effect on cooking characteristics and on consumer preference. Based on the results, it can be concluded that seedcoat thickness did not influence cooking time but the presence of seedcoat and variety.

Keywords: Cooking, dehulling, soaking, Pigeon peas, seed coat.

DELIMITATION OF CASSAVA GERMPLASM CLUSTERS IN KENYA BASED ON PHENOTYPIC TRAITS

Nyamwamu Nyarang'o Charles[1]| nyamwamucharles@gmail.com

Pascaline Jeruto[1], Elizabeth Njenga[1]

Peter Futi Arama[2] | arama.peter58@gmail.com

Richard Mwanza Mulwa[3]| rmulwa@egerton.ac.ke

[1]School of Science, Department of Biological Sciences, University of Eldoret, Eldoret, Kenya.

[2]School of Science, Agriculture and Environmental Studies, Rongo University, Rongo, Kenya.

[3]Faculty of Agriculture, Department of Agronomy, Horticulture and Soil Science, Egerton University, Egerton, Kenya

Cassava (Manihot esculenta Crantz) is a crucial staple food and cash crop in Kenya, supporting the livelihoods of millions of smallholder farmers. However, the genetic diversity and phenotypic variability of cassava in Kenya are not fully understood. This study focused on the delimitation of cassava germplasm clusters in Kenya based on phenotypic traits. A survey was done which collected 131 cassava genotypes from seven major cassava growing counties. These were planted at two experimental sites. Both quantitative and qualitative phenotypic traits data was collected at 3, 6, 9 and 12 months after planting. The data was subjected to Multivariate analysis at $p < 0.05$. Analyzed phenotypic traits categorized the genotypes into four cluster groups. Cluster 1, 2, 3, and 4 had 72.5%, 16.0%, 3.1% and 8.4% genotypes respectively. Out of the 25 phenotypic characters assessed, a total of 11 principal components (PCs) trait sets accounted for 71.58% cumulative genetic variation at $p<0.05$. Further, delimitation of these clusters was done based on the 11 assessed phenotypic traits. In Cluster 1, five principal components accounted for 61.7% of the total variation among the genotypes. In Cluster 2, four principal components accounted for 69.2% of the variation, while in Cluster 3, two principal components explained 100% of the variation. In Cluster 4, four principal components accounted for 71.1% of the total variation among the genotypes were identified. This systematic delimitation of cassava germplasm clusters based on phenotypic traits enables identification of the distinct clusters, which can inform targeted breeding strategies and conservation efforts.

Keywords: Cassava, Delimitation, Cluster analysis, Principal components, Kenya.

OCCURRENCE OF AFLATOXINS IN FOOD COMMODITIES PRODUCED AND CONSUMED IN ANGOLA AND MOZAMBIQUE

Cláudio Matusse[1,2], Aritson Tolentino[1], Zelda Lucamba[3], Sandra Afonso[3], Armando Venâncio[4], João Bila[5], Custódia Macuamule[6],

Paula Rodrigues[1,7] | prodrigues@ipb.pt

[1]Centro de Investigação de Montanha (CIMO), Instituto Politécnico de Bragança (IPB), Campus de Santa Apolónia, Bragança, Portugal

[2]Eduardo Mondlane University, Escola Superior de Negócios de Empreendedorismo de Chibuto, Gaza, Mozambique

[3]Instituto Politécnico de Cuanza Sul, Sumbe, Angola

[4]CEB - Centre of Biological Engineering, University of Minho, Braga & LABBELS – Associate Laboratory, Braga/Guimarães, Portugal.

[5]Eduardo Mondlane University, Faculdade de Agronomia e Engenharia Florestal, Maputo, Mozambique & Centre of Excellence in Agri-food Systems and Nutrition (CE-AFSN), Maputo, Mozambique.

[6]Eduardo Mondlane University, Faculdade de Veterinária, Maputo, Mozambique.

[7] Laboratório Associado para a Sustentabilidade e Tecnologia em Regiões de Montanha (SusTEC), IPB, Bragança, Portugal

Aflatoxins, the mycotoxins produced by molds from the genus *Aspergillus* sect. Flavi that infest food and feed commodities, are a pressing issue in most African countries and their presence has led to a surge in health problems and food insecurity. The lack of effective monitoring and control in the Portuguese-Speaking African Countries (PALOP) has resulted in the underestimation of these mycotoxins. The present work aimed to determine the occurrence of total aflatoxins (AFs) in several agricultural products – corn, beans, cassava flour, peanuts and rice – produced and consumed in the provinces of Cuanza Sul, Angola, and of Chongoene and Gaza, Mozambique. During 2023 and 2024, 236 samples (96 from Angola and 140 from Mozambique) were collected from local markets and analyzed for AFs using the lateral flow strip AgraStrip® Pro WATEX® (Romer) method. For Mozambique, 44% of all samples were positive for AFs (median=4.9 µg/kg). The highest incidence and contamination levels were found in corn, with all samples contaminated, ranging from the LOD to as high as 9200 µg/kg (median=26.9 µg/kg). Of these, 63% were contaminated above the Maximum Tolerable Limit (MTL) established by the Codex Alimentarius (15 µg/kg). AFs incidence in all

samples from Angola was 66% (median=1.25 µg/kg). Corn samples from this country showed a 96% incidence (median= 1.7 µg/kg, range LOD-82.3 µg/kg), but only 8% were above the MTL. The less contaminated commodity in both countries was cassava flour. For this crop, Angolan samples were all below the LOD, while Mozambican samples showed an AF incidence of 37% (median = 0.75 µg/kg), the highest level being 9.6 µg/kg. Considering the recommended MTLs, the aflatoxin contamination in crops produced and consumed in both countries is extremely high, mainly in corn, which constitutes the dietary basis for most people in the two countries, thus representing a significant public health risk and economic loss. Mozambique is particularly affected by this problem and, given the expected climate changes, the perspective is for its aggravation. Therefore, concerted efforts on mycotoxin control strategies are urgently needed.

Keywords: Mycotoxins, health risk, PALOP.

MORPHOLOGICAL CHARACTERIZATION OF 18 RICE VARIETIES

Salvado Kissokiy Moses Nduma Mropes[1], Leonel Domingos Moiana[2*]

Leonel Abel Alberto[1] | leonel.moiana@gmail.com

Jacinto Manuel Andreque[2]

[1]Universidade Zambeze, FEAF, Vila de Mocuba, Nacogolone-Zambézia

[2]Centro Regional de Liderança e Pesquisa do Arroz, Namacurra-Zambézia

In the present study, 18 varieties were characterized using morphological markers. The experiment was conducted in the experimental field of the Regional Center for Rice Leadership and Research/IIAM. The varieties were evaluated in a completely randomized block design with three replications. 16 descriptors proposed by IRRI were collected, 6 qualitative descriptors (ligule color, auricle color, leaf color, flag leaf posture, stem growth habit and leaf pubescence), and 10 quantitative descriptors (days until flowering, stem length, stem diameter, panicle length, number of tillers, fertile tillers, days until harvest, mass of 1000 grains and the yield). The RStudio statistical package was used for data analysis. For the quantitative variables, he initially performed the normality and homogeneity tests of the errors, the analysis of variance and the mean tests at the level of significance at 5%. Regarding yield, there were statistical differences between the averages and the Simão variety had the highest yield of 2614.17Kg/ha. The greatest distances from Manhattan were 53,140 between the genotypes (Mantega and Oziveliwa) and 51,691 (Vitamin and Oziveliwa), being one of the crosses to be considered for the generation of genetic variability in the Rice breeding program. The dendrogram was obtained by the method of grouping means/avarage and showed three groups: Group 1 (Oziveliwa, Faya, Simão, Zm30-57 and ITA34), group 2 (Roza Nhanguela, Mantega, Vitamina Namurava and Casambaua), group 3 (Sinabibi, Muworoma, Humwenhe, Nene, Mamima, Mbiguidi, Bebe and Chupa).

Keywords: Characterization, Diversity, Genetic improvement, Rice.

POPULATION GENETIC ANALYSIS OF CASSAVA BROWN STREAK VIRUS IN MOZAMBIQUE, TANZANIA AND KENYA AND GENETIC DIFFERENTIATION OF CBSD ASSOCIATED VIRUS SPECIES

Jamisse J.G. Amisse[1], Joseph Ndunguru[2], Fred Tairo[2], Laura M. Boykin[3], Monica A. Kehoe[4], Elijah Ateka[5], Chrissie Rey[6] and Peter Sseruwagi[2]

[1]Mozambique Agricultural Research Institute, Nampula, Mozambique

[2]Tanzania Agricultural Research Institute-Mikocheni, Dar es Salaam, Tanzania

[3]The University of Western Australia, ARC Centre of Excellence in Plant Energy Biology and School of Chemistry and Biochemistry, Crawley 6009, Western Australia, Australia

[4]Department of Primary Industries and Regional Development, DPIRD Diagnostic Laboratory Services, South Perth 6151, Australia

[5]Jomo Kenyatta University of Agriculture and Technology, Department of Horticulture, Nairobi, Kenya

[6]University of the Witwatersrand, School of Molecular and Cell Biology, Braamfontein, Johannesburg 2000, South Africa

Cassava brown streak disease is caused by Cassava brown streak virus (CBSV) and Uganda cassava brown streak virus (UCBSV). Previous phylogenetic analyses using full genome and individual genes sequences have demonstrated that among the CBSV sequences there are two main clades: CBSV clade 1 and CBSV clade 2, suggesting further speciation. Comparison of the levels of nucleotide diversity (π) between and within related species may provide relevant information for understand the genetic differentiation and demographic history of these species and signatures of past selection events. Using full genome sequence of CBSV from this study with other retrievd from Genbank we performed genetic differentiation and divesity of the closely related species associated to CBSD. Additional we determined the Population genetic analysis of Cassava brown streak virus from Mozambique, Tanzania and Kenya. The results, revealed lower nucleotide diversity within UCBSV (π =0.08258) than that in CBSV (π = 0.11246). Separate analysis between the two clades of CBSV indicated highest (two times higher) nucleotide diversity of isolates belong to CBSV clade 2(π =0.09251) than CBSV clade 1 (π =0.04858). Based on the individual genes within each CBSD species, P1 gene showed the highest π values: overall CBSV (0.17483), UCBSV (0.10977), Clade 2 (π=0.16900), except isolates belong to CBSV clade 1 which HAM1 was the

gene with highest π value (0.06288). On the other hand, Coat protein (CP) was the gene with lowest nucleotide diversity values: CBSV (0.05012), UCBSV (0.06363), and CBSV clade 2 (0.05588), except for the isolates belong to clade1 which the lowest π values (0.03410) was recorded in 6K1 gene CBSV Population genetic analysis showed that π varied between the geographical locations indicate that CBSV population from Mozambique has the lowest level of nucleotide diversity (π= 0.06843) than population from Kenya and Tanzania.

Keywords: Cassava, CBSV, genetic analysis, UCBSV.

EFFICACY OF ULTRAVIOLET (UV) IRRADIATION ON THE POSTHARVEST CONTROL OF COWPEA BRUCHID

Echereobia, C. O.[1] | echereobia@yahoo.com

Asawalam, E. F.[2], Emeasor, K.C.[2] And Sahayaraj, K.[3]

[1]Department of Crop Science and Technology, Federal University of Technology Owerri, Owerri, Imo State, Nigeria

[2]Department of Plant Health Management, Michael Okpara University of Agriculture Umudike, Umuahia, Abia State, Nigeria.

[3]Crop Protection Research Centre, St Xavier College, Palayamkottai, Tamil Nadu, India

The production of Cowpea which is a cheap source of dietary protein for millions of Nigerians is being threatened by Cowpea Bruchids which cause quantitative and qualitative losses to the seeds. Presently, control of Cowpea Bruchids using synthetic chemicals is being discouraged owing to widespread human and environmental hazards associated with it. Hence, there is need to explore alternative or complimentary control measures. Experiments were conducted under laboratory conditions (28°C, 70 – 75% RH and 11: 13 h Photoperiod) at Crop Protection Research Centre, St Xaviers' College, Palayamkottai, India to determine the effects of Ultraviolet (UV) irradiations on the protection of cowpea seeds against Cowpea Bruchid. Five pairs of 1 -2 day old cowpea bruchid were kept in Petri-dishes containing 50 wholesome Cowpea seeds and exposed to UV-C Lamp of 254 nanometer (nm) at a distance of 30cm for 0,5,10.15 and 20 minutes. Insect mortality, Percentage mortality, Weevil Perforation Index and Percentage Seed Perforation were determined using Standard Procedures. The experiments were carried out using a Completely Randomized Design (CRD) replicated 5 times. Results showed that UV irradiation was effective in protecting cowpea seeds. At increased exposure time of 20 minutes, 75.2% mortality of cowpea bruchid was recorded at 96 hours after exposure and a WPI of 55.7 after 3 months of storage. Results also showed that irradiations did not significantly (P≥0.05) affect viability of cowpea seeds. Results obtained from these studies showed that UV irradiations have great potentials in protecting cowpea seeds against cowpea bruchid and should be in cooperated into the integrated management strategy against cowpea bruchid.

Keywords: Bruchids, Cowpea, Irradiation Ultraviolet.

ADAPTABILITY OF THE FORMOSANA BANANA VARIETY IN THE SOUTHERN AGROECOLOGICAL ZONE

C.R. Bila Mussane[1]| musssanececilia@gmail.com

T.F. Chiconela[2]

[1]National Agrarian Institute of Mozambique (IIAM), Maputo, Mozambique

[2]Eduardo Mondlane University, Faculty of Agronomy and Florestal Engeneering, Maputo, Mozambique

Panama disease, caused by the fungus Fusarium oxysporum f. sp. cubense (Foc) tropical race 4 (TR4), has impacted banana cultivation in various countries worldwide. Mozambique stands as the sole country on the continent afflicted by this disease. The aim of this study was to assess the adaptability of the Formosana variety within the southern agroecological zone, as it currently represents the only variety exhibiting tolerance to Panama disease. Sowing was conducted in February 2022, employing a completely randomized block design with four replications and four blocks. Data collection encompassed measurements such as plant height, pseudostem diameter, leaf count, dimensions of leaf 3 (length and width), pseudostem height and diameter at flowering, bunch weight, number of hands, fruit length and diameter, brix value, number of days from planting to harvest, number of days from planting to flowering, and number of days from flowering to harvest. Data analysis utilized the STATA version 16 software, encompassing ANOVA calculations at a 5% significance level, determination of means, and the coefficient of variance for each variable. According to the test results, significant differences were observed between the two varieties in terms of height. At the conclusion of the cycle, the recorded data for Formosana and Williams were 2.8 and 2.9, respectively. For diameter, no significant differences were noted between the two varieties, with recorded values of 64.3 for both varieties in December. Regarding post-harvest measurements, the data indicate a bunch weight of 40 kg for the Formosana variety and 37.3 kg for the Williams variety. Banana length was measured at 24.3 for Formosana and 23.3 for Williams. The width of bananas for Formosana was 13 cm, while for Williams, it was 12.3 cm. Both the Formosana and Williams varieties exhibited 12 hands per bunch. In terms of days from planting to harvest, Formosana required 424.3 days, while Williams required 423.7 days. Days from planting to flowering were 314 for Formosana and 311.5 for Williams. The period from flowering to harvest was consistent for both varieties at 124.3 days. The Brix results for the Formosana variety averaged 22.6, while for the Williams variety, the value obtained was 22.3. Additionally, 12.25 leaves were obtained for the Formosana variety, compared to 12.50 leaves for the Williams variety.

Regarding leaf dimensions, the leaves of the Williams variety were larger, measuring 0.88 m wide and 2.33 m long, compared to the leaves of the Formosana variety, which measured 0.78 m and 2.22 m wide and long, respectively. The coefficient of variation (CV) indicates high precision for all variables in both varieties. Significant differences were observed between the two varieties in plant height, leaf width and length, fruit length and diameter, and bunch weight. These disparities can be attributed to inherent characteristics of each variety's genotype. The Williams variety showed higher values in the dimensions of the third leaf. However, the Formosana variety surpassed the Williams variety in fruit length and diameter, as well as bunch weight, with 40 kg per bunch compared to Williams' 37.3 kg per bunch.

Keywords: Banana, Formosana.

STUDY ON PERFORMANCE OF COW MANURE (CM), POULTRY MANURE (PM), TAP WATER (TW) AND THEIR EFFICIENCY ON THE PRODUCTION OF MAIZE FODDER UNDER LOW COST GREEN HOUSE HYDROPONIC FODDER PRODUCTION SYSTEM IN WESTCOAST REGION, THE GAMBIA

[1]**Michael Oluwarotimi Olojugba | mr.olojugba@oaustech.edu.ng**

[2]**Isack Mendy and** [3] **Fatoba Thomas Ayodele**

[1]Department of Crop, Soil and Pest Management, School of Agriculture, Food and Natural Rsources, Olusegun Agagu University of Science and Technology, Okitipupa, Ondo State, Nigeria.

[2]School of Agriculture and Environmental Sciences, University of the Gambia, Faraba-Banta Campus, The Gambia

[3]Department of Crop, Soil and Pest Management, School of Agriculture, Food and Natural Rsources, Olusegun Agagu University of Science and Technology, Okitipupa, Ondo State, Nigeria

Study on Performance of Cow Manure (CM), Poultry Manure (PM) Tap Water (TW) and their Efficiency on the Production of Maize Fodder under Low Cost Green House Hydroponic Fodder Production System in Westcoast Region, The Gambia between July to August, 2023. The design of the experiment was "Completely Randomized Design (CRD). Three (3) treatments of nutrient solutions: T_1 = control (tap water), T_2 = 10% diluted cow manure, T_3 = 10% diluted chicken manure, with 4 replicates. Proximate analysis of the treatments i.e cow and poultry manure was conducted before application. The Data were statistically analyzed using Gent start, on the analysis of variance (one-way ANOVA), with Probabilities of significance among treatments at; (P ≤ 0.05) were used to compare means among treatments. The experiment was conducted in three cycles, each cycle was terminated after 12 days from seeding. The parameters of measurement; plant height, weight, water use, nutrient use and their efficiency at 4th Day, 8th Day and 12th Day. At 4th Day, no significant difference among the treatments for the parameters measured at (P< 0.05). However, at day 8th, poultry manure (PM) showed higher significant value of 5.92 cm as well as 4.91 kg in weight of maize fodder produced. At day 12th, poultry manure (PM) also recorded significant higher values of 11.09 cm and 4.96 kg of height and weight respectively. Water and nutrient use

(WNU) were significantly higher on poultry manure (PM) with 2.02 m³/tray, while tap water (TW) has the lowest value of 1.52 m³/tray at day 8th. At 12th day, Poultry manure also recorded higher value when compared with the remaining treatments. At day 4th, no significant difference between the treatments. It was also noted and recorded that poultry manure (PM) used water and nutrient more efficiently than other treatments, this was followed by cow manure (CM) while tap water (TW) was the efficient water and nutrient user. The results implied that, manure tea (nutrient solution) influences performance of maize green fodder and Water Use Efficiency on under low-cost greenhouse under hydroponics condition. It can be concluded that this study qualifies the use of nutrition solution (manure Tea) as an alternative to inorganic liquid fertilizers for production of hydroponic green fodder with less water consumption.

Keywords: Cow manure, hydroponic, green house, maize fodder, poultry manure.

VARIABILITY STUDIES ON QUALITATIVE AND QUANTITATIVE CHARACTERS OF *Phaseolus lunatus* L. (LIMA BEAN) ACCESSIONS

Quadri, Z. T[1, 2] | quadrizainab11@gmail.com

Abberton M.T.[2], Oyatomi O.J. [2], And Olawuyi, O. J.[1]

[1]Department of Botany, Genetics and Molecular unit, University of Ibadan, Nigeria;

[2]Genetic Resources Centre, International Institute of Tropical Agriculture, Oyo State, Nigeria

Phaseolus lunatus (Lima beans) is one of the opportunity legumes with constraints in their utilization in Nigeria. Therefore, this study investigated the variation among 51 Lima bean accessions from the International Institute of Tropical Agriculture (IITA), germplasm, Ibadan, Nigeria. The field experiment was laid out in a randomised complete block design with three replicates. Twenty quantitative and five qualitative leaf, seed and pod characters were evaluated for lima bean. Data was analyzed using ANOVA at $_o$ while hierarchical analysis was performed on the characters. The result shows that accession 24-6 performed for date of sowing to date of first flowering (96), while accession 198-3 excelled for date of sowing to date of first pod (107). Accession 189 revealed superior performance for both the date of first harvest (629) and the date of last harvest (132). In addition, Tpl-2432 exhibited notable characteristics, particularly in seed length (16.67mm), seed width (11.24mm), and seed thickness (8.24mm). Furthermore, Tpl-2434 displayed the highest number of pods per plant (521) and pod weight (574.85g). Moreover, date of first harvest is positive and closely related to days of first flowering (r= 0.71) and days of first pod (r=0.71) while Total seed weight is correlated to number of pods per plant (r=0.68) and pod weight (r=0.72). Therefore, accessions 24-6, 198-8, Tpl-189 could be improved for early maturity, while Tpl-2432 and Tpl-2434 were high yielding accessions to be considered for future breeding of lima bean.

Keywords: Breeding, germplasm, Lima bean, morphology, variation.

EFFECTS OF WATER HYACINTH-BASED (*Eichhornia crassipes*) VERMICOMPOST TEA (AQUEOUS EXTRACT) SUPPLEMENT ON GROWTH PERFORMANCE OF LETTUCE UNDER A NON-CIRCULATING HYDROPONICS SYSTEM

Upile Ruth Pulaizi

African Center of Excellence for Water Management, Addis Ababa University, Addis Ababa, Ethiopia

Water hyacinth is a destructive weed which is found in most water bodies across Africa and mitigation measures have been implemented to control its spread have been put in place to try to control the weed. It is a nutrient-rich macrophyte depending on the water body. It can be used as an animal fodder and vermicomposting material. The purpose of the study was to investigate the potential use of water hyacinth-based vermicompost tea material in a non-circulating hydroponics system for improved production of lettuce and management of water hyacinth. A systematic random sampling design was applied with a total of 33 plants per unit. Three dilutions 30%, 40% and 60% were used to compare the effect of various dilutions of water hyacinth-based vermicompost tea and the growth performance of lettuce in non-circulating hydroponic systems. Growth was analysed using leaf area, shoot length, root-shoot ratio, growth rate, resistance to pests attack, and moisture content analysis. Ash and digesting methods were used to determine the effect of various dilutions of hyacinth-based vermicompost tea on the concentration of selected nutrients and heavy metals quantity in lettuce and vermicompost. Lettuce dosed with hydroponics nutrient solution was significantly different at ($P<0.05$) from lettuce supplied with water hyacinth-based vermicompost extract dosed at 30%, 40% and 60%, the plants had a higher growth rate, shoot length and moisture content, large leaf area and a small root-shoot ratio. Lettuce dosed with vermicompost tea was resistant to aphid and fungi attack, while the ones dosed with synthetic solutions were attacked. Lettuce dosed with WHBVCT were short in nutrient content in their solutions while the ones with synthetic solutions had enough nutrient supply. Lettuce dosed with WHBVCT had nutrient and heavy metal concentrations within the permissible limit, except for treatment dosed at 30% and 40% which showed higher Pd and Zn values. Therefore, a non-circulating hydroponics system can be used for lettuce production to conserve water with WHBCVT used as the nutrient supplement, but there is a need to perform trials on the use of WHBVCT with other nutrient supplements to improve production in leafy and fruiting vegetables.

Keywords: Hydroponics system, lettuce, WHBVCT.

BIOTECHNOLOGY STRATEGIES FOR THE CONSERVATION OF PLANT GENETIC RESOURCES

M.M. Abdulmalik[1] | uwa6474@yahoo.com

M.L. Umar[1] and L.A. Sani[2]

[1]Department of Plant Science, Ahmadu Bello University Zaria, Nigeria

[2]Department of Plant Biology, Bayero University Kano, Nigeria

Plant genetic resources (PRGs) are of enormous importance to man as they are sources of food, feed, shelter, and raw materials for industries. PGRs are also a source of genetic diversity needed by breeders to breed for important traits such as resistance to pests and diseases and enhance the nutritional value of crops. In recent times, these are rapidly being eroded as a result of human activities (construction of dams, roads, etc.) and climate change's accompanying stresses (flooding, drought). Therefore, conservation and sustainable use of PGRs become indispensable in order to meet the food requirements of an ever-increasing human population. Conventionally, germplasm is conserved using two approaches: in situ and ex situ methods, which pose a challenge for those plants that do not produce seeds or whose seeds are recalcitrant. Biotechnology now offers new alternatives for improved conservation of plant genetic resources using in vitro culture techniques such as slow growth for short- and medium-term conservation and cryopreservation for long-term preservation.

Keywords: Conservation, cryopreservation, plant genetic resources, slow growth technique.

STABILITY AND GENETIC ANALYSES OF COMMON BEAN (*Phaseolus vulgaris L.*) FOR ROOT TRAITS AND SEED YIELD IN MARGINAL ENVIRONMENTS IN CENTRAL MOZAMBIQUE

Binaissa U. Levene Castiano[1] | binaissaulevenec90@gmail.com

Paul K. Kimurto[2], Pascal P. Okwiri Ojwang[2]

[a]Instítuto Superior Politécnico de Manica (ISPM) - Divisão de Agricultura (DivAG, Manica, Mozambique

[b]Department of Crop, Horticulture, and Soils (CHS), Egerton Universit, Egerton, Kenya

Common bean (Phaseolus vulgaris L.) production is predisposed to extreme weather variability aggravated by the effects of climate change. In sub-Saharan Africa, there is limited access to suitable improved varieties adapted to marginal environments. Root system architecture is central to adaptation of common bean to adverse growing conditions and contributes to enhanced yield. Understanding genetic architecture of root traits and seed yield accumulation is a key step towards successful improvement of common bean for adaptation to marginal environments. The objectives of this study, were to: i) determine stability of common bean genotypes for root traits and yield in marginal environments, ii) determine combining ability and estimate genetic correlations of root and agronomic traits iii) determine the root traits associated with water deficit. The study was carried out under field conditions at three locations in Mozambique and in a greenhouse in Kenya. For the field experiments, forty-nine bean genotypes were evaluated in a simple lattice design with two replications for two cropping seasons. Four elite genotypes were selected and crossed to four local cultivars using North Carolina II design. The F_2s derived by selfing F_1s without selection, were evaluated for adaptability to multi-environments. Residual maximum likelihood estimates revealed significant (P<0.01) genotype-by-environment interaction effects for root traits and seed yield, demonstrating significance of environment on genotypic expression. Acute angles between vectors of different years at the same locations, established repeatability of environments in evaluating genotypes for root traits and yield. Genotype main effect plus genotype-by-environment biplots established stability of genotypes for root traits and seed yield across locations. Genotypes DAB256, DAB398, AFR398 and Guropequeno had superior overall performance and stability for root traits and seed yield across environments. Significant positive correlation between yield and both deep roots and deep root angles and seed yield was recorded. General and specific combining ability

mean squares were significant (P<0.05) for all traits measured. General predictability ratios ranged from 0.47 to 0.68 across locations suggested the significance of both additive and non-additive gene action modulating root traits and seed yield. Significant (P<0.05) bivariate and genetic correlations revealed significant association between root traits and yield. Genotypes AFR398 displayed significant positive GCA effects among its crosses for both root and agronomic traits hence was revealed as a potential germplasm for inclusion in a bean yield improvement programme. Moderate to high narrow sense heritability estimates ranging from 0.43 to 0.67 were obtained, signifying likelihood of good response to selection.

Keywords: Climate change, Genotype-by-environment interaction, GGE analysis.

EVALUATION OF SAFFLOWER GENOTYPES AS LEAFY VEGETABLE IN TWO AGRO-ECOLOGICAL ZONES IN KENYA

Agisanyang Tautsagae[1,2], Mwashasha Mwajita[1], Agnes Kavoo[1] And Aggrey Nyende[1]

[1]Department of Horticulture and Food Security, Jomo Kenyatta University of Agriculture and Technology, Nairobi, Kenya

[2]Botswana University of Agriculture and Natural Resources, Gaborone, Botswana

Safflower (Carthamus tinctorius L) is a very diverse, multi-purpose, temperate crop tolerant to many climatic conditions across the globe. As such, the crop could be utilized for amelioration of food security in drought prone areas. This crop is mainly grown for vegetable oil, animal feed, cut flower, pharmaceuticals, foods colorant, textile dye, cosmetics, bio-fuel production and as leafy vegetable. These attributes make safflower an ideal crop in diversifying the economy and improving the socio-economic status of many smallholder farmers in arid and semi-arid areas (ASALs) across the world. Safflower has high potential to be used as a leafy vegetable especially in Sub Saharan Africa (SSA). A study was therefore designed with the aim of evaluating safflower genotypes for adaptability and palatability and the best harvest interval for vegetable production in Kenya. Six safflower genotypes were evaluated in two sites (KALRO Embu and Katumani) with different agroecological zones in the Eastern part of Kenya. The experimental design in each site was a split-plot in randomized complete block with three replications. The treatments in each site were six safflower genotypes (Kiama composite, Wanjiru, Nyambura, BJ-1006, BJ-803 and Mexican Dwarf) and four harvesting intervall (wWeekly, fortnightly, monthly and at two months. The results showed significant (P 0.05) genotypic variability for all phenological development (germination percentage and days to flowering), plant growth (plant height, number of leaves, fresh leaves kg/ha and leaf area), the yield and yield components (number of branches/plant, number of capitula/plant and 1000-seed weight). Genotype Kiama composite had leaf yield of 1102.97 kg/ha in Katumani while Embu 865.18 kgs/ha respectively (was this the highest among tested genotypes? Why do you mention the Kiama genotype? Is it because it showed the highest yield? If yes, this information should be clear). However, genotypes did not vary significantly (P ≥ 0.05) in number of primary branches/plants. The mean (overall??) plant height, number of branches, number of leaves and leaf area for Embu was 72.95cm, 10.25, 123 ,23.52cm^2 and Katumani was 89.08cm,10.25,300 and 88.72cm^2 respectively (plant growth parameters were the same among genotypes? The growth, development, yield, and yield components of safflower genotypes varied across sites with Katumani being the most favorable. The genotype

Kiama composite was found to be the most stable and adaptable with above-average yields. The results suggested that safflower was best planted in Katumani and that Kiama composite was the best genotype to be planted in both agroecological zones.

Keywords: Genotype, location, leafy vegetable, Safflower.

MOLECULAR TECHNIQUE FOR SEX IDENTIFICATION AT EARLY DEVELOPMENTAL STAGE IN DATE PALM (*Phoenix dactylifera* L.)

[1]**Sani, L. A.,** [1]**Umar, K. M.,** [1]**Babura, S. R**.

[2]**Abdulmalik, M. M. |** labdul.bot@buk.edu.ng

[2]**Usman, I. S.,** [2]**Hassan L. B.,** [3]**Muhammad A. A and** [4]**Hamza A. M.**

[1]Center for Dryland Agriculture, Bayero University, Kano, Nigeria

[2]Department of Plant Science, Ahmadu Bello University Zaria, Kaduna State, Nigeria

[3]Department of Agronomy Ahmadu Bello University Zaria, Kaduna State, Nigeria

[4]National Institute for Oil palm Research, Date palm Substation Dutse, Jigawa Sate, Nigeria

Date palm (Phoenix dactylifera L.) is an important fruit crop in hot arid and semi-arid regions. During the establishment of plantations, it is often difficult to identify the fruit bearing female plants at seedling stage. We report in this study a PCR based method for sex identification at early development stage in date palm. Twenty (20) primers were designed and used to amplify targeted fragments in the sex determination region of date palm. Three out of the twenty primers amplified fragments of 350bp, 550bp and 1500bp from CYP703 male specific region but failed to amplify any region from DNA extracted from female plants. Validation of the primers indicated that these primers easily discriminate male and female date palm plants at seedling stage. This technology will facilitateting establishment of commercial date palm plantations in Nigeria.

Keywords: Date palm, Nigeria, Phoenix dactylifer.

PROCESSING PRACTICES AND ACRYLAMIDE LEVELS OF FRENCH FRIES FROM COMMERCIAL FOOD SERVICE ESTABLISHMENTS IN RWANDA

Theoneste Hagenimana[1] | hagenatheos2006@gmail.com

Joseph O. Anyango[2], Patrick S. Muliro[2], Clement Bitwayiki[1]

[1]Department of Food Science and Technology, University of Rwanda, Musanze, Rwanda

[2]Department of Dairy, Food Science and Technology, Egerton University, Nakuru, Kenya

Acrylamide is chemical food hazard, which can cause cancer and neurotoxicity in humans. It is a public health concern and food safety issue. French fries are the most contributor to the acrylamide risk exposure. Acrylamide is formed in French fries, via Maillard reaction, when is processed in conditions of high temperature, low moisture along with other processing practices. There is a need, by food handlers, of mitigating acrylamide formation during processing of French fries. In Rwanda, French fries is processed and more consumed in urban areas, particularly, served outside homes from different commercial food service establishments (FSEs): bars and restaurants (BRs), fast-food shops (FF) and hotels (H). However, due to the inexistence of an official procedure of good processing practices, French fries processed at those FSEs are potentially contaminated with high levels of acrylamide. Moreover, empirical data on that matter is missing in Rwanda. Therefore, the aim of this study was to assess processing practices and acrylamide levels of French fries served from FSEs in Kigali City, Rwanda. Data was collected from 205 FSEs: 120 BR, 30 FF, and 55 (1 to 5 Star) hotels (H), respectively. From each FSE, the information, on routine processing-practices of French fries with regard to mains aspects for acrylamide mitigation, was collected from a kitchen supervisor using a questionnaire; and about 200 g of French fries sample was collected in a zipped plastic bag and stored at -20 ℃ before analysis. Acrylamide was quantified through a QuEChERS extraction and LC-MS/MS method. Data were statistically analyzed using SAS tool (Version 9.4) for descriptive statistics to get a global picture on processing practices of French fries; and one factor ANOVA and Turkey test at 5% to evaluate the difference in acrylamide levels among FSEs. Results showed that responses on routine processing practices of French fries varied with FSE and were generally unfavorable for acrylamide mitigation. Acrylamide level levels were between 170.3 and 3217.42 µg/kg with mean values of 587.69, 595.88 and 786.40 µg/kg for FF, H and BR, respectively. Generally, levels of acrylamide varied with and was significantly ($P < 0.05$) affected by FSE type, and hotel-Star grade. This study showed

that gap in good processing practices and high acrylamide levels of French fries from visited FSEs. Results from this study could be a basis for intervention to minimize acrylamide levels of French fries from FSEs in Rwanda.

Keywords: Food service establishments, French fries, Processing practices, Rwanda.

THE NATIONAL SOYBEAN CULTIVAR TRIALS IN SOUTH AFRICA - 45 YEARS EXPERIENCES AND PROGRESS

[1]De Beer, A.S. | debeerannelie@arc.agric.za

Bronkhorst, L. and Cochrane, N.[2]

[1]ARC-Institute for Grain Crops, Potchefstroom, South Africa Potchefstroom

[2]ARC-Biometry, Pretoria, South Africa

Soybean (Glycine max) is an important component in the agricultural economy and is currently the fastest growing grain commodity in South Africa. The production increased from 26 400 t planted on 26 000 ha in 1978/79 when the programme started, to 1 148 300 ha (2 770 000 t) during 2022/23 when the largest harvest was recorded in the history of SA. However, individual cultivars are very limited in adaptability due to sensitivity to photoperiod. Growing any soybean cultivar without knowing its potential in a particular environment may have dire consequences, even though such a cultivar may perform satisfactorily elsewhere. The soybean cultivar trials were initiated in 1978/79 by the then Oil and Protein Seed Centre (now ARC-GCI) under government directives in order to stimulate and support the local soybean industry to counter act the protein deficit in the country. The purpose of the trials was to compare cultivars for agronomic and economic performance and to test the adaptability of cultivars and new releases for specific areas and cultivation practices. All the mayor seed companies in SA are participating in the project by enrolling cultivars to be evaluated as well as in the executing of trials. The trials were planted as a Latinized row-column design using three replications. Each trial plot consisted of four, 5 m rows. Four metres were harvested from each of the middle two rows, to avoid border effects. All seeds were inoculated with Bradyrhizobium japonicum bacteria at planting. The localities where trials were planted represent a wide range of climatic conditions. Trials were carried out on the ARC and Departmental Research Stations as well as on privately owned farms. Since the inception of the trials (1978) 1 292 entries were evaluated in 1 765 soybean trials on different localities representative of production areas. The cultivar trial mean yields linearly increased at a rate of 21.2 kg/ha per annum which resulted in an increase of 0.954 t/ha over the past 45 years. The monetary value calculated at a commodity price of R8 810/t is R8 404/ha.

Keywords: cultivar evaluation, yield, soybean cultivars.

EVALUATION OF DIFFERENT SOWING DATES ON THE AGRONOMIC PERFORMANCE OF ONION VARIETIES (*Allium cepa* L.) AT THE UMBELUZI RESEARCH STATION

Lopes Neves[1]

Hipólito Malia[1] | litomalia@gmail.com

Rodrigues Afonso[2], Antonio Taula[1], Carvalho Ecole[1]

[1] Instituto de Investigação Agrária de Moçambique, Moçambique

[2] Universidade Pedagogica de Maputo, Moçambique

Onion production is largely affected by several factors, where the sowing date is an important and essential component, with effects on productivity and the final quality of the bulbs. Therefore, the present work was elaborated, aimed to evaluate the agronomic performance of five onion varieties (Allium cepa L) submitted to eight sowing dates. The trial was conducted at Estação Agronómica de Umbelúzi, the experimental field of the Instituto de Investigação Agrária de Moçambique (IIAM), in Boane district. The design used was Random Complete Blocks (DBCC), based on split plot with four (4) repetitions, divided into main factor (plots) represented by Eight (8) Sowing dates and secondary factor (sub-plots) represented by five (5) onion varieties (Red Creole, Texas grano 502, IPA 10, IPA 11 and Alfa San Francisco). The experiment included 40 treatments and 160 experimental units, the data were collected in the useful area of the sub-plot, consisting on 10 plants from the two central lines, excluding the borders. The Statistical analysis showed higher yield performance and bulb weight in the varieties Alfa São Francisco (19.31 t ha-1) and IPA 10 (18.01 t ha-1), followed by IPA 11 (15.23 t ha-1) and Texas Grano (14.59 t ha-1) compared to Red Creole (7.17 t ha-1) which presented low yield and high number of non-commercial bulbs (known as waste). However, there was isolated effect on the sowing dates factor indicated greater yield performance on March 6th and April 2nd and 16th however, sowing is not recommended on March 21st, June 5th and 17th because, of low yield recorded on these date respectively.

Keywords: Allium cepa L., Yield and sowing dates, Onion.

DARTSEQ SNP-BASED GENETIC DIVERSITY AND POPULATION STRUCTURE OF SPIDER PLANT (*Cleome gynandra* L.) ACCESSION POPULATIONS FROM ZIMBABWE

Mativavarira M., Simango K., Gasura E., Ziyomo C., Paul Kimwemwe, Kyallo M. and Savadye D.

1365 DArTseq SNP markers were identified and used to assess the genetic diversity and population structure of 40 spider plant accessions from three agro-ecological (AEZ) regions in Zimbabwe. The mean polymorphic information content (PIC) of the SNP markers was 0.20. The unweighted Neighbor-joining, population structure and principal component analysis grouped the 40 accessions into three groups with the clustering not according to the AEZs. Analysis of molecular variance showed that 69% of the total variation was within individuals (Fit=0.310), 27% among individuals in populations (Fis=0.283), and only 4% among populations (Fst=0.038). There was low genetic differentiation in the total populations as evidenced by the high level of gene flow estimate (N_m = 6.399 per generation) among populations. Low mean expected heterozygosity (He= 0.192), observed heterozygosity (Ho =0.217) were observed for the populations. The mean negative fixation index (F= -0.059) observed suggest similarities among the accessions, which was further revealed by the unweighted neighbor joining tree. These results show that the spider plant accessions from the three AEZs used in this study revealed low genetic diversity. This valuable information on the genetic diversity and population structure of spider plant accessions is useful to future spider plant breeding and genetic resources management in Zimbabwe.

Keywords: Agro-ecological zones, differentiated, SNP markers, spider plant, sub-populations.

INHERITANCE OF SEED COAT COLOUR PATTERNS AND ANTIOXIDANT ACTIVITY IN COWPEA PARENTAL GENOTYPES AND THEIR F1 CROSSES

Bakang Kedumetse Kgasudi[1] | bkgasudi@gmail.com

Samodimo Ngwako[1], Goitseone Malambane[1], Motlalepula Pholo-Tait[2],

Lekgari Lekgari[3]

[1]Department of Crop and Soil Sciences, Botswana University of Agriculture and Natural Resources, Gaborone, Botswana

[2]Research Centre for Bioeconomy, Botswana University of Agriculture and Natural Resources, Gaborone, Botswana

[3]National Agricultural Research and Development Institute, Gaborone, Botswana

Cowpea (Vigna unguiculata (L) Walp) has one of the most important characteristics being seed coat colour which determines its acceptance and market introduction. These various patterns of seed coat are associated with different antioxidants (i.e. flavonoids and phenols) and their acceptance are region specific. This makes cowpea a potential functional food with a range of bioactive compounds. Thus, this study aimed to evaluate the inheritance of seed coat colour patterns and antioxidant activity of cowpea. The recurrent parent (B138) was hybridized with the non-recurrent parents (ER7) to generate the F_1 and reciprocal F_1 generations. Four F_1 and four reciprocal F_1 generations were generated and used in this study. B138 and ER7 are reddish brown and cream white in colour respectively. The F1 crosses; F1-BE-1 (B138 X ER7), F1-BE-2, F1-BE-3 and F1-BE-4 were speckled brown in colour. The reciprocal F1 crosses; F1-EB-1 (ER7 X B138), F1-EB-2, F1-EB-3 and F1-EB-4 also displayed speckled brown colour. All the crosses displayed a different colour compared to their parents. One gram of seeds was grounded with coffee grinder and used for antioxidants analysis. This study showed that the total phenolic content extracted with 50% acetone for all the genotypes were higher than those extracted with distilled water. A higher DPPH was displayed by F1-BE-2 (72.91%) compared to B138 (47.06%) but less compared to ER7 (73.03%) parental lines. Low flavonoid content extracted with distilled water and 50% acetone was recorded by F1-BE-1 (7.48 Quercetin equivalent µg/mL, 11.36 Qeµg/mL) and F1-BE-4 (9.46 Qeµg/mL, 16.08 Qeµg/mL), as compared to B138 (15.43 Qeµg/mL, 30.04 Qeµg/mL) and ER7 (12.15 Qeµg/mL, 16.28 Qeµg/mL). Studies have shown that acetone influenced antioxidants yield and could be considered as a good solvent for extraction. The inheritance pattern for seed coat colour and antioxidant activities in

the studied lines was found to be similar, indicating a strong relationship between these traits. Seed coat could be used to pre-screen high yielding genotypes for acceptance by consumers and F1 progenies with high antioxidant contents could be used in cowpea improvement. The combination of antioxidants and seed coat colour may provide practical support for the development of high-value varieties.

Keywords: DPPH, Phenols, Flavonoids.

GRAIN YIELD, STABILITY AND BACTERIAL BROWN SPOT DISEASE OF DARK RED KIDNEY DRY BEAN (*Phaseolus vulgaris* L.) GENOTYPES ACROSS SIX ENVIRONMENTS IN SOUTH AFRICA

Venâncio Alexandre Salegua | salegua@gmail.com

Mozambique Agricultural Research Institute (IIAM), Mozambique

Dry bean (Phaseolus vulgaris L.) is grown under an extensive range of agro-climatic conditions and is an essential source of protein and income globally. This study aimed to evaluate yield performance, stability, and bacterial brown spot (BBS) disease resistance of fourteen dark red kidney genotypes across environments in South Africa namely Carolina, Clarens, Cedara, Middelburg, Potchefstroom, and Warden. Analysis of variance (ANOVA), additive main effects and multiplicative interaction (AMMI) and the genotype plus genotype by environment interaction (GGE-biplot) analysis were used to evaluate grain yield performance, stability, and BBS disease resistance. The AMMI ANOVA revealed that mean squares for grain yield and BBS severity for the environment, genotype, and genotype by environment interaction were highly significant (P<0.001). Four interaction principal components (IPCA1 - 4) for grain yield and IPCA1 for BBS severity were highly significant (P<0.001, P<0.01). Genotype G12 showed broad adaptation for both high grain yield and low BBS severity across the six environments, while genotypes G08, G06, G03, G02, G05, and G04 had specific adaption for high grain yield and low BBS severity. These genotypes recorded grain yield above the grand mean and the best check cultivar, both with 1.43 t ha^{-1}, and BBS severity below the grand mean (31.90%) and the best check (48.89%). The genotypes identified with either broad or specific adaptation can be released in the environments they are adapted to, or used as parents in breeding programmes aiming to improve grain yield and BBS disease resistance of dry bean for farmers in South Africa.

Keywords: AMMI stability value (ASV), bacterial brown spot severity, broad adaption.

MORPHOLOGICAL CHARACTERIZATION OF PAPAYA GERMPLASM (*Carica papaya* L.) COLLECTED IN DIFFERENT LOCATIONS ALONG THE NACALA CORRIDOR, NAMPULA PROVINCE – MOZAMBIQUE

H. A. Miteca[1] | hmiteca@gmail.com

E.T.F. Conceição[1], M. Naimo[b], H.M. Bay[1] O.M. DA Paz[1], A. JORGE; N.S. Mussá[1]

M. Meneses[2], P. Hinrichsen[2], C. Muñoz[3] and L. Prat[3]

[1]Instituto de Investigação Agrária de Moçambique – IIAM, Centro de Formação em Frutas –CFF-Namialo, Nampula, Mozambique

[2]Instituto de Investigaciones Agropecuarias, INIA- la Platina, Santiago, Chile

[3]Universidade de Chile, Santiago, Chile

Papaya (Carica papaya L.) stands as a vital fruit globally, esteemed for its social, economic, and nutritional merits. Its rich vitamin A, B, and C content, coupled with its low acidity, render it as a favorite among consumers. Notably, papaya cultivation offers a lucrative avenue for small-scale farmers, given its year-round harvest cycle. However, its cultivation within the recourse poor family sector remains nascent, with individual producers typically limiting subsistence planting to less than a hectare. This limited expansion in Mozambique may stem from inadequate access to improved plant varieties suited to local conditions. This study endeavors to characterize 79 papaya accessions sourced from Monapo, Meconta, and Nampula districts along the Nacala Corridor, Nampula province, during September – November 2021. Morphological characterization employed fifteen IBPGR descriptors, comprising nine quantitative and six qualitative parameters. Descriptive statistics and multivariate analyses, particularly Principal Component Analysis (PCA), were conducted on quantitative traits. The resultant dendrogram, employing the UPGMA clustering method, delineated two distinct groups, A and B, based on average Euclidean distances. Quantitative analyses revealed significant diversity among local accessions, with fruit weight ranging from 125 g to 2513 g, and maximum soluble solids content reaching 14°Brix. Noteworthy variations in flesh color were observed, with 71% exhibiting yellow, 24% orange, and 3% red hues. These findings underscore the diverse traits inherent in local papaya accessions, laying a robust foundation for initiating a papaya breeding program tailored to Mozambique's agricultural landscape.

Keywords: Carica papaya, diversity, local access, Mozambique.

GENOTYPE BY ENVIRONMENT INTERACTION, ADAPTABILITY AND STABILITY ANALYSIS OF COTTON (*Gossypium hirsutum* L. Race Latifolium H.) IN NORTHERN MOZAMBIQUE

M.P. Maleia[1] | mmaleia@gmail.com

J. João[1], S.A.M. Salé[1], C.M. Domingos[1], J.O. Teca[1], A. Raimundo[1], J. Ussene[1], B.B. Irénio[1], V. Kimeles[1], A.F. Chicola[1], T.A. Perar[1], H.F. De Sousa[2], D.B. Guedes[2], E.C. Jamal[2], O. Carimo[2], D.E. Muhala[2],

P. Tebulo[3], C.C. André[4]

[1]Instituto de Investigação Agrária de Moçambique, Maputo, Moçambique

[2]Instituto de Algodão e Oleaginosas de Moçamnique, Maputo, Moçambique

[3]Universidade Católica de Moçambique, Faculdade de Ciências Agronómicas, Cuamba, Moçambique

[4]Sociedade Algodoeira do Niassa, Cuamba, Moçambique

Cotton, the "white gold", is one of the most important crops in the world. In Mozambique, cotton is a cash and foreign exchange crop and is regularly on the list of agricultural exports. Cotton cultivation in the country is mainly done by the small-scale farmers, which faces many challenges, characterized by low yields (< 500 kg.ha-1), due to the use of seed from unimproved varieties that are poorly adapted to local cultivation conditions and systematic use of recycled and non-certified seed. Research has been introducing new varieties in addition to the genotypes developed in the country. The objective of this study was to evaluate the adaptability and stability of 2 cotton varieties and 2 inbred lines for cottonseed and fiber yield. The trials were conducted under rainfed conditions in three consecutive seasons, 2021, 2022 and 2023 in Namialo, Namapa, Montepuez, Ribáuè and two seasons, 2001 and 2023 in Cuamba, making a total of 14 environments. The treatments, consisted of 9 cotton varieties/genotypes were established in a RCBD in 4 replications. Individual and combine ANOVA for seedcotton and fiber yields were carried out and adaptability and stability were applied using the GGE methodology. The PL-164/2 genotype was the most stable, with greater predictability, followed by Flash and MP2020. The MP2020 genotype showed greater fiber maturity; whereas, PL-164/2 had a standard fiber length in relation to the minimum required. Thus, PL-164/2, Flash and MP2020 are recommended to be registed and released for production.

Keywords: Biplot, cottonseed yield, fiber quality, GGE analysis, inbred lines.

EFFECT OF DIFFERENT HARVEST TIMES ON THE STRUCTURE AND CHEMICAL COMPOSITION OF THE ROOTS OF SIX VARIETIES OF CASSAVA (*Manihot esculenta* Crantz)

Jeje Mangue, Imaculada Esperança and Tivana, Lucas Daniel

Cassava (Manihot esculenta Crantz) is one of the main food crops in the world, serving as a raw material for the food industry. However, the quality of its roots can be influenced by variety, age and harvest season. In order to evaluate the variation of quality of cassava roots, studies were conducted with six varieties of cassava (Phora, Clone 4, Amarelinha, Kussi, Chinhembwé and Chizangara) with sampling at 6, 10, 14 and 18 months of age. Root yield, dry matter, starch, fiber and cyanide content were evaluated. Additionally, the color of the pulp and cortex was characterized, and the adhesion of the peel in the pulp. The enzyme used to determine the cyanide content was chosen on the basis of enzyme activity in leaf and latex extracts. The yield of cassava roots increased with age in all varieties. The Phora variety had the best yields (22.3 to 82.0 Ton. ha-1) and the Chinhembwé variety obtained the lowest (11.9 to 20.0 Ton.ha-1). Thes contents of starch and dry matter and fibers varied with age and variety, but influenced by the harvest time, and at 6 and 18 months (dry season) had higher levels of dry matter and starch and lower fiber than at 10 and 14 months (rainy season). The cyanide content was influenced by the variety, being the varieties Phora and Chinhembwé with lower levels (<100 mg/kg) and Clone 4, Kussi and Chizangara with higher levels of cyanides (>100mg/kg). The study showed that the quality of cassava roots varies with the variety and time of harvest and the Phora and Chizangara varieties presented better characteristics over time and latex was the best source of linamarase enzyme.

Keywords: Age, cassava, dry matter, HCN, starch, yield.

UNLOCKING THE POTENTIAL OF SORGHUM: a comparative study exploring the physical, chemical, technological, and digestibility properties of new cultivars from Mozambique

Aldo Mabureza

This study aimed to evaluate the physical, chemical, technological, and digestibility of three sorghum cultivars (Mucuvea, Otela, and Tocole) and compared them to a Local variety (criola) grown in Mozambique. Thousand-grain weight, hectolitre weight, and colour were determined in the grains. Proximal composition, antinutritional factors, starch and protein digestibility, and antioxidant activity were analysed in flours; starch was isolated and characterised by its physical, chemical, morphological, and digestibility properties. The grain characterisation varied among the cultivars compared to the Local variety, but not between the cultivars. The cultivars showed lower amounts of protein, lipids, free phenolics, tannin, soluble protein, digestibility of starch flour and proteins, and higher flavonoids and antioxidant activity. A high content of amylose (~37%), glycemic index (~82), Tp (64.83 °C), and resistant starch (57.73%) were verified in all cultivars. The peak viscosity of Local variety was higher (343.25 RVU) than the other cultivars, while the breakdown (less than 106.54 RVU) of the cultivars was significantly lower than Local (182.25 RVU). Such data suggest great potential use of Local variety in bakery products and the cultivars in products that require greater viscosity. These results will reinforce the research, production, and manufacture of new products in Africa, especially in sorghum-producing countries.

Keywords: Protein solubility, resistant, sorghum flour, starch, starch in vitro digestibility.

EVALUATION OF PLANTING DATES AND WHEAT GENOTYPES FOR OPTIMIZATION OF RAINFED PRODUCTION IN THE LICHINGA PLATEAU

Ângelo Saimone José[1,2,3] | angelosaimone@gmail.com

[1]Instituto de Investigação Agrária de Moçambique – Centro Zonal Noroeste – Estação Agrária de Lichinga, Niassa, Moçambique

[2]Instituto Superior de Agronomia, Universidade de Lisboa, Lisboa, Portugal

[3]LEAF—Linking Landscape, Environment, Agriculture and Food Research Center, Instituto Superior de Agronomia, Universidade de Lisboa, Lisboa, Portugal

The growing need to reduce spending on wheat imports in Mozambique and reduce vulnerability to fluctuations in the international market motivated the exploitation of national production. Given the deficient local irrigation infrastructure, rainfed wheat production emerges as a viable alternative. This study aims to identify optimal planting dates and best wheat varieties in the Lichinga Plateau, as a technological solution to the productive sector dominated by small farmers. The experiment was carried out in a randomized block design with 3 replications, using a factorial scheme (11x5), including 10 elite CIMMYT genotypes (G5, G7, G8, G11, G14, G17, G21, G24, G27 and G33), a variety from Zimbabwe (Nduna), and five sowing dates, spaced fortnightly between December 31 and February 28. The analysis of yield and incidence data for ears with hollow grains (2022/2023 and 2023/2024), using ANOVA with a significance of 5% and Tukey's test, revealed significant yield differences between dates and genotypes, with no interaction between the factors. The genotypes G11, G14, G17, G33, G5 and G7, sown between January 29 (D3) and February 14 (D4), showed higher yields, ranging from 2.3 to 4.5 t/ha, and lower percentages of hollow grains, from 15% to 35%. The correlation using Pearson's test was slightly weak and negative (-41.7%) among the variables analyzed. These preliminary results indicate promising dates and genotypes for rainfed wheat production in this region, contributing to the reduction of the trade deficit due to imports.

Keywords: Elite genotypes, Lichinga Plateau, planting dates, rainfed, wheat.

EVALUATION OF ADAPTABILITY AND STABILITY OF EIGHT POTATO CLONES IN NIASSA PROVINCE, MOZAMBIQUE

[1]Lourenço João Caunganha, [2]Eliah Munda, [1]Rosangela Pereira, [2]José Ricardo, [2]Edgar Francisco, [1]Peter Lee Thumbo, [1]Elias João Namanja, [1]Felisbela Meireles and [1]Laura Enriques

[1]Instituto de Investigação Agraria de Moçambique (IIAM), Lichinga, Mozambique

[2]International Potato Center, Maputo, Mozambique

Potato (Solanum tuberosum L.) is one of the most important non-cereal crops in Mozambique. It is the third most important food crop in the country after Maize, rice and wheat. One of the challenges in its cultivation is the shortage of seed to meet farmer's needs. The objective of this study was to evaluate the agronomic performance of eight potato clones in Niassa province The experiment was set up as randomized complete block design with three replications during the 2021/2022 and 2022/2023 cropping seasons in three districts of Chimbunila, Sanga and Lichinga, the eight clones 398990.605, 396033.102, 398190.59, 398098.99, 3992797.23, 398098.70, 398208.570, 304350.100, were the treatments plus variety Calinga (control). All agronomic practices were applied uniformly across all the treatments. Analysis of variance using the GGE biplot method. On average the clone 3992797.23 presented the best yield while clone 398098.7 had the lowest yield over the two seasons. The clone 398190.605 had bets yield in Sanga district.

Keyword: Adaptability, clone, district, stability.

ASSESSING SUGARCANE PRODUCTION SUSTAINABILITY IN MOZAMBIQUE: integrating the sustenagro approach with the entropy weight method

Gabriel Viegas[1] | gabrielviegas@unisced.edu.mz

Ana Marta-Costa[1], Rui Fragoso[2] and Edgar Cambaza [3]

[1] Centre for Transdisciplinary Development Studies (CETRAD), University of Trás-os-Montes and Alto Douro, Vila Real, Portugal

[2] Center for Advanced Studies in Management and Economics (CEFAGE), University of Évora, Évora, Portugal

[3] ISCED Open University, Estoril Expansion, Beira, Mozambique

The present study assesses the sustainability of sugarcane production in Sofala province, Mozambique, using an adapted SustenAgro Index approach. We selected a sample of 30 active sugarcane producers through intentional sampling, subsequently demonstrating the influence of the producers' socioeconomic characteristics on the sustainability index. The study's results demonstrate that the social dimension contributes more to the sustainability than the other two dimensions. In terms of sustainability performance, 20% of producers demonstrate high levels of sustainability in their production, while 16.7% report positive changes and trends towards higher levels of sustainability. The SustenAgro approach, which was combined with the entropy method to calculate weights, proves highly relevant, consistent, and transparent in assessing sustainability, as it covers the three primary dimensions of sustainability. However, environmental aspects, especially those related to water, continue to represent significant obstacles to the sustainability of sugarcane production. Additionally, the distance between sugar factories and production fields significantly impacts the sustainability of sugarcane production systems, because longer distances mean higher transportation costs and increased fuel consumption, leading to higher greenhouse gas emissions. The second reason is that sugarcane needs to be processed quickly after harvesting to maintain its sugar content, longer transportation times can lead to a decrease in the quality of the cane, which can affect the efficiency of sugar extraction. This model for determining sustainability levels is effective, user-friendly and adaptable to different regions, yielding specific and actionable results.

Keywords: Sustainability index, sustainability level, sugarcane, SustenAgro approach, Sofala province.

EFFECT OF INTERCROPPING OF COTTON (*Gossypium hirsutum L.*) AND COVER CROPS [PEANUT (*Arachis hypogaea L*) AND LABE LABE (*dollichos LAB-LAB*)] on yield and incidence of cotton pests

Shelcia Mery Sérgio Nhacudine | shelciasergio002@gmail.com

Faculdade de Agronomia e Engenharia Florestal, Universidade Eduardo Mondlane, Mozambique

In Mozambique, cotton is produced in rainfed conditions and mostly as a pure crop. This technique has advantages because it facilitates the management of the crop in the field, that is, it allows the cultural harvesting to be done in a simplified way. However, problems such as pests, diseases and lack of crop diversity contribute to losses of about 50 to 70%. In addition, intensive use of soils causes its degradation and as a consequence, affects agricultural productivity (Dias, 2012). In Niassa province, the practice of intercropping cotton with other food crops is common. However, little work has been done to study the relevance of this cropping system, in particular the intercropping between cotton and legumes (IIAM, 2018). The objective of this research was to evaluate how 2 intercropping systems, cotton intercropped with two cover crops: peanut (Arachis hypogaea L.) and Labe Labe (Dolichos Lab-Lab), affect cotton yield and pest incidence, and to analyze the impact of intercropping on cotton yield, and the presence and population levels of common pests in cotton op. was to study cotton response mechanisms when. A trial was conducted in the experimental field of the Faculty of Agronomic Sciences (Universidade Católica de Moçambique), in the 2023/2024 campaign, with three treatments (pure cotton; cotton + Lab lab; cotton + peanuts). A randomized complete block design was used, with four replications. Yield data was collected, and soil samples taken before sowing and after harvest. Results of the study indicate that the intercropping with cover crops (peanut and Lab-Lab) influenced cotton yield, as cotton yield was higher in all cotton intercropping systems when compared with pure cotton. The presence of cover crops reduced the incidence of pests in cotton, acting as natural repellents or hosts for natural enemies of cotton pests. The results of this study contribute to more sustainable and economically viable agricultural practices, promoting more efficient and environmentally friendly cotton production.

Keywords: Cotton (Gossypium hirsutum L.), cropping systems, cover crops, pests, productivity.

THE EFFECT OF SPATIAL ARRANGEMENT ON THE YIELD AND CROPPING EFFICIENCY OF MAIZE AND SWEET POTATO INTER-CROP IN LOWER AND UPPER MIDLAND AGRO-ECOLOGICAL ZONES IN EMBU, KENYA

Sammy Agili[1], Irene Njagi[2], Eliah Munda[1], Eliud Kagete[2], Tony Wanyoike[2], Pauline Njoroge[2] Seth Amboga[2] and Grace Muriithi[2]

cip-ddbioconsultant@cgiar.org

[1]International Potato Center, SSA, Kenya,

[2]Kenya Agricultural Livestock Research Organization, Embu, Kenya

Food and nutrition insecurity are one of the challenges in Kenya. Developing and evaluating technologies that enhances production and resilience in maize-based cropping systems is an important initiative towards the diversification of farming systems. The potential of the Sweetpotato cultivars to contribute to sustainable intensification of a maize-based cropping system as an inter-crop was investigated. Farmer managed maize / sweetpotato inter-cropping trials at two sites in Runyenjes and Manyatta sub counties in Embu County, Kenya were set up from October 2023 to April 2024. Nine spacial arrangement treatments(T) were investigated:T1= 2 rows of maize alternated with 2 rows of sweetpotato (Irene), T2= 2 rows of maize alternate with 2 rows of sweetpotato (KEMB10), T3= 4 rows of maize alternated with 4 rows of sweetpotato (Irene), T4= 4 rows of maize alternated with 4 rows of sweetpotato (KEMB10), T5= 2 rows of maize alternated with 4 rows of sweetpotato (Irene), T6= 2 rows of maize alternated with 4 rows of sweetpotato (KEMB10), T7= Sole plot maize (DK8031), T8= Sole plot sweetpotato (Irene), T9= Sole plot sweetpotato (KEMB10). Maize was spaced at 75cm between rows and 25cm between plants, and sweetpotato 30cm between plants and 75 cm between rows. The plot sizes for each treatment were 5 by 12 meters. Maize growth parameters measured at harvest were,100-grain dry mass, Cob yield and for sweetpotato was storage root yield. The data was analyzed using SAS software to generate ANOVA tables and means. Cropping efficiency was determined by calculating Land Equivalent Ratio, Land Equivalent coefficient, System Productivity Index, and Maize Equivalent Yield. The two rows of maize and two rows of sweetpotato intercropping arrangements in both sweetpotato cultivar plots produced highest maize yield (3.9 t/ha, in Irene and 3.6 t/ha, in KEMB10 variety plots). The two rows of maize and four rows of sweetpotato arrangement produced the lowest maize yield (1.7t/ha) in both sweetpotato varieties. Sole sweetpotato of KEMB10 and Irene varieties had the highest storage root

yield (12.1 and 7.6 t/ha). Two rows of maize alternated with 2 rows of sweetpotato intercropping system showed land equivalent ratio greater than 1 indicating higher land use efficiency of intercropping over the sole maize, land equivalent coefficient of 0,32 indicating yield advantage of over the sole cropping system, higher System productivity index (5.02) indicating greater yield stability than other cropping systems and highest maize equivalent yield (6860kg/ha) and gross returns (US$2110) and should be recommended.

Keywords: Inter cropping, Land equivalent ratio, Maize, Maize Equivalent yield, Sweetpotato.

PERFORMANCE OF HIGH IRON SWEETPOTATO CLONES FROM ELITE CROSSES ACROSS MOZAMBIQUE ENVIRONMENTS

Gervancio Covele, Aura Chichango, Gonzaga Madroba, Helio João, and Godwill Simbarashe Makunde

International Potato Center, Maputo, Mozambique

In Mozambique, 75% of preschool children and 52% of pregnant mothers are estimated to be anemic. The major factor contributing to these estimations is lack of iron in food diets. The International Potato Center has set up a goal to reduce iron deficiency, by developing sweetpotato varieties with enhanced iron contents through biofortification. To achieve this goal, about 600 clones generated from high iron elite crosses, were evaluated at four research stations, Nwalate, Maniquenique, Sussundenga and Gurue, which represents the major environments for screening sweetpotato in Mozambique. The performance of these clones was assessed based on commercial root yield (t/ha) and foliage yield (t/ha) using the Additive Main Effects and Multiplicative Interaction (AMMI) model and Stability index. Based on the analyses, Maniquenique was the best location for commercial root yield and foliage yield. The genotype and environment were significant for both commercial root yield and foliage yield, but the GxE interaction was significant only for commercial root yield. The principal component 1 was significant ($p<0.05$) for commercial root yield, explaining 52.8% of the variability. Based on on the stability index of commercial root yield, the top 10 most stable genotypes were CIP120004.3, CIP120004.8, CIP120001.18, CIP120004.13, CIP120001.141, CIP120001.38, CIP120003.62, CIP120004.14, CIP120004.4 with stability index of 81,125,152,164, 165, 175, 178, 181 and 188 respectively. Iron content and other nutritional qualities will be evaluated in the laboratory to facilitate selection of superior varieties both in terms of agronomic and nutritional traits.

Keyworlds: Anemia, AMMI-model, Biofortification, Iron, Stability-index.

EVALUATION OF THE NUTRITIONAL QUALITY OF SUNFLOWER (*Helianthus annuus* L.) GENOTYPES OF DIFFERENT COLORS OF ACHENE PRODUCED AT IIAM – NAMPULA

Yanick Leontino Langa[1,3] | yanicklanga@gmail.com
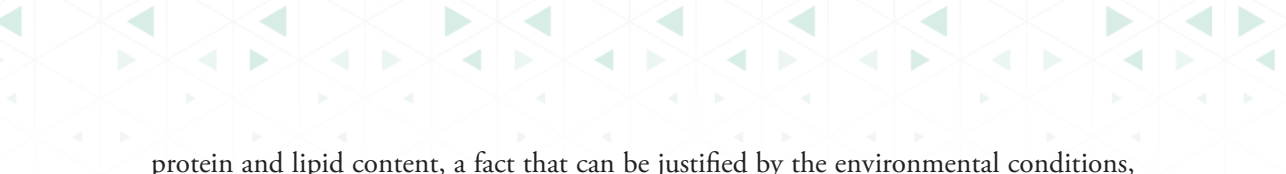
Alifo Sitoi Hassane[1], Josina Atanásio[1], Ceimira R. J. C. Pastola[1], Edson Cândido Bambo[3] Henriques Victor Colial[3], Porfírio Américo Nunes Rosa[1,2] and Fernando J. Tanleque-Alberto[1,2]

[1]Faculdade de Ciências Alimentares e Agrárias, Departamento de Tecnologia de Alimentos, Universidade Rovuma, Nampula, Moçambique.

[2]Centro de Produção e Processamento de Alimentos. Universidade Rovuma, Nampula, Moçambique

[3]Instituto de Investigação Agrária de Moçambique, CZnD, Posto Agronómico de Nampula

The sunflower (Helianthus annuus L.) is an annual plant of the Asteraceae family whose center of origin is probably North America. Among the oilseeds, it is among the ones with the highest growth rates in the world, due to the production of vegetable oil of excellent nutritional and organoleptic quality, with high physicochemical and nutritional characteristics. It is considered a versatile plant, and can also be used as grains for human and animal food, in the production of concentrated protein, as raw material for the production of biofuels and in the production of silage for ruminant feed. This research had a hybrid character (on station and on lab) with the objective of evaluating the Nutritional Quality of sunflower genotypes (Helianthus Annuus l.) of different achene colors, produced at the Institute of Agrarian Research of Mozambique (IIAM) – Nampula. The samples were collected at the agronomic post of Nampula based on the main criterion of achene color and number of stems. The analyses were carried out in the UniRovuma laboratory for humidity, dry matter, ash and organic matter parameters, according to the methodology of the Adolfo Lutz Institute and the Ceil Laboratory of UniLúrio. For the determination of roteins the Kjeldahl method was used and the determination of lipids was used using the Soxhlet method. In general, the studied sunflower genotypes showed average values of: moisture 7.20%, dry matter 92.79%, total ash 2.65%, protein in terms of 11.38 % and the lipid content was 26.823%. Based on the results obtained, it is concluded that the sunflower genotypes showed better adaptability in the agroclimatic conditions of Mozambique because they presented better agronomic and morphological characteristic. In terms of nutrients, they had low

protein and lipid content, a fact that can be justified by the environmental conditions, such as altitude, climate and soil composition that influence the content of substances that constitute the plants.

Keywords: Lipids, Proteins, Sunflower, Total Ash.

EFFECT OF DIFFERENT CONCENTRATIONS OF SUCROSE ON THE IN VITRO GROWTH OF CASSAVA CULTIVARS (*Manihot esculenta* Crantz)

Ricardo Josué Macia[1], Frederico Pedro Madabula[1], Graça Paindane[1] and Elsa Lucinda Albino Macandza[2]

[1]Instituto de Investigação Agrária de Moçambique (IIAM), Mozambique

[2]Escola Superior de Negócios e Empreendedorismo de Chibuto (ESNEC), Universidade Eduardo Mondlane, Mozambique

The establishment of slow growing conditions is fundamental to the management of an in vitro bank. This work aimed to evaluate the effect of different concentrations of sucrose in the reduction of in vitro growth of cassava plants (Manihot esculenta Crantz). The work was carried out in the biotechnology laboratory of Agrarian Research Institute of Mozambique with 4 cultivars realized by national cassava program namely Chinhembwe, Umbeluizi 2, Tapioca, Cucci and Amarelinha. Shoot tips were inoculated on MS medium, supplemented with 1.0 mg. L-1 of thiamine, 100 mg. L-1 of inositol, 0.02 mg.L-1 of NAA, 0.04 mg. L-1 of BA, 0.05 mg.L-1 of GA3, 20 g.L-1 of sucrose and 2.4 g.L-1 of Phytagel® with pH adjusted to 5.8. The shoot tips were incubated in a growth chamber at 27 ± 1 ºC, photoperiod of 16 hours and light intensity of 22 µEm-2s-1 for 30 days. Three subcultures were done in order to produce the plants to be used in the conservation assay established with 8S medium culture supplemented with 0 g.L-1, 10 g.L-1, 20 g.L-1, 40 g.L-1, 80 g.L-1of sucrose. The incubation conditions of this experiment was 22 ºC temperature, light intensity of 2.0 x 107 µmoles.m-2s-1 and a photoperiod of 12h. The best results were obtained with 10 and 20 g.L-1 of sucrose considering all evaluated cultivars. The concentrations of 40 g.L-1 promoted more growth in most varieties with exception of Tapioca. On the other hand, the cultivar Umbeluzi 2 was more efficient to retain leaves during the 12 months conservation period.

Keywords: Germplasm, in vitro conservation, osmotic regulator, sucrose.

DEVELOPMENT OF IMPROVED RICE VARIETIES FOR RAINFED LOWLAND ECOSYSTEM

Abade, H.[1], Munguambe, N.[1], Duarte, H.[1], Popisk, J.[1], Casimiro, B.[1]

Matimbe J.[1], Magia, J.[2], Fagema, J.[3] and Langa, M.[4]

[1]Instituto de Investigação agraria de Moçambique, Estação Experimental de Muirrua, Mozambique

[2]Instituto de Investigação agraria de Moçambique, Centro de Formação de Maniquinique, Mozambique

[3]Instituto de Investigação agraria de Moçambique, Posto Agronómico de Nampula,

[4]Instituto de Investigação agraria de Moçambique, Estação Agraria de Chokwe, Mozambique

For registration and release purposes**,** field experiments were carried out in 6 Districts of 3 Provinces in Central and North Mozambique, namely, Zambezia (Maganja da Costa, Nicoadala and Mopeia), Nampula (Angoche and Mogovolas) and Sofala (Caia), during 2016 and 2017 growing season **to** assess the adaptability and stability of rice lines in rainfed lowland ecosystem, following the randomized complete block design (RCBD), with three replications and 10 treatments. Data on Plant height, Tillering ability, days to 50% flowering, days to maturity, Grain yield, and Grain quality were assessed and analyzed. In the set of 12 environments of the lowland rainfed ecosystem (6 sites x 2 years), the lines CXT30 (7.8t/ha), IR50404 (7.8t/ha), and Mocuba (6.8t/ha), showed better yields than the control C4-63(4.6). In terms of days to 50% flowering, the earliest line was IR50404 (77) followed by CXT30 (82), when compared with C4-63 (104) in the global of the 12 environments. As for plant height, it shows that the genotypes had different average plant heights, with Mocuba having the highest average (120.95 cm) and C4-63 having the lowest average (87.54 cm). According to the study carried out, was possible to find genotypes (CXT30, IR50404, and Mocuba) with greater yield potential than C4-63. The study also showed that the lines (CXT30, IR50404, and Mocuba) are relatively earlier than (C4-63). During participatory selection, farmers preferred the CXT30, IR50404, and Mocuba lines because of acceptable yield and grain quality (long to extra-long grain, aroma, translucid, cooking quality, and flavor).

FACTORS THAT INFLUENCE THE CONSUMPTION OF BIOFORTIFIED YELLOW MAIZE PROVITAMIN A

Carlos Filimone | cfilimone@gmail.com

Américo Humulane[1] and Albertina Alage

Agricultural Research Institute of Mozambique, Maputo, Mozmabique

The biofortification of agricultural crops with the aim of developing staple crop varieties rich in micronutrients, in order to achieve provitamin A, has been proposed to contribute in reducing the vitamin A deficit that affects thousands of children in sub-Saharan countries. Studies conducted in several African countries, including Mozambique, show poor preference for provitamin A biofortified yellow maize when compared to white maize, and there are few studies in Mozambique that examine the factors that determine the consumption of biofortified yellow maize. In the present study, the social, personal and psychological factors that influence the consumption of biofortified provitamin A maize were examined, using as a reference the yellow maize that is widely known in Mozambique. The research was carried out in the districts of Boane, Moamba and Manhiça in the province of Maputo, in southern Mozambique, where maize is one of the basic foods and one of the most produced agricultural crops. The sample size was 213 households. The surveyed households were selected randomly. For data analysis, binary logistic regression was used in STATA 15. The results show that four out of fourteen variables tested are significant, namely the education, age, paid employment and producing yellow maize. Education and producing yellow maize have a positive relationship with yellow maize consumption, while the remaining variables have a negative relationship with yellow maize consumption.

Keywords: Biofortified provitamin A, consumption, Mozambique, Yellow maize.

GENETIC DIVERSITY OF *Coffea* spp. IN MOZAMBIQUE

Tapaça Inocência da P. E.[1,2] | isa125660@isa.ulisboa.pt
Mavuque L.[3], Pinheiro J.[1], Maquia Ivete S.[3], Brito Denise[3], Cassamo Crimildo[1,4]
Castigo Tongai[5], Romeiras Maria M.[6], Ramalho José C.[6,7], Marques Isabel[1]
and Ribeiro-Barros Ana[1]

[1]PlantStress & Biodiversity Lab, Forest Research Center (CEF), Instituto Superior de Agronomia (ISA), Universidade de Lisboa (UL), Lisbon, Portugal

[2]Agricultural Research Institute of Mozambique (IIAM), Muirrua experimental station Nicoadala Zambézia-Mozambique

[3]Biotechnology Center, Universidade Eduardo Mondlane, Maputo, Mozambique

[4]Nova School of Business and Economics (NSBE), Universidade NOVA de Lisboa (UNL), Carcavelos, Portugal

[5]E. O Wilson Biodiversity Laboratory, Gorongosa National Park, Beira- Mozambique

[6]PlantStress & Biodiversity Lab, Linking Landscape, Environment, Agriculture and Food (LEAF), ISA/UL, Lisbon, Portugal

[7]GeoBioTec, Faculdade Ciências e Tecnologia, UNL, Caparica, Portugal

The genus Coffea is native to Africa and comprises more than 130 species, of which only two dominate the world market: C. arabica L. (Arabica type of coffee) and C. canephora Pierre ex A. Froehner (Robusta type of coffee). In Mozambique, a community-based flagship project (GorongosaCoffee) is being developed in the Gorongosa Mountains, where an agroforestry management system with coffee and native trees was implemented, aiming to promote socio-economic development and revert deforestation. Integrated in this project, we are characterizing the introduced and native Coffea species based on distribution, taxonomic and genetic diversity studies of plants. Current distribution of the genus Coffea was assessed through herbarium data (IIAM, UEM, LMU and LISC), and validated through field surveys. Taxonomic analysis was based on morphological descriptors, and genetic barcodes (matK, rbcL, and ITS). Moreover, Microsatelites (SSRs) were used to assess genetic diversity and gene flow between Coffea populations in Mozambique. Genetic barcodes revealed the presence of cryptic species of Coffea, which is also supported by the presence of wide genetic variation values. A decrease in population genetic diversity was found between data obtained from herbarium vouchers and recently collected samples. The studied populations of Coffea in Mozambique showed high levels of genetic diversity, quickly reacting to changes in landscape structure and anthropogenic pressure despite the loss of native germplasm.

Keywords: Coffea sp, genetic diversity.

INVESTIGATION OF GENOTYPE X ENVIRONMENT INTERACTION FOR *Hordeum vulgare* L. ssp. VULGARE RECOMBINANT INBRED LINES IN MULTI-ENVIRONMENTS OF TIGRAY, ETHIOPIA

Hailekiros Tadesse Tekle[1], Yemane Tsehaye[2], Genet Atsbeha[3], Fetien Abay Abera[2], and Rogério Marcos Chiulele [4]

[1]Biological and Chemical Engineering, Mekelle Institute of Technology, Mekelle University, Mekelle, Ethiopia

[2]Department of Dryland Crops and Horticultural Science, College of Dryland Agri. and Natural Resources, Mekelle University, Mekell, Ethiopia

[3]Department of Applied Biology, School of Applied Natural Science, Adama Science and Technology University, Adama, Ethiopia

[4]Centre of Excellence in Agri-Food Systems and Nutrition, University Eduardo Mondlane, Maputo, Mozambique

The study examined the impact of 166 barley genotypes on yield performance in Tigray, revealing that year, environmental, and genotype factors significantly influence grain yield per plant (GYP). The analysis used AMMI and GGE biplot models, revealing environment as the dominant factor (95.3%), followed by genotypes (2.8%). The genotypes G126, G60, G108, G64, G52, G12, G62, G104, G47, G10, G83, G66, G39, and G30 were found to be highly productive genotypes showing low interaction with environments (genotypes centered near the origin) for the AMMI2 biplot for the IPCA1 and IPCA2 in GEI. The GGE biplot analysis also showed that top-performing genotypes outperformed in grain yield per plant, while Saesa and Himblil parental varieties fell below the top genotypes with yield scores of 15.34 gm/plant and 16.55 gm/plant, respectively. The IPCA1 and average environment coordination (AEC) scores at Mekelle_2018/19 (E3 & E7), Aleasa_2019 (E6), and Habes_2018/19 (E4 & E8) revealed the most stable environments. Though unstable and distant from AEC, Ayba_2018/19 (E1 and E5) significantly contributed to genotype-environment interaction. GGE-biplot of the "which-won-where" showed the 8 environments grouped into 4 mega-environments, with the winning genotypes of each environment being G112 for Ayba_2018, G82 for Aleasa_2018, G25 for Mekelle_2018, G61 for Habes_2018, and G4 for Ayba_2019. Similarly, AMMI biplot analysis revealed high average yields across test locations, with RIL genotypes G36, G72, G25, G118, and G112 showing genetic advancements and potential for future breeding initiatives.

Keywords: AMMI biplot, GGE biplot, Genotype environment interaction, GEI.

EVALUATION OF THE MICROBIOLOGICAL, SENSORIAL AND PHYSICOCHEMICAL QUALITY OF SOY MILK DERIVED FROM TGX 1904-6F ZAMBOANE VARIETY FROM THE PROVINCE OF ZAMBEZIA, MOÇAMBIQUE

Amade Dauto Ibramugy[1] | ibramugy@gmail.com

Eduarda Zandamela Mungói[2], José da Cruz Francisco[3]

[1]Agricultural Research Institute of Mozambique, Mozambique

[2]Ministry of Industry and Commerce, Mozambique

[3]Eduardo Mondlane University, Mozambique

Soy milk (SM) has been known since ancient times for not containing lactose in its composition, unlike cow's milk. It is used as a food alternative in people with lactase deficiency. The study aimed to evaluate the quality of SM extracted from TGx 1904-6F Zamboane variety soybean variety produced in Zambézia province, Mozambique. The extraction of the SM was followed by sensory analysis based on an acceptance test using a hedonic scale from **1** (I really disliked it) to **7** (I really liked it) points to evaluate flavor, color and aroma. Then we performed the microbiological analysis and the physicochemical evaluation. Our study demonstrated that there was no significant difference (p 0.05) in relation to the sensory analysis of SM (aroma=4.69 1.36, color=4.48 1.55 and flavor=3.94 1.68) on the hedonic scale. The physicochemical properties were: moisture (94.3 ± 0.06), ash (0.28 ± 0.35), proteins (2.39 ± 0.18), fat (1.1 ± 0.14) and carbohydrates (1.88 ± 0.22). Despite slight differences, these results are within the standards. In the microbiological aspect, the results demonstrated the absence of Staphylococcus, Coliforms (at 45°C) and Salmonella. In conclusion, the SM was notable for its good sensory acceptability for human consumption due to the fact that it does not have an astringent taste. Moreover, its physicochemical properties suggest that this product is could be recommended for human consumption. Thus, the massification of TGx 1904-6F Zamboane variety soybean variety will contribute to increase the consumption of plant-based milk, an alternative source of protein for communities with few resources.

Keywords: Chemical composition, sensory analysis, soy milk, TGZ 19046F soybean.

IMPACT OF PHOTON FLUX DENSITY AND LIGHT SPECTRAL QUALITY ON BIOMASS PRODUCTION AND ARBUTIN COMPOUND ACCUMULATION IN *Origanum majorana L.* PLANTLETS

Melvis Celeste Vilanculos Cossa[1], João Pedro Miranda Rocha[2], Rafael Marlon Alves de Assis[2], Jeremias José Ferreira Leite[3], Lurdeslaine Faria Texeira[3], Suzan Kelly Vilela Bertolucci[2] and José Eduardo Brasil Pereira Pinto[3]

[1]Laboratório de Biotecnologia Instituto de Investigação Agrária de Moçambique, Maputo, Moçambique

[2]Laboratório de Fitoquímica e Plantas Medicinais, Universidade Federal de Lavras, Lavras, Brasil

[3]Laboratório de Cultura de Tecidos e Plantas Medicinais, Universidade Federal de Lavras, Lavras, Brasil

Light is one of the factors that influence the growth, development and synthesis of secondary metabolites of different plant species in vitro. Origanum majorana is an aromatic plant belonging to a group of plants that produce arbutin, a substance of importance in the cosmetic industry. The objective of this study was to verify the effect of light intensity and wavelength on the growth and accumulation of arbutin in vitro in plantlets. Nodal segments were grown in MS culture medium under photon flux densities of 26, 51, 69, 94 and 130 µmol m^{-2} s^{-1}. In the light spectrum, nodal segments were grown under different light-emitting diodes LED: red; blue; a combination of blue and red light (30% B:70% R; 50% B:50% R; 70% B:30% R); and white, yellow and green. After 40 days, the growth, photosynthetic pigments and arbutin accumulation were evaluated by HPLC-DAD. The lowest light intensity (26 µmol m^{-2} s^{-1}) provided a higher content of photosynthetic pigments, and the intensity of 94 µmol m^{-2} s^{-1} increased dry biomass accumulation. Greater accumulation of arbutin was observed under a higher light intensity of 130 µmol m^{-2} s^{-1}. Regarding the quality of light, different wavelengths did not significantly affect the number of shoots or shoot length. The white light spectrum stimulated a greater accumulation of dry biomass. The green light provided a greater accumulation of photosynthetic pigments. The amount of arbutin was influenced by the different light spectra. The red spectrum promoted the highest arbutin content, and the yellow inhibited.

Keywords: HPLC, in vitro, light-emitting diodes, marjoram.

LOW COST IRRIGATION SYSTEM

Jossias Vilanculo, Arnaldo Chichongue, António Alfredro Nguambe and Herminio Vaso

Universidade Save, Moçambique

Water is essential for humanity and its transport, from the points of abstraction, is crucial to ensure its availability. This transport is usually done by gravity through natural slopes or by pumps that consume electricity or oil. To mitigate the water problem, an innovation was created that consisted of the construction of a low-cost hydraulic pump, made of mixed material (wood logs, pipes and stainless steel). The main objective was to increase agricultural production and productivity of the communities in the districts of Inharrime, Homoíne and Inhassoro, as a way to improve their livelihoods. The pilot phase began in August 2019. The target group was vulnerable widows, some living with HIV (20 women, aged 29 to 60) and vulnerable men (5 men aged 45 to 70 years). All of them had agricultural fields close to the irrigation system and agreed to participate in the pilot study. With the installation of the irrigation system, women gained more time for other activities. With the installation of the irrigation system, women gained more time for other activities.

Keywords: Hydraulic pump, irrigation, low cost.

RELATIONSHIP BETWEEN TEXTURAL AND SENSORY PROPERTIES OF SWEETPOTATO [*Ipomoea batatas (L.) Lam*] GENOTYPES GROWN IN MOZAMBIQUE

Guambe, O. J[1,2] | osvaldaguambe@gmail.com
Andrade, M.[2]
Makunde, G.[2] | G.Makunde@cgiar.org
Moyo, M3,
Ndeve, D[4] | ndevegod@gmail.com
Tivana, L[4] | lucastivana@yahoo.co.uk

[1]Faculty of Engineering, Eduardo Mondlane University, Maputo. Mozambique
[2]International Potato Center, Maputo, Mozambique
3International Potato Center, Nairobi, Kenya
[4]Faculty of Agronomy and Forestry Engineering, Eduardo Mondlane University, Maputo, Mozambique

Texture plays an important role in the overall acceptance and food quality. Breeding for new sweetpotato varieties requires assessment of sensory texture attributes of breeding materials. In this study, 13 sweetpotato genotypes from the International Potato Center's sweetpotato breeding program in Mozambique were boiled to cook and evaluated for descriptive sensory analyses using a trained panel and instrumental texture profile measurements using a Texture profile analyser to investigate the relationship between instrumental texture and sensory attributes of boiled sweetpotato. The Digieye images were also used to describe the texture of boiled sweetpotato pulp. The results showed variation of textural attributes of sweetpotato. The peak force ranged from 238 to 1567 g, and the absolute positive force ranged from 265 to 1634g. Mealiness was negatively correlated with tuber moisture release (r=-0.98), and positively correlated with fracturability (r=0.65), also it was moderately correlated with hardness (r=0.58). Hardness by mouth and fracturability we also highly correlated (r=0.83). Drier genotypes were mealy and, with fracturable texture, and exhibited higher instrumental force of deformation. These roots were the most preferred by the sensory panel. The watery genotypes had higher moisture, lower tractability texture and lower force of deformation, these roots were less preferred by the sensory panel. These results showed that Firmness and hardness can be measured instrumentally, and DigiEye imaging can be used to describe the texture of boiled sweetpotato pulp.

Keywords: Sensory analysis, sweetpotato, sensory analysis, texture.

EFFECT OF VINE CUTTING FREQUENCY ON SWEETPOTATO ROOT YIELD COMPONENTS IN SOUTHERN MOZAMBIQUE

Eliah Munda[1] | E.Munda@cgiar.org

Riquito Muassabo[1], Edgar Francisco[1], Jose Ricardo[1] and Clara da Gloria Samuel[2]

[1]International Potato Center (CIP), Maputo, Mozambique

[2]Universidade Eduardo Mondlane, Escola Superior de Desenvolvimento Rural (ESUDER), Vilankulos, Mozambique

Sweetpotato is widely produced by smallholder farmers with average yield of 7.3 t/ha in Mozambique. One of the challenges in sweetpotato production system is inadequate seed at the onset of the rainy season resulting in low crop productivity. The few sweetpotato seed multipliers (Decentralized vine multipliers (DVMs) resort to several vine cutting frequencies to meet farmers seed requirements at the peak of demand. Repeated vine cutting negatively affects sweetpotato storage root yield due to some interferences with biochemical processes such as photosynthesis. The objective of the study was to evaluate the effect of vine cutting frequency on sweetpotato yield components and determination of optimum vine cutting frequency for optimum sweetpotato storage root yield components. Three experiments were set up in three farmers' fields in Vilankulos district in Inhambane province in Southern Mozambique in the 2021/2022 and 2022/2023 cropping seasons using a sweetpotato variety Esther. The experiments were set up in randomized complete block design with three replications in each farmer's field. The treatments were no vine cutting (control), cutting only once at 8 weeks after planting (WAP), cutting twice at 8 and 12 WAP and cutting three times at 8,12 and 16 WAP. Total storage root yield number of roots per plant, root diameter and root length were measured in each treatment. Data was analyzed using R-programming. Results show that storage root yield was significantly higher in the control (19,2t/ha) and cutting once (18,1t/ha) compared to cutting twice (11,6t/ha) and three times (7,7t/ha) ($p < 0.05$). Cutting vines from one to two times resulted in 33.7 % storage root yield decline. Vine cutting twice resulted in 46.6% lower storage root yield compared to the control treatment. The same observation was noted for number of roots per plant where no significant difference (5 roots per plant) was observed in the control and cutting once treatments. However, a 40% decline in the number of roots per plant was observed when vine cutting frequency was increased from one to two. No treatment effect was observed on sweetpotato root length and diameter. Vine multipliers are recommended to harvest vines only once as planting material to obtain optimum storage root yield.

Alternatively, DVMs are recommended to have two fields, one for vine harvesting more than one cutting without expecting any storage root yield benefit and a second field without any vine cutting with specific purpose for storage root production only.

Key words: Sweetpotato, vine cutting, vine multipliers, vine cutting frequency.

THEME: RESILIENCE

OPTIMIZATION OF TOMATO (*SOLANUM LYCOPERSICUM L.*) PRODUCTIVITY UNDER WATER STRESS CONDITIONS USING SOME DIFFERENT PROTECTIVE FOLIAR TREATMENTS

Hamdino M. I. Ahmed[1] | hamdino@yahoo.com

Kawther K. Dawa[2]; Mahmoud M. Zaghloul[2] and Khadja M. Hamad[2]

[1]Department of Vegetable Crops Seed production and Technology, Horticulture Research Institute, Agricultural Research Center, Giza, Egypt.

[2]Department of Vegetable Crops and Floriculture, Faculty of Agriculture, Mansoura University, Egypt

Water scarcity is one of the factors limiting agricultural production in arid and semi-arid areas. Many countries suffer from severe water shortage, the misuse of water resources and inefficient irrigation techniques are among the important factors for the country's water security. Two field experiments were conducted to investigate the impact of the combination among deficit irrigation water treatments water (60%, 80%, 100% of ETc) and some foliar application (nano iron, nano zinc, nano silicon and yeast extract on plant growth parameters, chemical composition of leaves as photosynthetic pigments (Chl. a, Chl. b, total Chl. a+b), leaf mineral percentages (N, P, K) proline, yield and water use efficiency (WUE) of tomato plants (Fayruz hybrid) under drip irrigation system. A strip-plot design with three replicates was used. The vertical plots were allocated to the deficit irrigation, whereas the horizontal-plots were devoted to foliar spray treatments. Results indicated that the interaction among irrigation tomato plants at the level of 80 % Etc and spraying with different nano particles or yeast extract significantly increased all aforementioned parameters, meanwhile deficit irrigation treatments improved leaves proline content and WUE. The best interaction treatment for increasing plant growth parameters, chemical constitutes of leaves as photosynthetic pigments (Chl. a, Chl. b, total Chl. a+b) leaf mineral percentages (N, P, K) early and total yield is irrigation treatment with 80 % Etc and spraying with nano Si at 12 ppm and can be recommended to increase growth and productivity tomato plants of under similar conditions of this study.

Keywords: Deficit Irrigation, Nano silicon, Nano iron, Nano zinc, Water Use Efficiency.

IDENTIFICATION OF TAS14 AS A CANDIDATE GENE FOR DROUGHT TOLERANCE BY RNA-SEQ IN SWEET POTATO

Stella E. C. Nhanala[1] | sec.nhanala@gmail.com
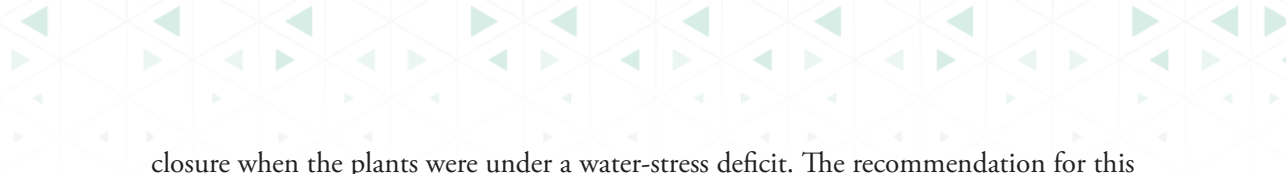
Bode A. Olukolu[2] and G. Craig Yencho[3]

[1]Instituto de Investigação Agrária de Moçambique (IIAM), Maputo, Moçambique

[2]Entomology and Plant Pathology Department at UTIA University of Tennessee, Institute of Agriculture, Knoxville, USA

[3]Department of Horticultural Science, North Carolina State University, USA

Sweet potato (Ipomoea batatas) is a crop grown predominantly in drought-prone areas, and it is considered to be adapted to hot and dry conditions. Yet, drought causes yield reduction in this crop. There is a need to improve the levels of drought tolerance in sweet potato varieties that are of interest to growers. The utilization of drought-tolerant cultivars is an approach to deal with this issue. This approach can be used for improving the tolerance to drought in sensitive varieties or for the adoption of tolerant genotypes. RNA sequencing (RNA-Seq) was performed for a comparative transcriptomic analysis of two varieties of sweet potato, Beauregard and Resisto, that were previously studied in a phenotypic assessment for drought tolerance. Leaf tissues of the two cultivars were collected during three time points: 24 hours before drought (24BD), 24 and 48 hours after (24AD and 48AD) the plants were exposed to drought. Drought stress is associated with the biosynthesis of abscisic acid (ABA) in plants and this hormone induces stomatal closure. There was a decrease in the stomatal conductance of both Beauregard and Resisto at 24AD and 48AD. The drop in the stomatal conductance was higher in Resisto than in Beauregard. The results of the transcriptomic analysis showed that the abscisic acid and environmental stress-inducible protein-like gene (TAS14) was differently expressed in both varieties through the drought events (24AD and 48AD). There was an overexpression of the TAS14 gene in both varieties when water deficit stress was imposed. The TAS14 gene was expressed at 24AD with a proportion of the fold change of Beauregard/Resisto of 1.21 and at 48AD the ratio was increased by 1.66. The Beauregard/Resisto ratio increase of the TAS14 gene was in accordance with the decrease of stomatal conductance in both cultivars. The TAS14 gene, a dehydrin, is a protein involved in protective reactions to plant dehydration and has been associated with drought tolerance in other studies. Based on the results of the phenotypic and transcriptomic analyses, it was concluded that TAS14 could be a candidate gene for drought tolerance in sweet potato. The changes in this gene were associated with stomatal

closure when the plants were under a water-stress deficit. The recommendation for this study is to include the cultivar Beauregard in further studies for drought tolerance in sweet potato.

Keywords: Beauregard, drought tolerance, Resisto, Sweet potato, transcriptomics.

INFLUENCE OF DROUGHT STRESS ON CROP GROWTH AND DEVELOPMENT: a review

Idris Z. Kiri[1] | idriskiri@slu.edu.ng

Biliyaminu Ado[2]

[1]Department of Biological Sciences, Sule Lamido University, Jigawa State, Nigeria

[2]Department of Biology, Jigawa State College of Education, Jigawa State, Nigeria

Crops face different abiotic stresses under field conditions which are either lethal or retard crop growth and development and one prominent among them is drought. Drought has been observed to impact on molecular, physical, physiological and biochemical processes that effect plant growth and development. Crops have developed unique forms of stresses adaptive measures to tolerate drought stresses. The present review, saw drought as the period without appreciable precipitation during which water contents of soil are reduced to such extents that plants suffer from lack of water. Plants relate variably with water stress at different habitats. Water deficits were reported to have major effects on plant photosynthetic capacity and inhibited the enzyme-nitrate reductase. Water Use Efficiency (WUE) referred to the amount of biomass accumulated per unit of water. Crop Water Use and WUE were described as crop-dependent. Quantifying effects of drought on crop production was difficult due factors such as poor irrigation practices, over exploitation of land etc. Drought resistance mechanisms were reported to have been divided into drought avoidance and drought resistance. The former referred to as the adoption of abilities of plants for reducing while the latter related to physiological traits developed for moderating water use etc. Various novel approaches have been tested in minimizing the negative effects of drought stress. Despite the main improvements there is still a challenge for improvement in drought tolerance. Thus, it is recommended that future research should employ biotechnological and molecular approaches to develop genetically engineered crops with enhanced tolerance against drought stress. Crop physiology is inevitable in contributing to plant breeding programmes designed to improve drought resistance.

Keywords: Crop- water stress, effects of drought, management strategies.

EVALUATION OF THE EFFICACY OF THE USE OF SYNTHETIC AND INORGANIC ORGANIC FERTILIZERS ON THE PERFORMANCE OF MAIZE VARIETIES INTRODUCED FROM SPAIN AT THE SUSSUNDENGA AGRARIAN STATION

Manuel Armindo Temo[1]| manueltemo@gmail.com

Pedro Fato[1] and Francisco Alberto Amela[2]

[1]Instituto de Investigação Agrária de Moçambique, Moçambique

[2]Instituto Superior Politécnico de Gaza, Moçambique

To achieve maize high productivity there is a need to add nutrients to the soil, which can be of mineral origin and/or synthetic organic. The study aimed to evaluate the effect of synthetic and inorganic organic fertilizers on maize cultivation and adaptability of yellow maize varieties introduced from Spain (Borja, CZH0524, Girona, Manacor, Oropesa, Pombal, Zamora). The work was conducted at the Sussundenga Agrarian Station, where two levels of synthetic organic fertilizers were used, one inorganic, one control, 6 yellow corn hybrids introduced from Spain and four local varieties, two hybrids and two open pollination (OPvs). The levels of fertilizer tested included: N0 (control); N1.1 (120-60-30 kg/ha inorg.1); N1.2 (120-39-42 kg/ha organ.1); N2 (62-21-24 kg/ha organ.2). The 10 varieties of maize included were: 1-Zamora, 2-Girona, 3-Pombal, 4-Oropesa, 5-Borja, 6-Manacor, 7-CZH0524, 8-PAN 53, 9-Dimba and 10-Matuba. The trial in total had 40 treatments. The experimental design was a randomized complete block, with split-plots and three replications. The application of synthetic organic fertilizers was done in different phases (1-7 days before sowing, 2- on the day of sowing, 3- plants with 55 cm height, 4- in flowering, 5- in the milky phase, 6- any stress of strong winds and rains) of corn development and inorganic fertilizer was applied at the time of planting and as a topdressing at 35 days after planting. The parameters evaluated were: Grain yield, flowering, plant and cob height, number of plants at the beginning and at harvest, number of cobs at harvest, aspects of the plants and cob and pests and diseases. There was no significant difference in maize yield when synthetic and inorganic organic fertilizers were appplied. There were significant differences between the organic levels (N2) with an average of 5,515 kg/ha and/or inorganic (N1.1) with an average of 4,842 kg/ha and the control with an average of 2,543kg/ha. There were also significant differences between the grain yield of the varieties under study as well as significant differences in the interaction between varieties and fertilizer. However, the local variety

PAN 53 had a yield above all with an average of 6,054 kg/ha and the worst variety was the introduced Girona. Of note is a variety introduced from Spain, CZH0524 which came in second place with an average of 4,900 kg/ha, even without significant differences between PAN53. It is thus up to the researchers to carry out further studies in various environments with the same material to reverify the effectiveness between synthetic and inorganic organic fertilizers in Mozambique.

Keywords: Adaptability and Synthetics, Inorganic fertilizers, organic fertilizers, varieties.

IMPROVING SOIL HEALTH, FOOD SECURITY AND INCOME OF SMALLHOLDER FARMERS IN MOZAMBIQUE THROUGH THE DEVELOPMENT AND USE OF APPROPRIATE FERTILIZER FORMULATIONS FOR MAIZE AND SOYBEAN IN THE BEIRA CORRIDOR

Domingos Feniasse[1], Rogério Borguete[2], Alcídio Vilanculos[1], Custódio Jorge[1], Abel Lumbela[2], Luís Savanguane[1] and Virgílio Massango[1]

[1]Instituto de Investigação Agrária de Moçambique (IIAM), Maputo, Mozambique

[2]Universidade Eduardo Mondlane (UEM), Maputo, Mozambique

Low soil fertility associated with fertility decline over time due to inappropriate agricultural practices puts the agricultural sector in Mozambique in a vicious cycle with a tendency to collapse if appropriate measures are not taken to reverse the scenario. In addition, the application of inorganic fertilizers in general is low and, even in places where it is applied, the formulation is often not adequate taking into account and considering the type of soils and the crop in question. In order to reverse this scenario, at least at the level of the Beira corridor, a consortium composed of 5 public and private institutions, namely: Institute of Agrarian Research of Mozambique – IIAM (Consortium Leader); Eduardo Mondlane University – UEM-FAEF (Partner); the National Directorate of Agriculture and Forestry (Partner), Public Extension at district level (SDAE's) (Partner); YARA / Greenbelt fertilizers Group (Partner); and Mozambique Fertilizer Company (MFC) (Partner) have carried out research with the aim of developing and validating new balanced fertilizer blends adapted to specific locations and crops. To this end, soil samples were georeferenced and collected using a transect approach in the Provinces of Manica (Gondoa and Barué), Sofala (Nhamatanda and Gorongosa) and Tete (Tsangano and Moatize). The soil samples were then sent to the soil laboratory for macro and micronutrient analysis. Based on the laboratory results of soil samples, the nutrient deficiency was calculated and the rates for corn and soybean were established. The formulas were proposed using the South African Recommendation Sheet. Then, validation tests were carried out for 3 years in the above-mentioned districts, which are part of agro-ecological regions 4, 7 and 10. Statistical analyses were performed in the R statistical package and maps were produced using spatial statistical tools in Arcmap. The results indicate that for the corn crop, fertilizers with the following formulations: 24N-21P-5K+5S; 15N-30P-5K+5S+0.2B+0.5Zn and; 29N-10P-5K+5S+0.2B+5Zn

had better agronomic and economic performance. For soybean crops, the formulations that stood out the best were: 5N+25P+0K+5S0.2Mn; 5N+30P+0K+8.5S+0.2B+0.5Zn and; 5N+25P+0K+5S+0.2B.

Keywords: Agro-ecological regions, corn and soybeans, fertilizers.

THE PREDICTED EFFECT OF CLIMATE CHANGE ON PLANTING DATE AND CULTIVAR CHOICE FOR MAIZE PRODUCTION IN SOUTH AFRICA

Robert Mangani[1] | robert.mangani@up.ac.za

Kpoti M. Gunn[2], Nicky M. Creux[1]

[1]Department of Plant and Soil Sciences, Forestry and agricultural Biotechnology Institute, Innovation Africa @UP, University of Pretoria, Pretoria, South Africa

[2]Resch School of Engineering, University of Wisconsin - Green Bay, United States of America

Maize (Zea mays L.) is one of Africa's most important field crops, particularly in Southern Africa. Given the expected climate change in South Africa, the ability to sustain strong maize production in the long run is of great concern. To formulate effective adaptation measures, it is important to understand how expected changes in temperature, precipitation, and climate extremes (heat and cold) at different developmental stages will impact maize production. The objective of this study was to explore the agronomic implications of climate change on maize production in two major South African maize producing regions, Mpumalanga and Free State. An analysis of climate change impacts under dryland maize production was conducted in Bloemfontein and Lichtenburg, locations that lie within the major maize growing regions in South Africa, using climate projections generated by six Global Climate Models under two radiative forcing scenarios: Representative Concentration Pathways (RCP) 4.5 and 8.5. Analyses were performed for four planting dates: November 15 (early), December 15 (optimal), January 15 (late), and February 5 (very late). Days to maturity receded as years progressed from the baseline period (1991-2020) to a far future period (2051-2080), at both locations with higher rates observed under the RCP 8.5 scenario. At the optimal planting dates, future climate will likely affect both the vegetative and reproductive stages of maize leading to a decrease in the days to maturity. Major factors affecting maize growth include water deficits and extreme temperature, with the number of days above 35°C expected to increase as climate change progresses. Exploring the growth parameters at later planting dates revealed a decrease in days to maturity trending towards the optimal number of days required for each cultivar in these regions. This coupled with the predicted receding frost dates and lower water deficit predictions at these planting dates under future climates indicates there may be opportunities to shift planting dates later in these regions to mitigate some of the adverse effects anticipated for the crop in future climates. These predictions need to be fully explored in a location-specific manner to understand

local climate changes and assess available mitigation strategies that can be regionally tailored to maintain crop production.

Keywords: Extreme temperatures, Growing degree days, Heat stress, Water deficit.

MOLECULAR AND MORPHOLOGICAL CHARACTERIZATION OF WHEAT GENOTYPES UNDER DROUGHT CONDITION IN NIGERIAN SUDAN SAVANNAH

Rabiu Sani Shawai[1], Magashi Auwal Ibrahim[1], Ibrahim Muhammad Bello[2]
Umar Haruna Gaya[1] and Kabiru Dauda Dawaki[1]

[1]Department of Crop Science, Faculty of Agriculture and Agricultural Technology,

Kano University of Science and Technology, Nigeria

[2]Department of Zoology, Faculty of Science, Ahmadu Bello University, Zaria, Nigeria

Drought stress is one of the most important abiotic constrains affecting cereal crop in the world that causes serious yield loses and threat to sustainability and food security especially in wheat thereby causing the insufficient supply of food. Therefore, understanding the genetic characterization of drought stress response is very important. This study was designed to reveal the morphological and molecular characterization of wheat genotypes using simple sequence repeat (SSR) markers and to estimate the genetic diversity and relationships among the cultivars subjected to drought conditions. A total of 15 wheat genotypes were evaluated for quantitative morphological traits such as plant height, number of seeds per spike, 1000 seed weight, spike length, flag leaf length, grain weight and proline content. Molecular characterization was done using a set of simple sequence repeat (SSR) markers. A total of 12 SSR markers were used to analyze the varieties and the genetic diversity and relationship among them. The results showed that, the drought-stressed plants had lower plant height, number of seeds per spike, 1000 seed weight, spike length, flag leaf length and grain weight than the non-stressed plants, while proline content was found to be higher in stressed plants than the non-stressed. Molecular analyses indicated significant variation among the genotypes with the mean PIC value of 0.64, mean heritability ratio of 0.67 and mean allele number of 8.9. This study also indicates the significance of SSRs as a useful tool in marker-assisted breeding about drought tolerance and for developing strategies for improving drought tolerance in cereals.

Keywords: Genetic diversity, Proline concentration, SSR markers, Wheat genotypes.

POTENTIALLY TOXIC ELEMENT POLLUTION LEVEL AND RISK ASSESSMENT OF SEDIMENTS IN A LOCAL FERTILIZER BLENDING PLANT AT KANKARA, KATSINA – NIGERIA

Joseph, E. | ejoseph@fudutsinma.edu.ng

Saifudeen I. and Baba-Kutigi, A. N.

Department of Physics, Federal University Dutsin-Ma, Katsina State, Nigeria

Potentially toxic elements (PTEs) which can originate from either natural sources or anthropogenic activities are metallic chemicals with densities that are higher than that of water. In this present study, we have investigated the PTEs of sediments from six (6) locations within the fertilizer blending plant at Kankara using thermal neutron activation technique. Five (5) potentially toxic elements including Arsenic (As), Cobolt (Co), Chromium (Cr), Vanadium (V) and Zinc (Zn) were analysed in terms of concentration, potential ecological risk, and human health risk. They include As, Co, Cr, V and Zn. The range and average values of the concentration of these elements are: As (1.43 – 5.03 mg/kg, 3.70 mg/kg), Co (2.3 – 30.9 mg/kg; 14.80 mg/kg), Cr (15.6 – 106 mg/kg, 56.18 mg/kg), V (23 – 241 mg/kg; 116.63 mg/kg) and Zn (24.5 – 130 mg/kg, 78.93 mg/kg). This study shows that the potentially toxic elements are not yet at elevated stage, except Co and V which were both above the permissible limit, while others are gradually reaching elevation. However, the human health risk assessment indicated that non-carcinogenic risks were all below threshold values. The total carcinogenic risks due to As and Cr were found to be within the acceptable range for both adults and children. This study therefore provides a scientific basis for the control of potentially toxic element pollution and environmental protection of the host community in Kankara.

Keywords: Human health risk, Kankara, potentially toxic element, potential ecological risk.

PERFORMANCE OF POTATO *(Solanum tuberosum L.)* VARIETIES WITH DIFFERENT LEVELS OF FARMYARD MANURE UNDER THE COLD HARMATTAN WEATHER OF GOMBE, SUDAN SAVANNA, NIGERIA

Muhamman M. A.| mmuhamman@gmail.com

I. Mohammed and I. H. Lakun

Department of Agronomy, Federal University of Kashere, Gombe State, Nigeria

Potato (Solanum tuberosum L.) has gained significance in the Nigerian agriculture due to consumer preference of the crop; however, its cultivation is restricted to few areas due to environmental requirement, suitable variety, availability and type of fertilizer requirement of the crop. Thus, field experiments were conducted in 2020 and 2021 cold harmattan dry seasons at the Teaching and Research farm, Department of Agronomy Federal University of Kashere (Latitude 9^0 54′ 49′′ N and Longitude 11^0 00′ 29′′ E with an altitude of 384.32 m above sea level) and Kwadon (Latitude 10^0 16′ 35′′ N and Longitude 11^0 17′ 21′′ E and an altitude of 348.28 m above sea level) to study the response of potato varieties to farmyard manure rates. Treatments consisted of three potato varieties (Caruso, Marabel and Lady christal) and five levels of farmyard manure (0, 5, 10, 15 and 20 t ha^{-1}). The varieties and farmyard manure levels in a factorial combination were arranged in an experiment laid out in a Randomized Complete Block Design and replicated three times. During the experiments data were collected on plant height, crop growth rate, number of tuber $plant^{-1}$, tuber yield $plot^{-1}$ and tuber yield ha^{-1}. Data generated were subjected to analysis of variance. Means showing significant F – test were separated using Least Significant Difference (LSD) at 5% level of probability. Results obtained showed a significant difference between the varieties on plant height, tuber yield $plot^{-1}$ and tuber yield ha^{-1}. Variety (marabel) produced taller plants and yield per hectare (10.3 t ha^{-1}). Similarly, farmyard manure had a significant effect on plant height at Kwadon and tuber yield per hectare in Kashere, 15 t ha^{-1} produced the highest yield (8.36 t ha^{-1}). From the results it was concluded that further research on the variety (marabel) with 15tha^{-1} farm yard manure be conducted for farmers adoption in Gombe and similar environments.

Keywords: Cold harmattan weather, Farnyard manure, Potato, Variety.

FENCING LANDS TO ENHANCED CLIMATE CHANGE RESILIENCE, PROMOTING BIODIVERSITY REGENERATION AND IMPROVED LIVELIHOODS OF CLIMATE CHANGE IN MAKUENI COUNTY

Frank Wesonga[1] | Frankwesonga2016@gmail.com

Francis Keya[2] | fkevogo@gmail.com

[1]Project Manager, African Alliance for Health, Research and Economic Development (AAHRED), Kenia

[2]National Non-Government Council (NGO), Kenya

Kenya is a food insecure country, weather patterns are drastically changing and people are losing livelihoods and earnings when their lands dry, water for domestic supply lacks and livestock die further frustrating livelihoods of the poor. This paper briefly discusses Fencing of lands as prerequisite to biodiversity protection and faster water retention mechanism, through tree planting, enhancing CO_2 sequestration as trees, shrubs and vegetation's find suitable environment to grow. Baringo and Makueni County are characterized by unsustainable agriculture, environmental degradation resulting from soil erosion, high poverty levels and food insecurity due to unpredictable dry spells and climate change. The present paper illustrates that Fencing of lands improves agricultural land management practices, biodiversity growth increased soil carbon sequestration.

Keywords: Climate change, food security, soil carbon sequestration, soil erosion.

EFFECT OF BIOFERTILIZERS ON PRODUCTIVITY AND AFLATOXIN PRODUCTION IN GROUNDNUTS (*Arachis hypogaea*)

Tariro Munyari[1q], Nancy Nleya[2], Kudakwashe Chitindingu[3] and Melody Ndemera[1]

[1]Department of Food Processing Technology, Harare Institute of Technology, Harare, Zimbabwe

[2]National University of Science and Technology, Bulawayo, Zimbabwe

[3]Chinhoyi University of Technology, Chinhoyi, Zimbabwe

Groundnuts (Arachis hypogaea) is an important crop globally, but susceptible to aflatoxin contamination, which poses serious health risks to consumers. Various physical, chemical, and biological methods have been established to reduce the aflatoxin contamination in crops. However, there are safety concerns surrounding some of these methods and their hostility towards the environment has prompted researchers into looking for sustainable methods of curbing aflatoxin contamination in crops. The aim of this study was to explore the impact of various biofertilizers on the yield and overall productivity of groundnut crops as well as investigating the potential correlation between the application of biofertilizers and the levels of aflatoxin production in groundnut. A review of studies on biofertilizers and their impact on productivity and aflatoxin production in groundnuts was carried out by referring to several scholarly articles and published research papers. All reviewed studies highlighted that biofertilizers can offer a sustainable alternative for improving crop productivity and soil health while reducing aflatoxin contamination thus ensuring food safety and food security. In most reviewed studies, biofertilizer application, particularly nitrogen fixing biofertilizers increased groundnut yield by about 40% and reduced aflatoxin contamination in groundnuts (preharvest reduction equated to 57-99% whilst the postharvest reduction equated to 93-95%). In addition, the reviews also revealed that long term use of biofertilizers is economical, eco-friendly, more efficient, productive and accessible to marginal and small farmers over synthetic fertilizers. Few peer-reviewed research studies are published on the effectiveness of different biofertilizers in reducing aflatoxin contamination in groundnuts thus there is need for advancement of knowledge in the field of agriculture and food safety by providing empirical data on the impact of biofertilizers on aflatoxin production.

Keywords: Aflatoxin contamination, biofertilizers, food safety, productivity,

sustainability.

COMPARATIVE EFFECTIVENESS OF DIFFERENT ANIMAL MANURE AND THE PHYTOTOXICITY EVALUATION ON THE GROWTH AND YIELD OF *Abelmoschus esculentus* L. (Okra) VEGETABLE

Kolawole, Opeyemi Saheed | kolawolesaheed@fukashere.edu.ng;

Bello, Munir Sikiru

Department of Biological Sciences, Federal University of Kashere, Gombe State

Over the years, prolonged use of synthetic fertilizer has led to soil acidity leading to low crop yield. The study aimed to evaluate the comparative effectiveness of different animal manures and the phytotoxicity evaluation on the growth and yield of Abelmoschus esculentus L. (Okra). A seed germination bioassay was conducted using the vegetable crop, animal litter extracts was prepared with distilled water (solid to water ratio of 1:10) and distilled water was used as control. 10 seeds of okra was placed on top of the filter paper, each having three replicates and placed in an incubator with no light for five days and the result revealed GI value of <50% was recorded on Okra seeds mounted on PM medium (45.81%) illustrating phytotoxicity, GI value of between 50% and 80% was recorded on Okra seeds mounted on GM medium (64.10%,) illustrating moderate phytotoxicity while GI Value of >80% was observed on Okra Seeds mounted on a CM medium (82.27%) illustrating no phytotoxicity. In addition, potting experiment was conducted to determine the effect of different animal manure on the growth and yield of the crop. The treatments were: Control (no manure applied), 10g, 20g, 30g and 40g of animal manure replicated three times and the results of the potting experiment showed that the highest evaluated parameters such as plant height. Stem girth, leaf area, number of leaves, number of fruits, weight of fruit, wet and dry weight of shoot and root was obtained on okra vegetable planted in PM at varying concentrations followed by GM and CM respectively while the control recorded the least values, excessive application of poultry manure can cause delay or no growth as what was observed in this study were there was slow germination rate at 1-4 WAP at a treatment of 40g. In conclusion the results revealed that Okra vegetable responded well to the application of poultry, goat and cow manure but poultry manure gave the best result. It is therefore recommended that when applying Poultry manure on okra vegetation, adequate and suitable application rate is necessary or rather biodegradation through composting as this will reduce the presence of phytotoxic compounds in poultry manure.

EFFECT OF INTEGRATED PEST MANAGEMENT TECHNOLOGIES ON THE YIELD OF MAIZE IN NIGERIA

P. T. Owombo | owombopaul@gmail.com

Department of Agricultural Economics and Extension, Olusegun Agagu University of Science and Technology, Okitipupa, Nigeria

Integrated Pest Management (IPM) technologies are proven options for improving crop productivity while preventing land degradation but the adoption of the technologies is low in Nigeria owing to a lot of barriers raging from socioeconomic to land variables. The study was therefore conducted to investigate the factors influencing adoption IPM technologies and determine the effect of adoption on yield of maize in the study area. The study used a multistage sampling procedure to collect data from randomly selected 400 maize farming households. Data were collected on socioeconomic and farm characteristics of responding households, using self-designed structured questionnaire. The study employed probit regression model to investigate factors influencing the adoption of IPM technologies and determine the effect of adoption on yield of maize using propensity score matching while endogeneity was corrected for. Findings showed that education of household heads ($p \leq 0.05$), farm size ($p \leq 0.01$) and household size $p \leq 0.05$) were positive determinants of adoption of IPM technologies in the study area. Results of analysis further revealed that IPM technologies had positive and significant effect on the yield of maize in the study area. Therefore, IPM technologies have the potential to raise household food security and welfare through increase in yield per unit area of land.

Keywords: Integrated pest management, farming households, technology, yield.

SCREENING OF WINGED BEAN (*Psophocarpus tetragonolobus* (L.) DC.) SEEDLINGS FOR DROUGHT TOLERANCE

Ufuoma Lydia Akpojotor[1,2] | akpojotorufuoma25@gmail.com

Jelili Opabode[2], Oyatomi Olaniyi[1], And Michael Abberton[1]

[1]International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria

[2]Obafemi Awolowo University, Ile-Ife, Nigeria

One of the impacts of climate change is drought which is a major production constraint causing food insecurity. It has been reported that underutilized crops such as winged bean can help to improve food security. However, these crops are also affected by drought therefore there is a need to screen winged bean accessions for drought to identify tolerant accessions. Hence, the objective of this study was to select drought-tolerant accessions of winged bean at the seedling stage using the wooden box screening technique. Fifty accessions of winged bean were subjected to drought stress one month after planting for four months. Data on chlorophyll content (CHL), wilting score (WLT), plant height (PHT), number of leaves (NOL), stem girth (SGT) and recovery rate was collected. Moisture content, temperature, humidity, and dew point ranged from 19.5-3.7%, 50-18°C, 95-11.5%, and 28.4-6.5°C respectively throughout the four months of drought stress. Data was taken on the 30, 60, 90, and 120 days after the implementation of drought. Analysis of variance (ANOVA) revealed significant differences among accessions and days for CHL, NOL, and WLT. There was significant correlation between WLT and NOL, SWD, and CHL. Among the accessions studied Tpt-11-A and Tpt-4-A were significantly different from all other accessions for wilting score. These accessions could be potentially drought-tolerant. However, none of the accessions were able to recover after the four months of imposing drought. The wooden box technique was effective for screening for seedling drought tolerance in winged bean.

Keywords: Moisture content, seedling drought, Winged bean, wooden box.

TOWARDS SUSTAINABLE AND REGENERATIVE AGRICULTURE: a case study of wheat production for food security in Oman

Muhammad Farooq | farooqcp@squ.edu.om

Department of Plant Sciences, College of Agricultural and Marine Sciences Sultan Qaboos University, OMAN

Bread wheat is the leading staple food crop in the Arabian Gulf. However, wheat production is far below the requirement, primarily due to the unavailability of stress-resilient genotypes, aridity, water scarcity, and heat waves. Sustainable and regenerative agriculture practices are increasingly recognized as imperative for addressing global food security challenges while mitigating environmental degradation. This study explores a multifaceted approach to bolster wheat production and ensure food security in Oman, integrating conservation agriculture practices, resilient wheat varieties, seed priming techniques, and the utilization of superabsorbent polymer developed from date palm waste leaves. Stress-resilient wheat genotypes, differing in morphology, phenology, and root architecture, were planted, with and without seed priming (using novel compounds in nano-formulations), in a conservation agriculture system (with minimum soil disturbance and soil cover with crop residue). Super absorbent biopolymers, developed from date palm leaf wastes were also evaluated for the potential to improve soil water holding capacity and soil health. The conservation agriculture system caused a significant reduction in the sub-surface soil strength primarily due to better water retention at this layer and increased total soil porosity. The soil aggregation and soil organic carbon improved primarily in the surface layer. The application of super absorbent biopolymers caused further improvement in soil physical properties and helped retain water for an extended period of time. The bread water genotypes with deeper roots yielded better under the conservation agriculture system. Seed priming techniques helped improve early stand establishment under a no-till system. The small farm holdings, weed and residue management, and non-availability of suitable farm machinery are key constraints to the adoption of a regenerative agriculture approach for improving wheat productivity in the Arabian Gulf. Planting primed seeds of stress-resilient wheat genotypes in a conservation agriculture system (with minimum soil disturbance and soil cover with crop residue) together with super absorbent biopolymers was the best suit of technology and may be disseminated through farmer's participatory on-farm trials and field days for achieving food security.

Keywords: Regenerative agriculture, stress-resilient, wheat.

URBAN AGROFORESTRY: case study of forest garden as a resilient agricultural system for food production

Ogunsusi, Kayode | k.ogunsusi@oaustech.edu.ng

Department of Forestry, Wildlife and Environmental Management, Olusegun Agagu University of Science and Technology, Okitipupa, Nigeria

Forest garden as a form of urban agroforestry systems may offer an alternative solution to the problem of food insecurity. The objectives of the study include assessment of trees, shrubs, and arable crops in urban forest garden. Data on tree and shrub in urban forest garden was collected in Ode-Irele, Ondo state, Nigeria within plots measuring 10m². Collected data was analysed using descriptive statistics. Findings of the study on plants show that the urban forest garden is associated with 32 species of trees and shrubs, while arable crops constitute 25 species. Among the trees and shrubs, abundance was highest for Ocimum basilicum, followed respectively by plantain (Musa parasidiaca), banana (Musa sapientus), small scent leaf (Ocimum gratissimum), and white butterfly (Clerodendron volubile), Combretum (Combretum spp), pawpaw (Carica papaya), moringa (Moringa oleifera), and Leucaena leucocephala. The results further indicated that the urban agroforestry is associated with 25 species of arable crops. Abundance for the arable crops was highest for Amaranthus hybridus, followed by Cocoyam (Xanthosoma sagittifolium), waterleaf (Talinum triangulare), tomato (Lycopersicum esculentum), soft cane (Thaumatococcos danieli), African egg plant (Solanum macrocarpon), fireweed (Crasscocephalum crepidioides) and pineapple (Ananas comosus). The perennial nature of trees and shrubs is a pointer to the multifunctionality of the plants as they are able to produce fruits and nuts every year nonstop for consumption and sale. If these plants are properly incorporated into urban agroforestry, they will go a long way in contributing to food security. Because of the perennial nature of trees and shrubs, they can recover easily and faster from unpredictable events like instability of ecological and environmental services than annual crops. This ability to recover from unpredictable events makes them to be more resilient. The management of these plants in the urban setting can thus help to improve the resilience of the urban areas and the wider environment around them.

Keywords: Agroforestry, forest-garden, food-security, resilience, urban.

AGRICULTURAL LAND USE IS INCREASING SOIL LOSS IN THE LUGENDA RIVER BASIN, PART OF ONE OF THE LARGEST CONSERVATION AREAS IN AFRICA: a multitemporal analysis

Cassamo Mahomed Ismail[1], Alberto Alaniz Baeza[2] and Carlos Valdivia Prats[3]

[1]Instituto de Investigação Agrária de Moçambique-Centro Zonal Noroeste, Moçambique

[2]Universidad de Chile, Chile

[3]Universidad de Los Lagos, Nigeria

Soil loss is a natural geomorphological process in which precipitation, soil cover, slope and soil characteristics interact. However, this process has benn significantly altered by human action, especially agriculture. The objective of this study was to evaluate soil loss in different covers in the Lugenda River basin, located in northern Mozambique, with a special focus on the Niassa Special Reserve. Soil and rainfall erodibility factors, topography and cover were used to calculate soil losses using the Universal Soil Loss Equation (USLE). The analyses were structured in an interval between the years 2000 and 2019, analyzing losses by type of coverage, as well as quantifying them inside and outside the Niassa Special Reserve. Statistical analyses were used to compare losses in different covers (evergreen forest, deciduous forest, mixed forest, tree savanna, savannah, grasslands, wetlands, agricultural zones) based on the years of analysis (2000, 2005, 2010, 2015 and 2019). The results show a reduction in soil losses between the years 2000 and 2005, by 4.15 and 2.95 ton/ha outside and inside the reserve, respectively. A reduction that can be explained largely due to the low values of rainfall erodibility and the reduction in the loss of vegetation cover in almost the entire basin. However, the loss process increased again from 2005 to 2019 by 7.33 and 5.34 ton/ha, outside and inside the reserve respectively. An increase that can be explained by the increase in the erodibility of rainfall and the reduction of the soil cover factor. From the analysis carried out over the period in reference, there were highly significant losses of soil outside the reserve (agricultural areas), compared to the interior of the reserve (with soils mostly with vegetation cover).

Keywords: Geographic information system, land cover, Niassa Special Reserve, soil loss.

ASSESSMENT OF ANIMAL MANURE TYPES AND LEVELS AS PROTECTANTS AGAINST FIELD DISEASE DEVELOPMENT AND YIELD OF PEPPER

Ihejirika[1], G. O., Ogbedek, K. O.[1], Akalazu, J. N.[2] and Ezenwoke, E. O.[1]

[1]Department of Crop Science and Technology, Federal University of Technology, Nigeria

[2]Department of Plant Science and Biotechnology, Imo State University, Nigeria

A two-season field experiment was carried out at the Federal University of Technology Teaching and Research Farm Owerri, Nigeria in 2022 and 2023 planting seasons, to investigate the effect of types and levels of animal manure as protectants against some field disease development and yield of pepper (Capsicum annum L.). The experiment was a 3x3 Factorial laid out in a Randomized Complete Block Design at 3 replications. Treatments comprised of 3 animal manures (poultry manure, cow dung and pig slurry) applied at 3 levels (0, 5 and 10 tons/ha). Data collected were analyzed using analysis of variance (ANOVA), and significant means separated according to SAS, (1999) at 5% level of probability. Result revealed that Rates and level of animal manure were statistically significant ($P<0.05$) on pepper yield, leaf blight and mosaic severities irrespective of the weeks and season investigated. Poultry manure had highest plant height in centimetres 8.59, 9.72; 24.44, 25.10 and 36.41, 35.25 while pig slurry was lowest at 3, 6 and 9 weeks after planting in 2022 and 2023 respectively. Same trend was observed on number of leaves and number of branches. Poultry manure treated plots had the lowest severity of blight 0.80, 1.66 and 1.82 at 3, 6 and 9 weeks after planting in 2023, followed by cow dung when pig slurry 1.43, 1.55 and 2.24 was highest and same trend was observed on mosaic severity in 2022 and 2023 respectively. 10 tons/ha recorded the highest plant height 8.21, 8.42; 25.76, 26.22 and 36.92, 37.10 when 0 tons/ha (No manure) 6.14, 6.18; 19.87, 19.95 and 31.16, 31.55 was lowest at 3, 6 and 9 weeks after planting in 2022 and 2023 planting seasons respectively. Also the same trend was observed on number of leaves, branches, leaf area, fruits and seeds per plant, as well as seed yield in tons/ha in all the seasons investigated. 0 tons/ha recorded highest blight severity 0.43, 0.48; 2.34, 2.55 and 5.51, 4.10 when 10 tons/ha was lowest 0.86, 0.70; 1.59, 1.62 and 2.59, 2.44 at 3, 6 and 9 weeks after planting in 2022 and 2023 respectively, and same trend was also observed on mosaic severity irrespective of season investigated. Interaction of poultry manure and 10 tons/ha had the highest growth and yield but lowest blight and mosaic diseases. Phytophtora sp and Bacillus sp were present in all the treatments including the control. Poultry manure performed better than all the

other treatments when applied at 10 tons/ha followed by cow dung and pig slurry when control was lowest. Microorganisms identified to be associated with diseased pepper include: Phytophthora capscici, Bacillus sp, Xanthomonas campestris, Colletotrichum sp, Verticillium sp and Fusarium sp respectively. I recommend that farmers should adopt the use of poultry manure at 10 tons/ha for the cultivation of pepper (Capsicum annum) for better growth, disease resistance and yield.

Keywords: Assessment, disease, manure, protectant, pepper, Yield.

INFLUENCE OF PLANTING DATE AND MULCHING ON AFRICAN EGGPLANT (*Solanum macrocarpon* L.) DURING EARLY SEASON IN OWERRI NIGERIA

N.C Adikuru | adikuru15@gmail.com

C.C. Nwaugo, O.M. Nnebue, and R. A. Alagba

Department of Crop Science and Technology, Federal University of Technology, Imo State, Nigeria

African eggplant (Solanum macrocarpon L.) is a traditional leafy vegetable (TLV) with edible leaves and fruits. It offers nutritional and health benefits, and yet it is an under researched crop. During the early season in the rainforest agroecology of Nigeria, moisture deficit occurs due to altered rainfall pattern. Farmers are therefore faced with the challenge of determining appropriate time to plant their crops in addition to the need for moisture conservation. This study was conducted to determine the response of Solanum macrocarpon to planting date and mulching during the early season in Owerri Nigeria. The treatments included poultry manure (PM), palm bunch refuse (PBR) and saw dust (SD) as mulch materials, while March 25, April 14 and May 4 were the planting dates. An unmulched treatment served as control. These were arranged as split-plot in randomized complete block design and replicated three times. The planting dates were the main plot treatments while mulch materials were subplot treatment. The parameters measured were plant height, number of branches, number of leaves, weight of fruit and weight of leaves. Results showed that planting date and mulch material improved vegetative growth (height, number of branches and number of leaves) of Solanum macrocarpon, while yield (weight of leaves and fruits) was not significantly affected. The height, number of branches and number of leaves of Solanum macrocarpon increased by 87.4, 164.3 and 107.8 % respectively when planted on March 25 compared to May 4. Compared to the control (no mulch), PBR improved height, number of branches and number of leaves by 27.7, 66.6 and 93.1 % while PM improved the same parameters by 20.1, 45.9 and 80.1 %. For improved production of Solanum macrocarpon in the rainforest of Nigeria, we recommend that planting should start early before the rains get fully established. Application of mulch materials like PBR and PM should also be practiced during the early season.

Keywords: Moisture deficit, palm bunch refuse, poultry manure, traditional leafy vegetable.

UTILIZATION OF FOOD WASTE-COW DUNG COMPOST AS SUBSTRATES FOR TWO PAWPAW VARIETIES IN THE NURSERY

Okoli N. A. | adikuru15@gmail.com

Nwaemesi M. C

Department of Crop Science and Horticulture, Faculty of Agriculture, Nnamdi Azikiwe University, Nigeria

Vigorous juvenile growth of seedling is dependent on the growth media quality and variety of the seed raised in the nursery. Two varieties of pawpaw (longsolo and maradonna) were sown in six substrates {Topsoil (TP), Compost (CP). TP + CP 1:1, TP + CP 2:1, TP + CP 3:1 and standard nursery media (SNM). The experimental design was a split plot experiment laid out in completely randomized design. Seeds of pawpaw were sown in perforated black polybags. Results showed that seeds sown in TP + CP 3:1 emerged earliest while seeds sown in CP (100%) emerged late. Seedling raised in CP (100%) was tallest (14.60 cm) while seedling raised in TP was dwarf (2.05 cm) at 12 WAE. Seedling raised in CP had highest number of leaves and highest fresh plant weight while seedling raised in TP (100%) had lowest number of leaves and fresh plant weight. Longsolo emerged earliest (13.31 days) while maradonna emerged late (15.94 days). Maradonna seedling was taller than longsolo seedling by 37.50% at 8 WAE and 41.50% at 12 WAE. Number of leaves was higher by 31.49 % in longsolo seedling than in maradonna seedling at 12 WAE respectively. Fresh plant weight was higher by 6.87% in longsolo seedling than in maradonna seedling. Interaction effect showed that maradonna seed sown in TP +CP 3:1 emerged earliest (11.17 days) while maradonna seed sown in CP (100%) emerged late (20.50 days). Maradonna seedling raised in TP + CP 2:1 was tallest (14.90 days) while longsolo seedling raised in TP (100%) was dwarf (2.56 days) at 12 WAE. Longsolo seedling raised in TP +CP 3:1 had significantly highest number of leaves (15.97) while maradonna seedling raise in SNM had no leaves (0.00) at 12 WAE. Fresh plant weight and fresh stem weight were significantly highest in longsolo seedling raised in CP (100%) and lowest in longsolo seedling raised in TP (100%) at 12 WAE. This research showed that compost can serve an alternative and cheap substrate for longsolo and maradonna varities.

Keywords: Compost, plant nutrition, Pawpaw, soil fertility, waste management.

INFLUENCE OF FERTILIZER TYPES ON VITAMINS, PHYTOCHEMICAL AND PROXIMATE CONTENTS OF *Ocimum gratissimum L.*

Okoli N. A. | Na.okoli@unizik.edu.ng

Udoh, E. S. and Lambert, C. M.

Department of Crop Science and Horticulture, Faculty of Agriculture, Nnamdi Azikiwe University, Nigeria

Nutrient content of a crop is one of the determinant factors in the measurement of the quality of a crop. Scent leaf stem cuttings were grown in poly bags using the following treatments; fertilizer sources (control, 5 tha^{-1} of cow dung, 5 tha^{-1} of compost, 400 kgha^{-1} of NPK fertilizer 20-10-10 and 400 kgha^{-1} of urea). Leaves of scent leaf were harvested at eight weeks after planting (WAP) and assessed in the laboratory for vitamins, phytochemical and proximate contents. Completely randomized design was used to design the experiment and treatments were replicated three times. Results of vitamin contents showed that scent leaf produced with NPK fertilizer had highest vitamin A (25.53 ± 0.49 mg/100mg), B1 (2.88 ± 0.11 mg/100mg), B2 (2.86 ± 0.23 mg/100mg), and proximate contents while scent produced without fertilizer had lowest vitamin A (14.57 ± 0.67 mg/100mg), B1 (1.34 ± 0.03 mg/100mg), B2 (0.91 ± 0.09 mg/100mg) and proximate contents. Scent leaf produced with compost had highest alkaloid and saponin. Flavonoid of scent leaf produced with NPK fertilizer (4.21 ± 1.06 %) and compost (3.79 ± 0.19 %) were significantly ($p < 0.05$) the same. This research showed that compost can be used to improve phyto-chemical contents of scent leaf for medicinal purpose and NPK fertilizer used to improve vitamins and proximate contents of scent leaf for food.

Keywords: Compost, crop quality, inorganic fertilizer, nutrients, phyto-chemicals, vitamin.

EFFECTS OF CANOPY MANAGEMENT OF *Terminalia brownii* (Fresen) ON MICROCLIMATE AND YIELD OF MAIZE (*Zea mays* L.) IN PARKLAND AGROFORESTRY OF SOUTH ARI DISTRICT, SOUTHERN ETHIOPIA

Mitiku Ayele Handiso[1,2,3] | **mitikuayele43@gmail.com**

Zebene Asfaw[2], Bruno Glasser[3], Tobias Bromm[3] and Bruk Lemma[3,4]

[1]Jinka Agricultural Research Center, Southern Agricultural Research Institute, Jinka, Ethiopia

[2]Wondo Genet College of Forestry and Natural Resources, Hawassa University, Ethiopia

[3]Institute of Agricultural and Nutritional Sciences, Soil Biogeochemistry, Martin Luther University Halle-Wittenberg, Germany

[4]Forest and Rangeland Biodiversity Directorate, Ethiopian Biodiversity Institute, Addis Ababa, Ethiopia

Smallholder farmers manage trees on crop fields in the South Ari District of southern Ethiopia through pruning and pollarding. Among those trees, Terminalia brownii is one of the preferred and dominant tree species, with numerous multipurpose uses such as tools, firewood, charcoal, medicine, shade, and soil improvement. However, the effects of their canopy management on microclimate and maize yield have not been scientifically quantified; even the results of other tree studies have been contradictory. Hence, this study investigated how Terminalia brownii canopy management affects microclimate and maize yield in parkland agroforestry. As part of the study, data were collected on microclimate and maize yield at three different distances from the tree trunks to the open field: D_1 (0–4.1 m), D_2 (4.1–8.2 m), and D_3 (15 m outside the tree canopy cover). The study also included three different tree canopy management treatments (pollarding, pruning, and control), which were replicated three times in a randomized complete block design with a factorial arrangement. The study results revealed that canopy management of the tree affected the microclimate, which in turn influenced yield. Statistically significant differences ($P<0.05$) were observed in the yield and yield components of maize when grown under tree canopies compared to open fields under either canopy-managed trees or control. The highest grain yields (3,717 kg ha⁻¹ and 3,718 kg ha⁻¹, respectively) were observed in plots with pruned and pollarded trees, while the lowest yield (2,642 kg ha⁻¹) was obtained from the control plot. The observed differences in yield might be due to the highly concentrated soil nutrients,

modified microclimate under the tree canopies, and reduced shading effects under canopy-managed trees. It is therefore recommended that either pruning or pollarding of Terminalia brownii trees be adopted to enhance yield by modifying the microclimate and improving soil nutrients.

Keywords: Agroforestry, microclimate, open field, tree management, shading effects.

CORRELATION AND PATH COEFFICIENT ANALYSIS IN TOMATO (*Lycopersicon lycopersicum* Mill.) GENOTYPES UNDER WATER STRESS

A. Abdullahi | **abbasabdullahisaki@gmail.com**

M.M. Abdulmalik and M.S. Mohammed

Department of Plant Science, Ahmadu Bello University, Zaria, Nigeria

Drought stress has been considered as one of the most important causes of alterations in physiological processes of the tomato plant which affects normal growth and development as well as fruit yield in tomato. Improving tomato yield requires an understanding of the traits associated with yield. Therefore, this study was aimed at identify traits having greater association with fruit yield under water stress in tomato using correlation and path analysis. Twelve tomato genotypes were used for the analysis of ten traits. The experiment was laid out in a completely randomized design in a screen house in 2023-2024 at the Institute for Agricultural Research, Ahmadu Bello University Zaria, Nigeria. Correlation analysis revealed that fruit yield per plant was significant and positively correlated with leaf area (0.70**, 0.58**) plant height (0.47**, 0.52**) and chlorophyll content (0.39*, 0.44**) under both optimum and water stress conditions, respectively. Path coefficient showed that number of leaves per plant, leaf area, membrane stability index and number of flowers made maximum direct contribution to fruit yield under optimum condition while plant height, leaf area, relative water content, chlorophyll content and number of fruits per plant made maximum direct contribution to fruit yield under water stress. This result implies, direct selection of these traits will be beneficial for crop improvement under water stress.

Keywords: Correlation, Path coefficient, tomato, water stress.

BREEDING FOR CLIMATE STRESS-TOLERANT VARIETIES EXPLORING COMMON BEAN *(Phaseolus vulgaris L.)* PLANTS RESILIENCE: screening for drought and salinity stress tolerance and optimizing pre-treatment strategies for enhanced abiotic stress resistance in different bean lines

Deborah Thayo | deborahthayo@gmail.com

Lilongwe University of Agriculture and Natural Resources, Malawi

This study focuses on exploring the resilience of bean plants to drought and salinity stress which are crucial factors affecting common bean (Phaseolus vulgaris L.) yield due to climate change. The research entails screening of bean lines grown in Malawi for morphological and morpho-physiological responses to abiotic stress, alongside assessing pre-treatment strategies' efficacy in enhancing stress resistance. Initial greenhouse experiments where thirty lines were screened for drought and salinity stress, identified thirteen bean lines displaying varying degrees of tolerance and susceptibility to drought and salinity stress based on morphological responses of the plants. Out of the thirteen, seven exhibited tolerance and six exhibited susceptibilities. Interestingly, four lines were found to be tolerant to both stressors and two lines were found to be susceptible to both stressors. Susceptibility and tolerance of the lines was determined by Stress Susceptibility Index. The ongoing study aims to further investigate the morpho-physiological responses of these thirteen lines to delineate tolerant and susceptible lines. Four lines will be selected from the second screening based on physiological responses of plants to abiotic stresses under study. Selection of susceptible and tolerant bean lines will be determined by Stress Susceptibility Index. Subsequent experiments will evaluate the effectiveness of pre-treatments using Polyethylene Glycol and Sodium Hydrosulfide Hydrate on four selected bean lines from the second screening to enhance their resilience to drought and salinity stress. Ultimately, this research seeks to identify resilient bean lines for integration into breeding programs and develop pre-treatment methods to mitigate the adverse impacts of abiotic stress on bean production.

Keywords: Bean, drought stress, salinity stress, resilience.

ASSESSING THE DIFFERENTIAL IMPACT OF CONSERVATION AGRICULTURE TECHNIQUES ON CROP PRODUCTIVITY, ADOPTION LEVELS AND FARMER PREFERENCES

Martin Philani Moyo, Alec Magaisa | alec.magaisa@icrisat.org

Farayi Dube

International Crops Research Institute for the Semi Arid Tropics (ICRISAT), Malawi

Conservation agriculture (CA) is inarguably a proven climate smart agriculture technique that has been widely promoted targeting the smallholder farming sector. It is a farming practice that encompasses a package of techniques namely minimum tillage, integrated soil fertility management practices and mulching. However, smallholder farmers rarely utilize these CA practices as a whole package compromising crop productivity. Due to climate change the then information on the impact and perceived benefits of CA practices might be now obsolete. Again, there is little or no information in quantifying the gains or losses associated with utilization or non- adoption of specific CA practices. Evidence-based future CA programming is imperative and a study was conducted in three districts of Zimbabwe during the 2023/24 season. Aim was to disentangle the contribution of CA techniques on crop productivity, assess adoption levels and to interrogate community-based technology evaluation approaches. Seven most common CA practices were evaluated under maize crop laid out in a randomized complete block design at each site and replicated three times per district. Plant growth data was collected and subjected to analysis of variance using GenStat Software 17th Edition. Differences between the treatment means was detected using the Turkey's test at the 5% significance level. A survey score sheet was designed for evaluation of CA practices by local farmers. Results showed that crop growth can be optimised through application of a whole package of CA practices. The use of mulch was unexpectedly proven ineffective. Mulching to have enhanced plant resource use efficiencies under drought conditions that prevailed during the 2023/24 season. Mulching was unpopular suggesting problems to its adoption or improper standard of application. Overall, there are barriers to adoption of conservation agriculture practices and presence of significant losses and gains associated with the adoption or non-utilization of specific CA practices. Such evidence generated can be used to educate and inform future programming.

Keywords: Conservation agriculture evidence generation study.

INHERITANCE STUDIES OF HEAT TOLERANCE TRAITS IN TOMATO (*Lycopersicon lycopersicum* Mill.) GENOTYPES UNDER FIELD CONDITION

[1,2]*Hamisu, H.S. | saleh00073hamisu@gmail.com

[2]Ishiyaku, M.F., [2]Mohammed, S.M. [2]Umar, L.M., [2]Abdulmalik., M.M., and [3]Usman, A.

[1]National Horticultural Research Institute, P.M.B 3390, Bagauda Station, Kano State

[2]Department of Plant Science, Institute for Agricultural Research, Ahmadu Bello University, Samaru, Zaria, Kaduna State.

[3]Department of Crop Science, Federal University, Lafia, Nasarawa State

Global warming because of climate change revealed an increasing heatwave worldwide including Nigeria which terminates tomato growth and productivity due to the effects of heat stress. Heat stress because of high temperatures has become a major abiotic factor that limits tomato production between March and October months in Nigeria. This situation necessitates development of tomato genotypes tolerant to high-temperature stress through proper breeding program to expand tomato productivity and meet the demand for tomato throughout the year. The study was designed to determine the mode of inheritance, gene action and correlation of heat tolerant traits under heat stress conditions. P_1, P_2, F_1, F_2, BCP_1 and BCP_2 generations of Red cherry x Jablonelistnyj and Yamal x Alpatieva (Tree-Shaped) crosses were evaluated at National Horticultural Research Institute, Bagauda station, Research farm for between January to May 2023 to synchronize flowering stage with the heat months (March to May) using RCBD with two replications. Data were collected on number of branches per plant, number of flowers with stigma exertion, number of aborted flowers, number of flowers per plant, number of fruits per cluster, number of fruits per plant, fruit length traits, fruit diameter, percentage fruit set, fruit yield per hectare, relative leaf chlorophyll content, pollen viability, canopy temperature depression, cell membrane thermostability and relative heat injury. The results of the analysis of variance and mean performance of the six generations revealed significant and sufficient variations for the heat-tolerant traits among the generations in both crosses. Additive gene effect [d] was found to be positive and significant for fruit length and percentage fruit set in both crosses. Duplicate epistasis was observed for number of branches per plant, fruit diameter, cell membrane thermostability and relative heat injury. The results of correlations showed that the percentage fruit set had significant positive correlation with number of flowers per plant, pollen viability,

cell membrane thermostability and relative leaf chlorophyll content in both crosses. Significant negative associations with number of flowers with stigma, fruit length, fruit diameter and canopy temperature depression were recorded with percentage fruit set. The results for the mode of gene action revealed additive gene effect [d] contributed to the inheritance of heat tolerance traits in tomato under heat stress conditions. Hence, genetic improvement for heat tolerance in tomato can be achieved by simple selection such as pure line and mass selections under high-temperature environments. Number of flowers per plant, pollen viability, cell membrane thermostability and relative leaf chlorophyll content traits could be considered as selection criteria for improving heat tolerance in tomato under heat stress conditions.

Keywords: Global warming, heat tolerance, Tomato.

INFLUENCE OF POULTRY MANURE MIXED WITH PALM BUNCH ASH ON GROWTH AND YIELD OF *Amaranthus cruentus* IN OWERRI SOUTH EASTERN NIGERIA

Alagba, R.A. | Rosemondelder@gmail.com

Ibeawuchi, I.I., Adikuru, N.C., Okoli, N. A. and L.C. Emma-Okafor

Federal University of Technology, Owerri, Imo State Nigeria

Nnamdi Azikiwe University, Awka, Anambra State Nigeria

The study evaluated the effect of poultry manure mixed with palm bunch ash rates (tha[-1]) on growth and yield of Amaranthus cruentus in Owerri south-eastern Nigeria. The 4x3 factorial experiment was fitted into a completely randomized design (CRD) with three replicates. There were four levels of poultry manure (0, 3, 6 and 9tha[-1]) and three levels of palm bunch ash (0, 1.5 and 3tha[-1]). Planting bags were filled with top soil, and poultry manure mixed with palm bunch ash was applied at relevant doses in the last week of May, 2023. Amaranth seeds were planted in the second week of June, 2023. Core soil samples were collected at pre-planting period and sent to the laboratory for pre-experimental soil physico-chemical characterization. Growth and yield parameters were collected and analyzed using Genstat. Mean separation was done using least significant difference (LSD) at 5% level of probability. Poultry manure siginificantly ($P<0.05$) influenced growth parameters at almost all stages of growth while palm bunch ash significantly($P<0.05$) influenced plant height at all stages of growth, and leaf area at 2and 4 weeks after planting respectively. Interaction of poultry manure and palm bunch ash significantly ($P<0.05$) influenced stem girth of Amaranth at all stages of growth. Amaranth plots treated with 9tha[1] poultry manure mixed with 1.5tha[-1] palm bunch ash significantly ($P<0.05$) recorded the highest percentage emergence (100%), produced the tallest plants at 2 and 6 weeks after after planting (6.09cm, and 81.50cm), largest stem girth at 6 weeks after planting (4.21cm), highest number of leaves at 2 weeks after planting (7.21leaves), broadest leaf area (LA) (cm²) at 2 and 4 weeks after planting (12.58cm² and 28.48cm²) respectively and produced the highest fresh leaf yield at first harvest (4.78tha[-1]). Control plots on the other hand recorded the least values for plant height (1.15cm, 5.40cm and16.20cm) at 2,4 and 6 weeks after planting, stem girth, and other growth parameters at almost all stages of growth as well as fresh leaf yield (0.11tha-) at first harvest. The post experimental soil physico-chemical characteristics indicated that the plots receiving 9tha[-1] poultry manure mixed with 1.5tha[-1] palm bunch ash contained higher quantities of organic matter (6.31%), total nitrogen (0.32%)

potassium (0.31cmolkg⁻¹) and available phosphorus (26.73mgkg⁻¹) while the control plots recorded the most acidic pH in water (5.33), pH in* KCL (4.40), least quantities of organic matter (4.09%),, available phosphorus (6.00cmolkg⁻¹)⁾ total nitrogen (0.17%) and potassium (0.20 cmolkg⁻¹).

Keywords: Amaranth, growth, poultry manure, yield.

GENE ACTION AND HERITABILITY CONTROLLING MAIZE WEEVIL AND LARGER GRAIN BORER RESISTANCE IN TROPICAL MAIZE GERMPLASM

Egas Nhamucho | egasnhamuchomz@gmail.com

IIAM, Chókwe Research Station, Mozambique

The maize weevil (MW), Sitophilus zeamais Motschulsky (Coleoptera: Curculionidae) and the larger grain borer (LGB) Prostephanus truncatus (Horn) (Coleoptera: Bostrichidae) are the most damaging post-harvest insect pests of maize in Africa causing losses of up to 90% when maize is stored without use of chemical protectants. Host plant resistance is thus a vital component of an integrated pest management strategy against them and small-scale farmers can greatly benefit from resistant maize cultivars. This study aimed at determining the genetic action influencing inheritance of resistance to MW and LGB using generation mean analysis in two crosses, CKDHL120731×CKDHL120918 (cross one) and CKDHL120517×CKDHL120918 (cross two). The inbred lines CKDHL120731 and CKDHL120517 are resistant to MW and LGB while CKDHL120918 is susceptible. Six generations (P1, P2, F1, F2, BCP1 and BCP2) were developed from each cross. The various generations were evaluated in separate experiments for MW and LGB in a post-harvest laboratory in Kiboko- Kenya, in a complete randomized design, replicated twice in three months. Fifteen cobs were used for P1, P2 and F1, 30 cobs for BCP1 and BCP2 and 60 cobs for F2. Data was collected on weight loss, kernel damage and number of living insects. The resistance traits for MW did not fit a simple additive-dominance model in both crosses, suggesting the existence of epistasis effects. However, for LGB resistance, cross one fitted well on it but cross two did not, suggesting both simple model and digenic interaction model were present in the inheritance of LGB resistance, depending on the genetic background of the parent used. Additive, dominance and epistasis gene effects played a significant role in the inheritance of resistance to both insects in the selected maize genotypes. This was further confirmed by moderate narrow-sense heritability estimates. This suggest that it is feasible to improve maize genotypes for insect resistance.

Keywords: Sitophilus zeamais, post-harvest pest resistance, Prostephanus truncatus,

EVALUATION OF COWPEA ELITE LINES (*Vigna unguiculata*) FOR DROUGHT TOLERANCE IN NAMPULA – MOZAMBIQUE

Henriques Colial[2] | hvcolial@gmail.com

Michael Chipeta[1], Jessica Kampanje[1], Belarmino Divage[2], António Chamuene[2], Venâncio Salegua,[2] Luis António[2], Salva Somueque[2], Dionecleciano Alexandre[2], Cândido Bambo[2], Cesar Pedro[2], Marques Donça[2], Ludimila Lampião[2], Yanique Langa[2], and Idalina Napita[2]

[1]Lilogwe University of Agriculture and Natural Resources (LUANAR), Main Campus, Lilongwe-Malawi

[2]Mozambique Agricultural Research Institute (IIAM), Northeast Zonal Centre, Nampula-Mozambique

The development of high yielding and stable cultivars of various crops is crucial for raising production and productivity, consequently increase of food security and nutrition among small household farmers across the country. This study, therefore, focused on evaluating of cowpea (Vigna unguiculata (L.) Walp.) lines sourced at IITA, IIAM, LUANAR and TARI for yield, stability and drought tolerance at Nampula Research Station under stress and non-stress environments, using the additive main effects and multiplicative interaction (AMMI) analysis, and genotype plus genotype by environment interactions (GGE biplot), drought susceptibility index (DSI) and rank summation index (RSI). Ninety-two cowpea elite lines were evaluated during the 2021/22 growing season in split plot design (incomplete block design) replicated two times. The analysis of variance revealed that the genotype (G), water regime (WR) and genotype x environment interaction (GEI) effects were highly significant (p <0.001), with contributions to total observed variation of 58.33, 16.33 and 14.88 %, respectively. Grain yield and related components such as leave area index (LAI), day to flowering (DF), days to physiologic maturity (DPM), number of seed per pod (NSP), hundred seed weight (100SW), number of pods per plant (NPP), plant height (PH), pod length (PL), and grain yield, explained 78.74, 74.58, 84.52, 75.96, 85.99, 64.37, 68.24, 78.99 and 90.98% of coefficient of determination (R^2), respectively. The AMMI ANOVA revealed that the G, E and GEI effects were highly significant (P < 0.001). The GEI effect accounted for 16.68 % of the total variation whilst genotype and environment main effects contributed 68.14 and 18.19 %, respectively. The IPCA1 was highly significant (P <0.001) and explained 100% of total GEI sum of squares. The mean yield of the best genotypes under non stressed water regime ranged from 1.11 ton ha^{-1} to 1.74 ton ha^{-1}. Whereas,

under stressed water regime the mean grain yield ranged from 0.66 ton ha^{-1} to 1.32 ton ha^{-1}. Genotypes Guariba, IT97K-1069-6 (MW), IT99K573-1-1, IT10K-817-3, IT07K-299-6, Danila, IT04K-227-4, IT00K-126-3 (MZ), IT97K-1069-6 (MZ), IT-16 and IT98-390-2 had higher grain mean yield under both environments, non-stressed and stressed water regime. The genotypes selected had the mean grain yield above the grand mean (0.65-ton ha^{-1}). The results of RSI of geometric mean of grain yield (GM), DSI, 100SW, NPP, NSP and PL of the cowpea genotypes shows the first ten genotypes are Guariba, IT97K-1069-6 (MW), IT10K-985-3, IT93K-452-1, IT-16, IT00K-126-3 (MZ), IT07K-299-6, CB27, Danila and IT99K573-1-1 are ranked among the best drought tolerant and grain yield potentials cowpea lines under stress and non-stress water regimes. Therefore, these genotypes can be exploited as drought tolerant parents in plant breeding program.

Keyswords: AMMI ANOVA, Cowpea DSI, GEI, Yield.

EFFECT OF DIFFERENT RATES OF INORGANIC AND ORGANIC FERTILIZER ON GROWTH AND YIELD OF ONION (*Allium cepa* L.) IN GOMBE, NIGERIA

Y. Mustapha | myunusan64@gmail.com

I. Manu and H. Saleh

Department of Agricultural Education, Federal College of Education (Technical), Gombe, Nigeria

Inappropriate fertilizer application and poor soil fertility management practices are among the factors constraining onion production in Gombe state. Field experiment was conducted at students' demonstration farm, Department of Agricultural Education, Federal College of Education (Technical) Gombe, from June to October, 2022 to assess the effect of different rates of organic and inorganic fertilizer on growth and yield of onion. Treatments included To (0 t/ha PM + O kg NPK), T1 (20 t/ha PM), T2 (15 t/ha PM + 50 kg NPK), T3 (10 t/ha PM + 100 kg NPK), T4 (5 t/ha PM +150 kg NPK) and T5 (200 kg NPK/ha). The experiment was laid out in a randomized complete block design (RCBD) with three replications. Plant treated with 20 t PM/ha recorded the tallest plants (45.17 cm), produced more leaves per plant (12.67), average thin bulb neck (4.80 cm) and average big bulb neck (12.77 cm) while the least values were obtained from the control. Longest leaf (17.37 cm) was recorded from plants treated 10 t/ha poultry manure + 100 kg/ha NPK and longest days to maturity was obtained from plants treated with 200 kg/ha NPK while least values of 11.10 cm and 76 days respectively. In conclusion, Plant treated with 20 t/ha PM performed relatively better than other treatments in most of the parameters measured but not significantly different from those applied 10 t/ha + 100 kg/ha NPK, thus, either of the treatments is recommended for the farmers in the study area for optimum production of onion.

Keywords: Growth, NPK, onion, organic manure, gombe, yield.

EFFECTS OF WATER DEFICIT STRESS ON THE PHYSIOLOGICAL PARAMETERS OF SIX *Corchorus olitorius* ACCESSIONS

Pholoma, Senewa Bobby, G. Malambane, S. Tshwenyane, S. Haki and J. Adgetei

2000009960@buan.ac.bw

Botswana University of Agriculture and Natural resources, Botswana

Water deficit (WD) is expected to increase in intensity, frequency and duration in many parts of the world because of climate change, with potential negative effects on plant growth and development. It has been found to greatly affect the physiological process of most crops thus subsequently affect yield as it disturbs the photosynthesis process. A greenhouse pot experiment was laid in RCBD with three replications. The experiment was conducted during November 2022 until March 2023 season and was repeated November 2023 until March 2024. The six Accessions (Bafia, TOT6684, Local, SUD3, MSB072 and Delele1) were subjected to 30% FC as water deficit stress and 80% FC as control. Data was collected after every three days of stress until the 12th day then were re-watered. The current study on six Corchorus olitorius accessions chlorophyll fluorescence showed that some of the measured parameters that are related to photosynthetic biochemistry activity were affected significantly ($P < 0.05$) at 30% FC water deficit stress compared to 80% FC. The maximum quantum yield of PSII (ρPSII), coefficient of photochemical fluorescence quenching of PSII (qL) and the dark adapted ratio (Fv/Fm ratio) had a similar trend where they all decreased under water deficit stress while electron transport rate (ETR) decreased with accessions under study. Under water deficit stress, (ρPSII) recorded 0.449±0.1660 as the lowest significant value while the control was the highest significant value of 0.613±0.137. A similar trend of (ρPSII) was observed on qL results. MSB072 accession recorded the highest significant mean value of 154±38.43 of ETR while Bafia and TOT6684 recorded the lowest significant value of 68.38±33.125 and 51.38±22.84 respectively. Delele and Local accessions had increased capacity to regulated excess energy to reduce photo damage caused by water deficit effects, this was confirmed by a significant increase of (ΦNO) as well as increase in non -photochemical quenching (ΦNPQ) under the water deficit stress. Results show that Jew's mallow has some mechanism that helps it to tolerate the drought stress and protect the photosynthesis apparatus hence allowing the crop to produce average yield even during water deficit stress.

Keywords: Chlorophyll fluorescence, ETR, Jew's mallow, maximum quantum yield (ΦPSII), Non photochemical quenching (ΦNPQ).

COMPARATIVE PHENOTYPIC AND PHYSIOLOGICAL RESPONSES OF PIGEON PEA (CAJANUS CAJAN L. MILLSP.) GENOTYPES TO WATER DEFICIT

Boodia N.[1,] | 4075059@myuwc.ac.za

Govinden-Soulange J.[2], And Ludidi N. N.[3,4]

[1]Plant Stress Tolerance Laboratory, Faculty of Natural Sciences, University of the Western Cape, South Africa

[2]Department of Agricultural and Food Sciences, Faculty of Agriculture, University of Mauritius, Mauritius

[3]Faculty of Agriculture and Natural Sciences, University of Mpumalanga, Mbombela, South Africa

[4]DSI-NRF Centre of Excellence in Food Security, University of the Western Cape, South Africa

Pigeon pea (Cajanus cajan L. Millsp.) is a strategic orphaned crop for climate-resilient regenerative agriculture. It shows potential for food and nutrition security in semi-arid African regions, where droughts are frequent and severe due to climate change. The study aimed to determine drought-tolerant and drought-sensitive genotypes. In a controlled-environment glasshouse at the University of the Western Cape, South Africa, a completely randomized design experiment was conducted with 12 treatment combinations (6 genotypes x 2 water treatments) and 8 replicates. Under aseptic conditions, sterilized seeds of C. cajun were pre-germinated and sown in 3L plastic pots containing Promix Organic substrate, adjusted with diluted nutrient solution to a water potential of 0.025 ± 0.005 MPa. All the plants received 200 ml of water per pot on every alternate day for the first 15 days of the experiment. Well-watered (WW) plants received 200 ml per pot, while the water-deficit treated (WD) plants obtained no water from 15 days after sowing. The plants were grown for 43 days at a temperature of 26°C during the day and 21°C at night under a 16/8 hours light/dark cycle at a an average photosynthetic photon flux density of 200 $\mu mol.m^{-2}.s^{-1}$. The plants were harvested when most WD plants showed signs of water deficit, which was 28 days after the last day of watering. C. cajun genotypes responded differently to water deficit in terms of the phenotypic and physiological traits, signifying that the genotypes have varying sensitivity to drought. All the genotypes showed reduced shoot and root growth ($p<0.05$) in response to water deficit. The SAMP4_RB genotype showed the

lowest reduction (p<0.05) in the following traits: root and shoot fresh weight, shoot length, number of trifoliate leaves, leaf area, and leaf water potential, demonstrating that it was most tolerant to water deficit stress. Large reductions in root and shoot fresh weight, shoot length, number of trifoliate leaves, leaf area, and leaf water potential were observed in WLD_TRIO, indicating its high sensitivity to drought. Some phenotypic traits, namely stem diameter and root length, did not reveal conclusive findings in determining drought tolerance. WLD_TRIO plants experienced the highest soil water potential (-0.72 MPa) – highest plant available water – and yet it showed the worst performance in terms of growth traits, confirming that it was the most drought-sensitive genotype. SAMP4_RB shows promising potential for breeding C. cajan varieties with enhanced drought tolerance.

Keywords: C. cajan, climate-resilience, drought-tolerant, pigeon pea, water potential.

COMBINED EFFECT OF DIFERENT LEVELS OF POTASSIUM AND BORON ON THE YIELD AND QUALITY OF ORANGE FLESHED SWEET POTATO (*Ipomoea batatas* L.)

Orlando Mabureza Tuco-Tuco[1] | orlando.tuco064@gmail.com

Daniel Chongo[1], Zélia Menete[1], Roland Brouwer[2]

[1]Faculty of Agronomy and Forestry Engineering, Eduardo Mondlane University, Mozambique

[2]International Potato Center (CIP), Mozambique

In Mozambique, orange-fleshed sweet potatoes are used as a strategic crop to achieve food and nutritional security for the population. Potassium is an essential macronutrient for plant growth and a lack of it in the soil can lead to a sharp decrease in crop productivity. Also, it plays an importnat role in the formation and growth of tuberous roots and their quality. A trial was conducted in Nwalate, Boane district, between the months of October 2015 and March 2016 with average temperature of 27.2 °C and total rainfall of 61.1 mm for the entire cycle, on a clayey textured soil to evaluate the effect of fertilization with combined levels of potassium and boron on the yield and quality of orange-fleshed sweet potato. The Randomized Complete Block Design (DBCC) was used with 4 replications arranged in 3×3×4 factorial to evaluate the combination of 3 levels of potassium (0, 100 and 200 kg.ha-1) and 3 of boron (0, 1.5 and 3 kg.ha-1) on the yield and quality of 4 varieties of orange-fleshed sweet potato (Irene, Ininda, Bela and Delvia). The results of the analysis of variance (ANOVA) showed that fertilization, both isolated and combined, did not have a significant effect on total and commercial yield ($p > 0.05$), but the interaction had a significant effect on the average number of roots per plant ($p < 0.05$), unlike the varieties ($p < 0.05$) and with 20.5, 16.1 ton.ha-1 and 3 roots per plant. Fertilization and varieties had a significant effect ($p < 0.05$) on the content of dry matter, beta-carotene, starch and proteins in the roots, with average levels of 27.2%, 14.2%, 61.1% and 5.9%, respectively.

Keywords: Orange-fleshed sweet potatoes (Ipomoea batatas L.), potassium, boron, varieties, yield.

EVALUATION OF THE EFFECTS OF POTASSIUM TOP DRESSING FERTILIZATION ON STRAWBERRY YIELD AND PLANT GRAY MOLD (*Botrytis cinerea*) DISEASE SEVERITY

Teresa Mutemba[1] | terezagbl@gmail.com

Ana Maria Mondjana[2], João Bila[2], Carvalho Ecole[1]†, Stella Nhanala[1]

[1]Instituto de Investigação Agrária de Moçambique, Mozambique

[2]Eduardo Mondlane University, Mozambique

Agronomic research has sought to reduce production costs and the impact of pesticides on the environment by using low-cost and less polluting products. Thus, the use of potassium can constitute an important alternative for managing pests and diseases, which can have a positive impact on strawberry productivity. The present research aimed to evaluate the effects of potassium top dressing with on strawberry yield and plant gray mold (Botrytis cinerea) disease severity. The study was conducted at the Agricultural Research Institute of Mozambique (IIAM), in the district of Boane. The study was performed in a randomized complete block design, with the following treatments: four levels of potassium (0, 50, 100, and 150Kg/ha), two levels of difenoconazole fungicide (first level, second level) and two (2) levels of gray mold inoculation levels (inoculated and not inoculated). In this assessment, incidence, severity, area under the disease progression curve, and yield were evaluated. In this study, it was found that the interaction between potassium, fungicide and inoculum demonstrated a significant effect on the following parameters: gray mold disease incidence and severity, area under the disease progression curve and yield. However, the interactions of potassium x inoculum, fungicide x inoculum and potassium x fungicide x inoculum, did not have a significant effect on the severity parameter in the plant. The application of potassium doses significantly affected the expression of Botrytis cinerea since plots with potassium application and without fungicide resulted in significantly lower levels of disease incidence. When compared to plots without potassium application and without fungicide. The potassium top dressing fertilization could have induced plants to conserve more. water in their issues when they developed the gray mold disease. The application of potassium could also have helped plants to resist the invasion of microorganisms, strengthening the structure of the cell wall. From the study, it was concluded that Potassium had a significant effect on gray mold severity and strawberry yield.

Keywords: Gray mold disease, potassium, strawberry.

MODELLING IMPACTS OF CLIMATE CHANGES ON YIELD AND WATER REQUIREMENTS OF SUGARCANE (*Saccharum officinarum* L) IN INCOMATI RIVER BASIN: CASE OF MANHICA DISTRICT

Jaime Pechiço[1] | jpechico@gmail.com

Rui Brito[2]

[1]Institute of Agrarian Research of Mozambique, Mozambique

[2]Eduardo Mondlane University, Mozambique

The objective of this study was to quantify the impacts of climate changes on sugarcane yield and water requirements, using modeling techniques and scenario analysis. Climate data projected for end of century (2080 to 2100) with baseline 1980 to 2010, from IPSL model (dry scenario) and CNRM (wet scenarios) model under A1B emission of IPCC AR4 were used. FAO Aquacrop model was employed to simulate yield and water requirements. The study also evaluated adaptations measures such as mulching and altering planting dates. Statistical analysis consists on linear regression and trend analysis test for baseline dataset, and t test for quantifying variation in yield and water requirements, between future and baseline. The results showed that only minimum temperature exhibited increasing trends by 0.032 C. year-1 during baseline period. The IPSL and CNRM models projected increasing of maximum temperature in 2.6 C and 3.7 C, respectively, and minimum temperature in 4.3 C and 4.7 C, respectively. The Aquacrop model accurately simulated sugarcane yields (r2 = 0.72, d = 0.5 ton.ha-1, and E = -1.7 ton.ha-1). Sugarcane yield is projected to increase by 10.8 % and 12.2% under CNRM and IPSL scenarios, respectively, while crop water requirements only will increase in 16.3 % under IPSL scenario. Mulching and altering planting dates only influenced in water requirements, reducing under baseline (6%) and CNRM (17.5%) scenarios, while altering planting dates increasing water requirements under IPSL and reducing under CNRM. These projected changes in yield and water requirements are primarily driven by increases in temperature and CO_2 concentrations and changing in rainfall pattern. Mulching is identified as a technical viable adaptation strategy, while optimal planting dates will be April for IPSL and July for CNRM scenarios.

Keywords: Aquacrop model, Adaptation measures, Sugarcane yield, water requirements.

FACTORS THAT CONTRIBUTE TO THE FOOD AND NUTRITION SECURITY OF HOUSEHOLDS IN MECONTA DISTRICT, NAMPULA PROVINCE

Zecas Gomate

Universidade Eduardo Mondlane, Mozambique

Ensuring food and nutrition security in Mozambique, especially in rural areas, where there are higher levels of food insecurity and malnutrition, is one of the greatest challenges today. The design and implementation of effective measures to improve food and nutrition security depend, to a large extent, on in-depth knowledge of their covariates. The present study was carried out to assess the main socioeconomic factors affecting the food and nutrition security of households in Meconta district, Nampula province. Data from the Food and Nutrition Security Assessment/2021 of the Technical Secretariat for Food and Nutrition Security (SETSAN) were used, with a sample of 96 households. The food consumption index was a key indicator to classify the food and nutrition security situation of households, while the logistic regression model was used to analyze the variables significantly associated with food and nutrition security. The results showed that 69% of households were food secure, while 31% were food insecure. Binary logistic regression revealed that of the 9 variables included in the model, only gender, education level, marital status of the head of the household and family size were the factors significantly associated with food and nutrition security, at a significance level of five percent (= 5%). Marginal effects indicated that the probability of food and nutrition security in households whose head of family is married decreases by an average of 6%; conversely, the likelihood of food and nutrition security in households headed by a male head increases by an average of 9%; the probability of food and nutrition security in a household increases by an average of 50% as the level of education of the head of the household increase. Finally, the probability of food security reduces by an average of 10% with the increase in household size. Therefore, it is recommended to intensify the process of adult literacy, training in women's inclusion, management and diversification of income sources, design and implementation of programs to encourage household heads to adhere to education and the adoption of family planning methods to minimize the rates of exacerbated growth in household size.

Keywords: Food security, marginal effects, nutrition security.

COMPARATIVE EFFECTS OF BIOSLURRY AND CHEMICAL FERTILIZER ON SOIL PROPERTIES AND PERFOMANCE OF SPIDER PLANT (*Cleome gynandra* L.)

Mosamarea Motladi | 201100116@Buan.Ac.Bw

Thebeetsile Scott Moroke, Utlwang Batlang, Baganetsi Karabo Sebogisi and Thembinkosi Mathowa

Department of Crop and Soil Sciences, Botswana University of Agriculture and Natural Resources, Botswana

Spider plant (Cleome gynandra L.) is a promising indegenous leafy vegetable in the diet of many African rural populations. However, soil fertility for its production remains an unexploited area leading to low crop yields. Bioslurry (BS) is a by-product of biogas production rich in organic matter and plant nutrients and a potential substitute for chemical fertilizer (CF) and a soil amendment to restore soil health. Pot and field experiments were conducted to compare the effects of BS and CF on soil properties and yield of spider plant. A factorial combination of two landraces of spider plant were laid out in CRD and RCBD with three replications in the greenhouse and field, respectively. Treatments were landraces (Tot 89-26 and Rothwe), and N applied as Urea at 0, 60, 120, and 180kg N/ha and bioslurry at 0, 10, 20 and 30 ton/ha using a sandy loam soil. Results revealed that fertilization with BS and CF significantly (p<0.05) increased plant growth parameters. However, the influence of both fertilizers on plant performance were statistically similar. The Highest plant height (27.04cm), leaf number (23.39) and leaf petiole length (9.43cm) were recorded from BS20, CF60 and BS20 respectively compared to the control. Accession alone influenced leaf petiole length and leaf number. All fertilizer treatments significantly increased yield parameters. Furthermore, application rate of 120kg N /ha and 20 ton/ha BS recorded the highest chlorophyll content while high stomatal conductance was recorded from 30 ton/ha BS and the results were at par with BS20, CF60, CF120 and CF180. Spider plant efficiently used N when low rates of bioslurry and urea at 10 ton/ha and 60kg N/ha respectively were applied. Results showed a highly significant (p≤ 0.001) effect of fertilizer application on CO_2 emissions and carbon sequestration. High CO_2 emissions and low carbon sequestration were recorded from 180kg N/ha of Urea while low emissions and high carbon sequestration were recorded from 30 ton/ha of bioslurry. Different application rates of bioslurry and urea significantly influenced soil chemical properties while no significant effect was observed on soil physical properties. Overall, the results of this study showed that the effect of bioslurry and urea on growth and yield of spider plant

were not significantly different. Thus, bioslurry can be used as an alternative source of nitrogen for spider plant cultivation. Bioslurry significantly improved soil properties, reduced CO_2 emissions through carbon sequestration, hence promoting sustainable crop production.

Keywords: Bioslurry, Carbon sequestration, Soil properties, Spider plant.

PLANT-GROWTH-PROMOTING, DROUGHT-TOLERANT RHIZOBACTERIA IMPROVED MAIZE BIOMASS PRODUCTIONVITY IN A SEMI-ARID REGION OF SOUTH AFRICA

Ayansina S. Ayangbenro

Olubukola O. Babalola | olubukola.babalola@nwu.ac.za

Food Security and Safety Focus Area, Faculty of Natural and Agricultural Sciences, North-West University, South Africa

Drought is an extremely detrimental condition to crop productivity worldwide for susceptible plant species, such as maize (Zea mays L.), and poses a critical threat to agricultural production. To confront this, the application of bioinoculants inclusive of plant growth promoting rhizobacteria (PGPR) are is a viable alternative to chemical inputs to enhance the plant water stress tolerance. In this study, we sampled different rhizobacterial strains from the Mmaize (Zea mays L) and established their tolerance to drought stress under different concentrations of PEG-8000. These bacteria were also tested for their potential to promote plant growth. Eleven (11) bacterial isolates belonging to the genara Bacillus, Aeromonas Pseudomonas and Priestia were identified. These isolates expressed positive reaction for the production of indole-3-acetic acid (IAA) and siderophore, 1-amino cyclopropane-1 carboxylate (ACC) deaminase, ammonia production, nitrogen fixation and phosphate solubilization but negative for hydrogen cyanide. In this regard, Aeromonas strains A1-2 and C7_8 were characterized by the highest drought tolerance with coefficient values of 0.71 and 0.77, respectively. These strains were also used for the bioinoculation tests; either individually or in consortia. These bacterial inoculants improved significantly the biomass yields of maize plants in terms of above ground and below ground biomass at 100%, 50%, and 25% water holding capacity. Strikingly, a plant that was subjected to these bacteria increased aerial biomass by as much as 89% under moderate (50%???) water limitation. This mean that these bacterial strains can be considered as useful potential for manipulating role in drought tolerance and nutrient uptake in order to reduce the negative impact of water scarcity on the growth of plants.

Keywords: Abiotic stress, climate change, plant-microbe interactions, sustainable agriculture.

EVALUATION OF THE SUITABILITY OF AGRO-ECOLOGICAL CONDITIONS FOR THE DEVELOPMENT OF FALL ARMYWORM (*Spodoptera frugiperda*) IN MOZAMBIQUE

Dércio Romão | derciorbromao@gmail.com

Domingos Cugala and Laura Canhanga

Universidade Eduardo Mondlane, Mozambique

The fall armyworm (Spodoptera frugiperda) (Lepidoptera: Noctuidae) is a polyphagous and devastating pest of a range of hosts. In Mozambique, the pest was detected in 2017 and rapidly spread nationwide with high densities and high levels of infestation that reach 100% in the absence of control measures. Since its detection, potential invasion zones in the country have not yet been reported. Thus, the present work aimed to evaluate the suitability of agro-ecological zones for the development and establishment of fall armyworm in Mozambique. The study was conducted in February and March 2019 across the country. In each province, 3 districts were selected, with 3 locations selected in each of them and 5 sampling fields in each location. In each field, 50 maize plants were evaluated to determine the percentage of infestation and level of damage. The geographical points of absence and presence of the fall armyworm were introduced in MaxEnt 3.4.4 to predict the suitability of agro-ecological zones in the current and future potential distribution of S. frugiperda. The results showed that the percentage of infestation ranged from 29.47 – 92.76% with damage severity considered medium, except for the province of Sofala and the northern region of the country which have a low level of damage. The modeling carried out was classified as good and indicates that Mozambique presents, as a whole, high aptitude for the dispersal and establishment of the corn funnel bollworm due to favorable environmental conditions for the occurrence, in the present and in the future, of S. frugiperda, with great influence of annual precipitation and temperature variation. The areas most likely to occur can serve as a basis for the implementation of sustainable pest control measures, such as the use of biological control agents in integrated management programs to mitigate their impact on maize production in the country.

Keywords: Distribution, modelling, Mozambique, Spodoptera frugiperda.

OPTIMIZING NITROGEN FERTILIZER RATE FOR UPLAND RICE (*Oryza sativa* L.) VARIETIES IN SOUTHEASTERN BOTSWANA, GABORONE

Winnie Nchoko[1] | winychok@gmail.com

Thebeetsile Scott Moroke[1], Goitseone Malambane[1] and Utlwang Batlang[1]

[1]Department of Crop and Soil Sciences, Botswana University of Agriculture and Natural Resources, Botswana

Rice consumption in Botswana has seen an upward trend with the latest generation preferring rice over many traditional cereals like sorghum and maize. The biggest challenge is that the country's rice production currently stands at almost zero. With increased interest in consumption it also triggers increased interest in venturing into production. However, as a new crop in the country, proper and sustainable management practices like water management and adequate fertilizer application needs to be evaluated to better advice potential farmers. Most cereal farmers in the country lack information on accurate application fertilizer rates which are key in improving resource use efficiency, soil health, yield and its quality. Therefore, greenhouse and field experiments were carried out at BUAN, Gaborone, Botswana to determine the optimum nitrogen fertilizer rate of the three upland rice varieties under Haplic Lixisols. Experimental treatments were three upland rice varieties; AA073, AA128, and AA212 with six nitrogen fertilizer rates: 0, 40, 60, 90, 120, and 150kg/ha. The treatments were replicated three times in both studies. The study was laid out as completely randomized design and 3*6 factorial randomized complete block design in greenhouse and field, respectively. The results from the study showed a significant effect ($p<0.05$) of nitrogen fertilizer rate on panicle length, the total number of tillers, plant height, the number of filled grains per panicle, 1000 seed weight, stover and grain yield. In the field, the highest grain yield was recorded from 120kg/ha with variation on the genotypes at 12.15, 10.57 and 5.97 t/ha for AA128, AA212 and AA073 respectively. The greenhouse study revealed that the maximum grain yield was 6.20, 6.80 and 6.40 t/ha for AA073, AA128 and AA212, respectively. Upon quadratic linear graph fitting analysis, the optimum nitrogen fertilizer rates under Lixisols in Gaborone for upland rice varieties, AA073, AA128, and AA212 was 99, 255, and 276kg N/ha respectively and 110, 233, and 275kg N /ha respectively, for field and greenhouse studies. Fertilizer response need to be conducted considering market and grower economics, and environmental protection.

Keywords: Food security, grain yield, nitrogen fertilizer, upland rice.

EFFECT OF BUNCHING ONION CRUDE EXTRACT CONCENTRATIONS AND IRRIGATION LEVELS ON QUALITY OF TOMATO

E.M. Shikoli1, J.O. Ogweno[1], M. Saidi1 and F.W. Obuoro[2]

[1]Egerton University, Department of Crops, Horticulture and Soils, Faculty of Agriculture, Egerton, Kenya

[2]Kenya Agricultural and Livestock Research Organization, Non-Ruminant Research Institute, Kenya

Tomato (Solanum Lycopersicon L.) fruit quality is a vital factor that should be improved through sustainable means to meet future food demands. This study aimed to determine the effect of bunching onion (Allium fistulosum) crude extract concentrations and irrigation levels on the quality of tomatoes the study was carried out at KALRO-Kakamega, Kenya. The laboratory experiment was conducted in a single-factor treatment in a Completely Randomized Design (CRD) with combinations of Allium fistulosum crude extract and different irrigation levels treated as distinct treatments. The treatments comprised combinations of different levels of Allium fistulosum; 20%, 15%, 0%, positive control with 0.5L, 1L, 1.5L and 2L levels of irrigation. In this study, Allium fistulosum crude extract combined with irrigation levels generally improved the quality parameters of the tomato plant. Shelf-life of fruits was high, under 20% combined with 1.5L of water. At the same time, total soluble solids, ascorbic acid ($C_6H_8O_6$) content, lycopene content and beta-carotene ($C_{40}H_{56}$) content of tomato fruits were maintained at the highest content under 20% + 0.5 L of water then followed by 1 L of water as compared to negative control combined with 2 L of water. In conclusion, an Allium fistulosum crude extract concentration of 20% combined with 2L of water was recommended in tomato production systems to enhance tomato quality.

Keywords: Ascorbic acid, bacterial wilt, Allium fistulosum, shelf-life, tomato quality.

EFFECT OF VARYING PHOSPHORU APPLICATION RATE

Maduna M. K.[1] | Mokoni.Maduna@ump.ac.za

Thosago S. S.[1], Bopape-Mabapa M. P[2] and Kutu F. R.[1]

[1]School of Agricultural Sciences, Faculty of Agriculture and Natural Sciences, University of Mpumalanga, South Africa

[2]Department of Plant Production, Soil Science and Agricultural Engineering

Cowpea (Vigna unguiculata L) is an important dual-purpose leguminous crop grown throughout the world but mostly cultivated in dry savannah regions of sub-Sahara Africa. It is a multi-faceted crop that provides protein, minerals, vitamins, and constitutes key source of improved diet in many rural poor households often characterized by starch-based food consumption. It also serves as key revenue source for millions of smallholder farmers and rural women traders. However, average cowpea grain and fodder yields obtained in South Africa, 10.3 t ha^{-1} and <3.0 t ha^{-1}, respectively remain low compared to the reported average of 19.8 t ha^{-1} and 10.0 t ha^{-1}, respectively from major cowpea growing countries. This study assessed the effect of variable P fertilizer rates on growth and biomass accumulation of four cowpea genotypes planted under a controlled environment. The 4x4 factorial experiment was fitted into a completely randomized design and planted using 10-kg sterilised sandy loam soil containing 23% clay, 16 mg P kg^{-1} and 5.94 pH (KCl). Phosphorus fertilizer (8.3% single superphosphate) was applied at 0, 30, 60 and 90 kg ha^{-1}. The cowpea genotypes (G) comprised of CV17I, CV17F, CV17B, and CV18-1A that differed in their growth habit. Parameters measured at the flowering stage included plant height, leaf length, leaf width, stem diameter, chlorophyll content, number of trifoliate leaves, number of branches and dry weight biomass. Results revealed a significant ($p<0.05$) GxP interaction effect on leaf width with the broadest width (15.45 cm) obtained from CV18-1A at 30 kg P ha^{-1}. Similarly, a significant ($p<0.05$) GxP interaction effect on biomass accumulation with the highest biomass (6.73 g plant^{-1}) obtained from CV17B at 30 kg P ha^{-1}. Plant height and chlorophyll content benefitted significantly ($p<0.05$) from P application with the tallest plants (35.19 cm) obtained at 60 kg P ha^{-1}. These findings further underscore the importance of P fertilization as a critical agronomic strategy required to maximize cowpea growth and biomass accumulation with CV17B genotype considered a potential suitable candidate with greater adaptation to low soil P condition.

Keywords: Biomass accumulation, cowpea, smallholder farmers, yield gap.

POTENTIAL OF WASTE BREWER'S YEAST AS FOOD BASED ATTRACTANT FOR MONITORING OF FRUIT FLIES *(Diptera: Tephritidae)* IN CENTRAL MOZAMBIQUE

Luis Domingos Bota[1] | luisbota@yahoo.com.br

Domingos Jequessene[1], Marc De Meyer[2], Domingos Ranquene Cugala[4]and Laura Canhanga[3]

[1]National Fruit Fly Laboratory, Provincial Directorate of Agriculture and Food Security, Manica, Mozambique

[2]Royal Museum for Central Africa, Invertebrates Section & JEMU, Belgium

[3]Faculty of Agronomy and Forest Engineering, Eduardo Mondlane University, Maputo, Moçambique

From an economic point of view, true fruit flies are the most important insect family attacking horticultural crops, causing damages over more than 2 billion dollars annually worldwide. Detection surveys and population monitoring are an essential part of the management program, allowing farmers and government officers to establish the density and distribution of the population, and according to this information determine when, where and which controlling measures to apply. Trapping materials can be expensive for most of African farmers since they need to be imported. Waste Brewer's Yeast is being tested in many countries for its use as an alternative for Protein Baits, and because it is available locally it can provide a low-cost alternative to the more expensive synthetic lures or protein baits. Material and Methods: Waste Brewer's Yeast was collected at Mozambique Brewery Company. Three orchards were selected in Manica Province at Manica, Macate and Vanduzi districts. Three concentrations of dilution of Waste Brewer's Yeast were prepared (10%, 25% and 50%). Commercially available Protein baits (Torula yeast) and Protein bait-based insecticide (GF120) were used for comparison. Chempac Bucket Traps were used and each trap baited with 250 ml of protein bait solution. Results: 4026 specimens of fruit flies were collected, belonging to eight fruit fly species in four genera: Bactrocera dorsalis (Hendel), Ceratitis cosyra (Walker), Ceratitis rosa Karsch, Ceratitis capitata (Weidemann), Dacus bivittatus (Bigot), Dacus vertebratus Bezzi, Dacus punctatifrons Karsch and Celidodacus sp. (Hendel). From these species, B. dorsalis was the most abundant, followed by Celidodacus, D. bivitatus and C. rosa. The three concentrations of Waste Brewer's Yeast were as effective as the commercially available protein baits, with more females captured than males. Conclusion: Results

of the study indicates that Waste Brewer's Yeast can replace the commercially available products Torula yeast and GF120 especially on small scale farmers, due to its cheap price, for fruit flies trapping.

Keywords: Fruit Flies, Mozambique, Trapping, Waste Brewer's Yeast.

IMPROVING NITROUS OXIDE EMISSIONS ACCOUNTING IN KENYA: INSIGHTS AND MEASUREMENT RESULTS FROM FERTILIZER PRACTICES, ENVIRONMENTAL DRIVERS, AND N_2O ISOTOPIC COMPOSITION IN UASIN GISHU COUNTY

T. Ouma[1,2], P. Agredazywczuk[1], M. Barthel[2], A. Otinga[3], R. Njoroge[3], S. M. Leitner[4], Y. Zhu[4], C. Oduor[4], F. Perez-Cruz[1], J. Six[2] and E. Harris[1]

[1]Swiss Data Science Center (EPFL and ETH Zurich), Switzerland

[2]Sustainable Agroecosystems Group, Department of Environmental Systems Science, ETH Zurich, Switzerland

[3]Department of Soil Science, University of Eldoret, Eldoret, Kenya

[4]International Institute of Livestock Research (ILRI), Nairobi, Kenya

The use of mineral fertilizers in Sub-Saharan Africa holds promise for increasing agricultural productivity but also raises some concerns about exacerbating nitrous oxide (N_2O) emissions, a potent greenhouse gas with the highest warming potential, contributing to climate change. However, gaps in knowledge on N_2O emissions impedes the development of robust N_2O inventories for different scenarios and thus the adoption of climate-smart agricultural practices. This study investigates N_2O emissions and their drivers in maize and potato crops under varying fertilizer application levels in Uasin Gishu County, Kenya through the dry and wet seasons of 2024. Treatments include a blanket rate of triple superphosphate (TSP) and urea at levels of 25, 50, 100, and 125 kg N ha^{-1} for the maize plots with a control plot left without N application, while for potato plots, an application of 50 and 100 kg N ha^{-1}. We measured fluxes of N_2O, CO_2, and CH_4 using a mobile GHG flux trailer equipped with a Picarro gas analyzer in combination with pneumatically operated automatic static chambers. Additional semi-continuous measurements using laser spectroscopy coupled with a pre-concentration unit will offer valuable insights into N_2O isotopic compositions, shedding light on emission sources and processes. Preliminary findings show initially stable N_2O flux values, with higher N applications generally resulting in elevated emissions for both crops, with potatoes showing a more pronounced response in N_2O emissions. Emission factors varied significantly, with the highest emissions observed in the Maize_100kgN/ha and Potato_100kgN/ha treatments, especially after top dressing. Temporal patterns revealed that emission factors were significantly influenced by fertilization timing and

subsequent precipitation events. These results stress the significance of timing of fertilizer applications and considering environmental factors to understand N_2O production and consumption dynamics and ultimately comprehensive net N_2O emissions. In the later stages of the project, data science methodologies will be employed to analyze N_2O emission pathways, using both campaign measurements and existing data from SSA to inform regional-scale modeling efforts. These efforts aim to contribute to the data on GHG emissions which is scarce for SSA agricultural systems, quantify emissions accurately, predict future trends, and inform policy for sustainable agriculture, addressing food security and climate change in SSA.

WATER AVAILABILITY AND FUTURE DEMAND DYNAMICS IN AWASH BASIN WITH CLIMATE CHANGE PROJECTIONS

Mesfin Mitiku Feleke[1,2], Solomon Gebreyohannis Gebrehiwot[1], Zeleke Agide Dejen[1] and Tilahun Derib[1]

[1]Addis Ababa University, Ethiopian Institute of Water Resources (EIWR), Ethiopia

[2]Federal Technical Vocational and Educational Training Institute

This study focuses on water availability and future demand dynamics in the Awash River Basin, considering the impacts of climate change. The Water Evaluation and Planning (WEAP) model, leveraging climate data from 1977 to 2020 and discharge data from 1999 to 2020, and pertinent soil and demographic data was employed to assess water availability and demand dynamics. Besides, Geographic Information Systems (GIS), MATLAB, and SPSS were utilized in data processing and analysis. The findings revealed a clear water deficit in the basin, starting from 2026 and persisting throughout the projection period till 2080. Projections indicate significant deficits of -67.8 million cubic meters (MCM), -110.1 MCM, -1608.7 MCM, and -3855.3 MCM in 2026, 2030, 2050, and 2080, respectively. The projected water deficits highlight the urgent need for effective water resource management strategies in the Basin. These deficits have significant implications for various sectors, including agriculture, domestic water supply and livestock water demand. Sustainable solutions, such as improved water storage and conservation measures, efficient water management practices, and demand management initiatives, should be considered to mitigate the projected gaps. The integration of climate change projections, hydrological modelling, and data analysis tools provides valuable insights into the future water availability and demand dynamics in the Awash Basin. The findings of this study can inform policymakers, water resource managers, and stakeholders in making informed decisions and formulating adaptive measures to ensure water security in the face of changing climatic conditions.

Keywords: Climate change, water deficit, water demand, water management, WEAP.

FATE OF N-FERTILIZER IN MAIZE MONO-CROP SYSTEMS OF TROPICAL HIGHLANDS

K.C. Oluoch[1] | churchilkevin2@gmail.com

A.N. Otinga[1], R. Njoroge[1], T. Ouma[2, 3], P. Agredazywczuk[2], M. Barthel[3], J. Six[3], S. M. Leitner[4] and E. Harris[2]

[1]Department of Soil Science, School of Agriculture and Biotechnology, University of Eldoret, Kenya

[2]Swiss Data Science Center (EPFL and ETH Zurich), Switzerland

[3]Sustainable Agroecosystems Group, Department of Environmental Systems Science, ETH Zurich, Switzerland

[4]International Institute of Livestock Research (ILRI), Nairobi, Kenya

Fertilizer use in Kenya has been on an upward trajectory in recent years, and maize, being the main staple food, receives the highest fertilizer application rate. However, fertilizer adoption and application rates among maize-growing farmers in different agroecological zones vary considerably. Maize fields in high-potential areas receive the highest application rates of ~ 190 kg ha^{-1}, similar to those seen in Asia and Latin America. Nitrogen is the most applied nutrient, as a basal (NPK compound fertilizers and Di-Ammonium Phosphate) and top-dress (Urea and Calcium Ammonium Nitrate). Unfortunately, nitrogen (N) is highly susceptible to losses from maize cropping systems through gaseous emissions, leaching, runoff, and volatilization. This negatively influences ecosystem functioning, especially due to the deposition of nitrates (NO_3^-), ammonia (NH_3) and nitrogen oxides (NO_x). Excess N also contributes to climate change, particularly nitrous oxide (N_2O) gas emission (a potent greenhouse gas). It is, therefore, crucial to understand N flows in maize-monocrop systems. This will improve the ability to quantify and predict potential environmental effects of continuous and increasing use of synthetic N fertilizers, especially in the Rift Valley highlands.

This study, therefore, aims to better understand the influence of N inputs on N_2O emissions, NO_3 leaching and N use efficiency in maize cropping systems in the Rift Valley region, Kenya. The experiment was set up at the University of Eldoret involving maize plots treated with six different N-fertilizer rates (0, 25, 50, 75, 100 and 125 kg N ha^{-1}) replicated three times. Initial results indicate that the soil was strongly acidic, with adequate organic carbon (1.96%), nitrate (21.73 ppm and varying ammonium ion levels (0.48-4.09 ppm). Subsequent measurement of meteorological conditions and sampling of N_2O gas, soil and tissue is done

throughout the maize growing period. These will be used to compute N budgets in agricultural soils under different fertilizer use scenarios.

Keywords: Emissions, greenhouse gas, leaching, N-fertilizer, reactive nitrogen.

EFFECT OF WONDERGRO-A SOIL CONDITIONER-FOR ENHANCING FERTILIZER USE EFFICIENCY IN MAIZE PRODUCTION

D. O. Ogutu[1] | dishonogutu001@gmail.com

R. Njoroge[1], A. N. Otinga[1], J. Wanjiku[2], D. Priest[2] and P Seward[2]

[1]Department of Soil Science, School of Agriculture and Biotechnology, University of Eldoret P. Eldoret Kenya

[2]FIPS-Africa. Nairobi, Kenya

The agricultural sector plays a key role in the food security state of nations. Despite maize being considered a staple food crop in Keny its productivity is low mainly due to inappropriate soil fertility management specially by smallholder farmers. The continuous decline in soil fertility is a consequence of acidic conditions, nutrient imbalances and sub-optimal fertilizer use causing depressed maize yield. Use of balanced and adequate fertilizers while improving other soil conditions is a prerequisite for increasing maize crop productivity and production. On-farm trials were conducted during the long and short rains seasons of 2023 to asses performance of two formulations of WonderGro (WG3 & WG21)-a soil conditioner-in combination with the commonly applied Di-Ammonium Phosphate (DAP) fertilizer at different rates under a range of soil pH(<5.5->5.5). The study sites (16) were spread across Kakamega(4), Bungoma(4), Nandi(4)and Uasin Gishu(4) counties under three different soil types;Acrisols, Ferralsols and Nitisols. We hypothesized that the soil conditioner (WonderGro) would enhance nutrient uptake, increase maize yields while reducing the required quantities of DAP to be applied. The trials involved five treatments; 0kgDAPha-1(absolute control), 133kgDAP ha-1, 67kgDAP ha-1, 67kgDAP+WG3 ha-1and 67kgDAP+ WG21ha-1. Results of applying half rate of DAP+ either formulation of WG3 or WG21 increased yield above full rate of DAP(4.2t ha-1)with5% and10%respectivelyin Kakamega. Application of full rate of DAP, half rate of DAP with either WG3 or WG21 on other 12 sites had no significance differences in yield with an average of 4.0 t ha-1in Bungoma, 7.1t ha-1in Nandi and6.0t ha-1in Uasin Gishu except with half rate of DAP+WG21which had ana average yield of 5.5 t ha-1irrespective of the pH. Application of half rate of DAP+WG3hadan average yield of1.6tha-1while full rate of DAP and half rate of DAP had an no significance difference with an average yield of1.9t ha-1inBungomaduring the short rains.

Keywords: Acrisols, ferralsols, food security, nitisols, soil fertility.

ANTIFUNGAL POTENTIAL OF PLANT BIOACTIVE COMPOUNDS, SULPHUR AND COPPER FORMULATIONS AGAINST ALTERNARIA LEAF SPOT IN KALES, KENYA

Victor Vedasto Ngaiza | 20937.2021@students.ku.ac.ke

Kenyatta Univesity, Nairobi, Kenya

Alternaria Leaf spot (ALS) disease is one of the potential biotic stressors responsible for diminishing the yield quantity and quality of kale. The disease is caused by Dothideomycete, necrotrophic and saprotrophic fungi known as Alternaria brassicicola. Kale farmers majorly manage ALS using synthetic fungicides. Sustainable ALS management approaches need to be developed to protect consumers and the environment in its entirety. This study hypothesized that plant bioactive compounds, Copper and Sulphur formulations are effective against A. brassicicola. The efficacy of the plant bioactive compounds from Jatropha curcas, Tephrosia vogelli, Persea americana, Cymbopogon citratus, Ocimum gratissimum, and Carica papaya was tested in vitro. The disease kale samples were extracted from the Githughuri and Lari sub-counties in Kiambu County. The pathogen was isolated and characterized morphologically, culturally and in molecular aspects. Bioactive compounds were extracted using five solvents in order of decreasing polarity: petroleum ether, benzene, chloroform, methanol and ethanol, using the serial exhaustive method. The Sulphur formulations (Wetsulf® 80% w/w, Thiovit® Jet 80% w/w) and Copper formulations (Vifra® 40 WG, Isocap® 50WP) were tested against the pathogen. The food poison technique was employed to test the efficacy of both plant compounds and Copper and Sulphur formulations. The result reveals that bioactive compounds present in J. curcas and T. vogelli are effective against the pathogen by inhibiting mycelial growth of the pathogen by 69.9% and 60.3% respectively. The study also reveals that both Sulphur formulations Thiovit Jet 80w/w (68%) and Wetsulf 80w/w (64.5%) and one Copper formulation Vifra 40WG (66%) were effective against A. brassicicola. These findings suggest that bioactive compounds from J. curcas and T. vogelli are good candidates that can be considered in the commercial manufacture of control products for ALS. Most of the Sulphur and Copper formulations are effective against ALS and thus can be used by farmers as part of the IPM strategy.

Keywords: Alternaria, bioactive compounds, disease, Kale.

FIRST REPORT OF BANANA BUNCHY TOP VIRUS DISEASE ALTERNATE HOSTS IN MOZAMBIQUE

Ronaldo Zunguze[1], Carlota Monjane, Marília Mazivele[2], Nils Hogberg[3], Anna Berlin[3]

Joao Bila[1,4] | Jbilay@gmail.com

[1]Faculdade de Agronomia e Engenharia Florestal, Universidade Eduardo Mondlane, Mozambique

[2]Centro de Biotecnologia, Universidade Eduardo Mondlane, Mozambique

[3]Department Of Forest Mycology and Plant Pathology, Swedish University of Agricultural Sciences, Uppsala, Sweden

[4]Centre Of Excellence in Agri-Food Systems and Nutrition, Universidade Eduardo Mondlane, Mozambique

Banana is one of the most economically important fruit crops globally, contributing to the livelihoods and nutrition of millions of people in the tropics including Mozambique. However, in 2016 Mozambique reported the first outbreak of Banana bunchy top virus (BBTV) disease in Gaza province, threating banana production in Mozambique as well as in the region. Since then containment quarantine measures have been imposed by the government and partners, nevertheless the effort failed to contain disease, with the new outbreak being progressively reported in new sites including Maputo provinces. This study aimed to search for BBTV alternative hosts in Southern Mozambique. Sample were collected in banana production fields from the districts of Manhiça (in Maputo) and Chokwe (in Gaza), around BBTV infected banana plants, from plants showing some symptoms of viral infection or harbouring sucking insects such banana aphids. BBTV virus screening was done using polymerase chain reaction (PCR) molecular toll. A total of 103 plant species was identified, with 42 species from 13 families in Manhiça and 61 species from 18 families in Chokwe. The Asteraceae family stood out as the most representative, totalling 37 identified species, while the Solanaceae family presented 9 species, Acanthaceae was represented by 5 species and the Amaranthaceous family with 4 species. Other families such as Poaceae, Malvaceae, and Commelinaceae each contributed 3 species. The Apiaceae, Fabaceae, and Araceae families were represented by 2 species each. Additionally, there was the presence of a single species in families such as Cucurbitaceae, Lamiaceae, Rutaceae, Lophiocarpaceae, Musaceae, Oxalidaceae, Phyllanthaceae, Portulacaceae, Sapindaceae, and Zygophyllaceae. The PCR diagnostic results detected three species of weed plants as hosts of BBTV: Conyza canadensis

(Asteraceae) and *Corallocarpus* sp. (Cucurbitaceae) in Manhiça, and *Centella asiatica* (Apiaceae) in Chokwe. Nucleotide BLAST search and phylogenetic analysis results confirmed that the virus strains detected on the weed alternates belongs to the group already reported. The detection of BBTV alternate hosts in Mozambique pave the way for more sustainable BBTV integrated management as well as the taxonomy of BBTV strains devastating banana production in Mozambique.

Keywords: Alternative hosts, Banana bunchy Top Virus, BBTV, banana

EVALUATION OF SPAD LEAF GREENNESS INDEX AS A YIELD INDICATOR FOR LEAFY VEGETABLES GROWN IN SALT-AFFECTED SOIL

Matias Siueia Junior[1,2], Jakob Herrmann[3], Alberto Luís[4], Sebastião Famba[5]

[1]Maputo Municipality Council, Department for Agriculture and Extension (DAPPE), Mozambique

[2]Aquila University, College of Agrarian Sciences, Mozambique

[3]Weltweit – Association for the Promotion of Local Initiatives e.V., Bad Soden, Germany

[4]ABIODES - Association for Sustainable Development, Program for Agriculture and Food Security,

Maputo Mozambique

[5]University Eduardo Mondlane, Faculty of Agronomy and Forestry Engineering, Maputo, Mozambique

Soil salinity affects crop growth through osmotic stress, ion toxicities, and nutrient imbalances, inducing physiological changes in affected plants, i.e. altering the chlorophyll content of leaves. Soil Plant Analysis Development (SPAD) leaf greenness index measurements enable users to determine chlorophyll content and nutrient (nitrogen) status of crop plants in the field. The SPAD index has been suggested as a good indicator of plant health and crop performance. Our study evaluated the SPAD index along with yield parameters in lettuce (Lactuca sativa) and collard green crops (Brassica oleracea var. costata) grown in two field locations with different salinity and sodicity levels subjected to different organic amendments. The experiment was conducted in the dry season (30.06.2022 - 18.08.2022) in the peri-urban vegetable production areas of Maputo city (Mozambique) under field conditions. It followed a randomized block design with 5 treatments (i. Control; ii. Chicken Manure; iii. Compost, iv. Biochar, v. Biofertilizer). Site 1 (S1) was classified as slightly saline and alkaline (ECe = 2.4, pH = 8.9, ESP = 4.6), while Site 2 (S2) was categorized as saline-sodic (ECe = 3.0, pH = 9.0, ESP = 20.8). The data from the field experiments were introduced to an individual analysis per experiment, after accepting the assumptions for the joint analysis of experiments, a joint analysis of variance was performed with the two sites, considering simultaneously all the experiments developed in the S1 and S2, and the means were compared by Tukey's test $p \leq 0.05$. The useful area considered the two central rows for harvesting, readings were taken before harvesting with the SPAD chlorophyll meter in three different positions

on the plant and the readings were reported in the morning, the cooler hours of the day. The preliminary results showed a clear difference between sites. Site 1, with a lower salinity level, demonstrated the highest SPAD readings in both crops: lettuce (25.05) and collard greens (59.96). Although the treatments did not have a significant effect, the treatment iv. Biochar amendments showed the best indicator to increase N in the soil under saline/sodic conditions, increasing the rate of SPAD index instead of organic fertilizer application, especially in the collard green crop, even on-site 2. A more detailed evaluation is needed to understand the best results comparing two seasons regarding the effect on salinity and nutrient dynamics in these two crops.

Keywords: Abiotic stress, organic manure, photossintese, salt stress.

COMPATIBILITY OF ENDOPHYTIC FUNGUS (*Colletotrichum nigrum*) WITH VELUM® (SYNTHETIC NEMATICIDE) AGAINST ROOT-KNOT NEMATODE (*Meloidogyne* spp.) ON TREE TOMATO

Waswa, Stanlous Juma[1,2] | waswastanlous@yahoo.com

Waceke, J. Wanjohi[1] and Maina Mwangi[1]

[1]Department of Agriculture Science and Technology, Kenyatta University, Nairobi, Kenya

[2]Department of Biological Sciences, Kibabii University, Bungoma, Kenya

Root-knot nematodes (Meloidogyne spp.) are one of the major hindrances to agricultural production worldwide. Many control methods have been put forward. However, integrated management using endophytic fungi and Velum® (active ingredient=fluopyram) is sought in this study to leverage on their synergistic antagonism to control root-knot nematodes (RKNs). Therefore, this study was conducted to evaluate the compatibility of endophytic fungus (Colletotrichum nigrum) isolated from roots of tree tomato and commercial Trichoderma asperellum with Velum® to contain RKNs attacking tree tomato in vitro and in the greenhouse. Before solidification, 1 ml of Velum® suspension was dispensed into a 1 L conical flask containing 1L sterilized molten PDA media and gently agitated for even mixing. The mixture was poured into 90 mm petri dishes and allowed to cool and solidify. Discs from actively growing margin of the colony of endophytic Colletotrichum nigrum or Trichoderma asperellum were removed using a sterile 5 mm cork borer and inoculated onto PDA media amended with velum®. Control plates contained un-amended sterile PDA media. The plates were sealed and incubated for seven days at 25°C. The tests were replicated four times in Completely Randomized Design (CRD) in the lab to check for colony inhibition. The spores of the fungi were mass-multiplied using millet grains. Forty milliliters of 1×10^6 spores/ml of C. nigrum and T. asperellum alone and in combinations with Velum® (1ml/L) were tested for their efficacy against J2s of RKN in the greenhouse with six replicates in CRD. The positive control was inoculated with J2s only while negative control had no J2s and no treatments. The experiments were repeated once. Data was analyzed by ANOVA SAS 9.2. There was no significant inhibition in the colony growth of C. nigrum by Velum® compared with control in vitro. The fungi were found compatible with velum. The combined treatment of C. nigrum with Velum® significantly ($P \leq 0.05$) reduced the RKN J2s, nematode reproduction factor, galling and egg mass indices in

both experiments more than when applied alone compared with the control. There was also a significant increase in the plant growth parameters of tree tomato treated with C. nigrum combined with Velum®. This study has shown that combining endophytic C. nigrum and T. asperellum with Velum® successfully controlled RKNs on tree tomato and recommends to promote their use in integrated nematode management especially under field conditions where efficacy of biological control agents) (BCAs is limited.

Keywords: BCAs, root-knot nematodes, second stage juveniles (J2s).

CO-OCCURRENCE AND NICHE DIFFERENTIATION OF LEPIDOPTERAN PEST AND ITS PREDATOR (*Doru luteipes*) IN MAIZE IN CONSERVATION AGRICULTURE IN NAMPULA, MOZAMBIQUE

Ali Ussene[1,2] | aliussene05@gmail.com
António Chamuene[2] and Francisco José[2]

[1]Departamento de Entomologia, Programa de Pós-graduação em Entomologia,
Universidade Federal de Lavras, Lavras, Minas Gerais, Brasil
[2]Instituto de Investigação Agrária de Moçambique-IIAM, Centro Zonal Nordeste, Sector de
Proteção de Plantas, Namapula, Moçambique

In Mozambique, maize is infested by different lepidopteran pests. S. frugiperda is an invasive species that has been introduced since 2017, little is known about its co-occurrence and spatial distribution in relation to native pests and their associated natural enemies. The objective of this study was to evaluate the co-occurrence and niche differentiation between lepidopteran pests, stem borers (Chilo partellus), (Sesamia calamistis) and fall armyworm (Spodoptera frugiperda, JE Smith) and its earwig predator (Doru luteipes) in maize (Zea mays)) in a conservation agriculture system. Rainfed field trials under natural infestation were established in the districts of Meconta (Namialo), Ribaue (Moroccane). Five maize genotypes (Matuba, Tsangano, PRIS 601, ZM 523 and Sussuma) were used associated with cowpea (Vigna unguiculata) and allocated to two plots. In the first plot, minimum tillage was applied with residue retention and in the second conventional tillage was carried out. Data collection for S. frugiperda infestation and earwig density were done at 45, 50, 65 and 70 days after emergence and for infestation of the borers was done after corn harvest in 10 plants randomly per plot, determining the population density of the earwig and pest infestation. An infested plant was considered to be one with signs or presence of pests. The results indicate that there is spatial distribution of pests in the same plant, especially in the leaf, stem and ear, causing defoliation, boring and ear damage. The pests C. partellus and S. calamistis broqueae stem and ear for their feeding and shelter, while S. frugiperda established itself in the leaves and funnel of the corn plant for its feeding and shelter. Lepidopteran pest infestation varied significantly as a function of the regions and species occurring together. Maize genotypes were more infested by S. frugiperda and less by S. calamistis regardless of the cropping system used. The minimal tillage with retention of residues in the soil and the agroecological conditions of Namilao in the district of Meconta in Nampula, independently, favored more the biology and niche of the earwig (D. luteipes).

Keywords: Chilo partellus, Dorus luteipes, Sesamia calamistis, Spodoptera frugiperda.

INSECTICIDAL POTENTIAL ASSESSMENT OF COFFEE (*Coffea arabica* L.) IN CABBAGE CULTIVATION (*Brassica oleracea* L. var. acephala D.C)

Cynthia Miguel

Íris Victorina | <u>irisvictorino@gmail.com</u>

Rucila Abobacar, Milton Pinho, Sónia Guilundo, Célia Martins, Orlando Quilambo

Department of Biological Sciences, Faculty of Sciences, Eduardo Mondlane University, Maputo, Mozambique

In Mozambique, the production of vegetables, especially cabbage (Beta vulgaris e Beta campestris), for both commercial and subsistence use, holds an important place in agriculture, contributing to both sustainability, especially women who are the main workers in this crop cultivation and human diet enrichment, due to their high content of health-promoting phytochemicals. The action of pests (whiteflies, slugs and snails), defoliation or even the death of the plant itself however reduces production levels, productivity and consequent commercialization. Chemical pesticides have been widely used by farmers in cabbage cultivation for pest management, but its use can cause increase in production cost, toxicity to the farmer himself, to those who consume it, to the soil and to the microorganisms present in it. Organic farming has gained notoriety in recent years, not only for providing chemical-free products, but also for being more economically attractive, much less pollution, without interfering with the final quality of the product. Coffee (Coffea arabica L.) is known for producing and releasing compounds resulting from secondary metabolism such as caffeine and trigonelline, compounds with pesticide potential. In Mozambique, coffee is being increasingly cultivated and it is estimated that its cultivation will increase in the following years, meaning that its use along with its derivatives from the plant itself may represent an added asset in its chain value. The present study tested for the first time extracts produced from coffee beans in 2 different concentrations (25% and 50%) in cabbage cultivation. Both concentrations were found to be effective in eliminating slugs and snails, and preliminary results indicate that neither concentration tested influenced whiteflies. These results are indicative that in fact the compounds present in coffee could have an effect as a biopesticide and thus allow a more sustainable and environmentally safe cultivation, and, simultaneously, enrich the already promising chain value of coffee cultivation in Mozambique with the use of other parts of the plant in addition to the grains.

Keywords: Biopesticide, soil conservation, pest management, women empowerment.

EVALUATION OF THE EFFICIENCY OF BIOPESTICIDES FOR COTTON PEST CONTROL IN REGENERATIVE AGRICULTURE SYSTEMS

Jennifer Laura Langa | jenniferlanga01@gmail.com
Universidade Eduardo Mondlane, Mozambique

In Mozambique, Cotton (Gossypium hirsutum L.) is a very important crop generating income for rural families. Regenerative agriculture is one of the most viable processes to respond to the intensification of agricultural demand by integrating planting, the environment and sustainability, although it is not yet widely disseminated worldwide. The use of organic pesticides represents a sustainable and ecologically responsible approach to protecting crops such as cotton from pests, so the search for more environmentally friendly reflecting a commitment to sustainable agriculture and the preservation of the ecosystem. The present study objective was to evaluate the efficiency of biopesticides in cotton pest control. A trial was conducted during the 2023-2024 season, between December 2023 and June 2024, in the Experimental Field of the Faculty of Agronomic Sciences-Cuamba, Niassa province. A Randomized Complete Block Design was used with 4 blocks using a hierarchical factorial scheme with two additional treatments, 5 biopesticides (Solanum incanum, Bobugnia madagascariensis, Azadircachta indica, Ricinus communis and Bacillus thurigiensis) and 3 different doses in each of these biopesticides that make up the hierarchical factorial structure were tested. For the additional treatments, 2 control treatments were considered (1 - use of chemical pesticide and 2 - no application of pesticides), each block consisting of 17 plots of dimensions of 5m4m separated by 1m from each other with a distance between the blocks of 1.5m. The statistical software STATA 17 was used, and Analysis of Variance (ANOVA) was performed followed by a test to compare the means of the treatments using Tukey test at 5% of significance level where the results of the ANOVA indicated that there is an effect of the treatments (p value < 0.05). An approach based on orthogonal contrasts was also used in the analyses given the structure of the treatments. In general, the interaction between biopesticides and dose had no significant effect on pest incidence, yield (df=10, Fcalc= 1.1681, Pr> Fcalc = 0.3351, P>0.05), seed cotton yield (df=10, Fcalc= 1.1680, Pr> Fcalc = 0.3352, P>0.05), number of capsules per plant (df1=10, Fcalc=0.3776, Pr > Fcalc = 0.9504, P>0.05), the number of good capsules (df=10, Fcalc=0, Pr > Fcalc = 0, P>0.05) and the average weight of capsules per plant (df=10, Fcalc=1.1835, Pr > Fcalc = 0.3252, P>0.05). The contrast between the treatments with biopesticides and the additional treatments showed significant differences only in the number of good capsules per plant (df=1, Fcalc= 5.4837, Pr > Fcalc = 0.0234, P<0.05), where a higher number of good capsules per plant was observed in the additional treatments (50.6250 > 34.8333).

Keywords: Gossypium hirsutum L., organic pesticides, regenerative agriculture.

NEMATODE PROBLEMS IN SUBSISTENCE GRAIN PRODUCTION AREAS OF SOUTH AFRICA

K.N. Ntidi | ntidin@arc.agric.za

H. Fourie

Agricultural Research Council-Grain Crops, Potchefstroom, South Africa

Unit for Environmental Sciences and Management, Potchefstroom, South Africa

Amaranthus species, also referred to as African Leafy Vegetables (ALV), play a significant role in the traditional diets and food security of underprivileged people in rural and urban areas. Since plant-parasitic nematodes (PPN), particularly root-knot nematodes (Meloidogyne spp.), hamper the production of these crops, the objective of this study was to determine the abundance and diversity of PPN assemblages associated with the rhizospheres (soil and root samples) of Amaranthus cruentus (accession Arusha) in four provinces of South Africa. Twelve PPN species belonging to 11 genera were identified from rhizospheres of accession Arusha. The information generated during this study for A. cruentus (accession Arusha) is the first for South Africa and is valuable and useful.

Keywords: African leafy vegetables, food security, Meloidogyne spp.

PRELIMINARY STUDY: association of nematode assemblages on pigeon pea with special reference to *Meloidogyne* spp.

K. N. Ntidi[1] | ntidin@arc.agric.za
Z. Bello[1,2]

[1]Agricultural Research Council-Grain Crops, Potchefstroom, South Africa
[2]Agricultural Research Council-Vegetable, Industrial and Medicinal Plants, Pretoria, South Africa

Pigeon pea (*Cajanus cajan*) is a versatile and valuable pulse crop that is mainly cultivated in developing countries in sub-Saharan Africa and Asia. In South Africa, pigeon pea is a minor crop in terms of both production and consumption. This presents a great economic opportunity for farmers as a niche market. Furthermore, it can be grown in diverse environments in different cropping systems due to its unique characteristics such as drought tolerance, nitrogen-fixing ability, low input requirements and wide temporal variation in maturation period. However, the production of pigeon pea is characterized by lower production yields that are often attributed to unfavorable climatic conditions, lack of improved varieties and scarce information on agronomic practices as well as pests and diseases. Among the pests, plant-parasitic nematodes (PPN) such as root-knot (Meloidogyne spp., and lesion (Pratylenchus spp.) are responsible for enormous economic losses in pigeon pea. This study was initiated to determine the association and impact of nematode assemblages on Pigeon pea with special reference to the Meloidogyne spp. Complex. Root and rhizosphere samples were obtained during 2022/23 growing season from the field trial section of Agricultural Research Council–Grain crops, Potchefstroom Institute. Eggs and second-stage juveniles of sessile, endoparasitic genera were extracted from the 50 g roots using an adapted NaOCl method. Individuals of other nematode pest genera were extracted from 5 g roots using the sugar-flotation method, while both plant-parasitic and beneficial nematodes were extracted from soil samples using the decanting and sieving, followed by the sugar-flotation method. The population densities from soil rhizosphere of Pratylenchus were exceptionally high in the field sampled followed by Helicotylenchus, Rotylenchus, Tylenchus, Aphelenchus, Meloidogyne and Aphelenchoides indicating that mono-cropping can lead to a build-up in populations. To date seven parasitic nematode genera (Pratylenchus, Meloidogyne, Helicotylenchus, Rotylenchulus, Aphelenchus, Aphelenchoides & Tylenchus) two families (Trychoridae & Dorylaimidae) as well as the freeliving nematodes were reported in association with the Pigeon pea. The glasshouse screening for host suitability of Pigeon pea against root-knot nematodes is underway.

Keywords: Cajanus cajan, density, Meloidogyne, nematode.

EFFECT OF WEED INTERFERENCE ON THE PERFORMANCE OF CABBAGE (*Brassica oleracea* L.) IN BUEA, CAMEROON

Ayeoffe F. Lum[1] | lumfontem@yahoo.com

David Chikoye[2]

[1]Kings University, Odeomu, Osun State, Nigeria

[2]International Institute of Tropical Agriculture, Lusaka, Zambia

Cabbage (Brassica oleracea L.) is an important vegetable crop widely cultivated and consumed in Cameroon. It is a good source of vitamins and minerals. Weeds are a major constraint to its production. A field experiment was conducted at the Teaching and Research Farm, University of Buea, Cameroon in 2018 to determine the effect of weed interference on the productivity of cabbage. The treatments were four weeding regimes: weedy check, weeding only at 3 weeks after transplanting (WAT), weeding at 3 and 6 WAT, and weeding only at 6 WAT. The experimental design was a randomised complete block with three replications. Data were collected on weed identification and dry biomass, and weight of cabbage heads. The results indicated that the different parameters varied significantly (P<0.05) among the treatments. The prominent weeds were Panicum maximum Jacq., Ageratum conyzoides L., Cynodon dactylon (L.) Pers, Eleusine indica (L.) Gaertn., Cyperus spp, Commelina benghalensis L., Amaranthus spp, Phyllanthus amarus Schumach. & Thonn. and Talinum triangulare (Jacq,) Willd. At 5 WAT, all plots weeded at 3 WAT had lower weed dry biomass than all other treatments. At harvest, plots weeded only at 3 WAT had higher weed dry biomass than all other weeded plots. The weed intensity was higher in the weedy check than in all other treatments and resulted in the highest weed dry biomass and lowest head weight (0.09 kg plant^{-1}). Plots weeded at 3 and 6 WAT had the highest head weight (2.62 kg plant^{-1}) while those weeded only at 6 WAT resulted in the lowest (1.38 kg plant^{-1}). The weedy treatments reduced the head weight by 96.4% compared to plots weeded twice at 3 and 6 WAT; and by 93.2% compared to those weeded once at 6 WAT. All weeded treatments had lower weed dry biomass and higher head weight than the weedy check. Weeding at 3 and 6 WAT provided superior head weight and low weed dry biomass compared to all other treatments; and should therefore, be adopted. Proper weed management, early in the season, is crucial to prevent weed competition, and optimize cabbage growth and productivity.

Keywords: Cabbage, weed competition, weeds.

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Ayeoffe F. Lum[1] | lumfontem@yahoo.com

David Chikoye[2]

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Keywords: Cabbage, weed competition, weeds.

RESEARCH INTO SUSTAINABLE MANAGEMENT METHODS OF THE FALL ARMYWORM, *Spodoptera frugiperda* IN FOUR REGIONS OF MOZAMBIQUE

Hipólito Malia[1] | litomalia@gmail.com

Angelo Cumbane[1], Antonio Chamuene[1], Aly Momade[1], Nelsa Garrine[1] and Domingos Cugala[2]

[1]Instituto de Investigação Agrária de Moçambique, Mozambique

[2]Faculdade de Agronomia e Engenharia Florestal, Universidade Eduardo Mondlane, Mozambique

Maize is the main food crop in Mozambique, and in recent years it has been attacked by the fall armyworm, Spodoptera frugiperda. The fall armyworm is a pest native to South America and had its entry into our country at the end of 2017. As maize is a highly important crop in Mozambique, management trials were carried out in order to ensure alternatives to control this pest because, when not controlled, it can cause damage to the crop of up to 100%. During the period from 2017 to 2023, management trials of the fall armyworm were carried out in four IIAM stations, respectively Lichinga, Nampula, Sussundenga and Umbeluzi, which are places with different agroecological characteristics. The trials were on variety effect, conservation agriculture, botanical pesticides, synthetic pesticides and sowing dates. The experiments were set up in a randomized complete block design where the levels of infestation, crop damage and yield were evaluated. The first trials clearly showed no effect of the varieties on the levels of infestation and damage to the maize crop. In relation to conservation agriculture, it was found that intercropping and crop rotation reduces fall armyworm attack levels. This result shows the importance of continuing with some practices that the small farmers already uses with numerous advantages. Several botanical pesticides were tested, and the combination of castor and neem, biol and tephrosia stood out with a significant effect on the control of the pest. Regarding synthetic pesticides, more than 10 active ingredients have been tested, and flubendiamide and emamectin + lufenuron have shown a significant effect. Sowing early (with the first rains) significantly reduces infestation levels and consequently increases yield. There are several caterpillar management alternatives available to the producer, and they should be used in an integrated way to ensure their sustainability. Synthetic pesticides should be a last resort.

Keywords: Corn, management, pests, pesticides, Spodoptera frugiperda.

WOOD ASH RECYCLING FOR RESTAURATION OF ACIDIC SOIL FERTILITY IN MOZAMBIQUE: a geochemist's workbench (gwb) predictive model use

Luis C. Savanguane[1,2] | lcsavanguane@gmail.com
Ieyasu Tokumoto[2], Tsutomo Sato[3], Hiroyuki Cho[2], Domingos Feniasse[1] and Virgilio L. Massango[1]

[1]Instituto de Investigação Agrária de Moçambique, Mozambique

[2]Saga University, Japan

[3]Hokkaido University Address: Instituto de Investigação Agrária de Moçambique, Estação Agrária de Sussundenga, Mozambique

Wood ash recycling is a valuable and economic strategy for restoring and ameliorating the acidic soil fertility. However, the chemical complexity of wood ash, dependent on the plant and carbonization process, limits its reuse for agriculture and requires appropriate management to obtain better environmentally accepted benefits. Thus, the study aimed to develop a geochemical model to use in wood ash recycling for the sustainable restoration of acidic soils fertility. For this purpose, the complexation and adsorption kinetic model was used through the Geochemistry Workbench (GWB12) software to predict the application dose of wood ash from Vanduzi in the Manica province-Mozambique, reaction time of wood ash in acidic soil, changes in soil pH and availability of ions in two acidic soils, one from Vanduzi and the other from the experimental field at Saga University in Japan. Followed by a laboratory experiment in pots with five doses of wood ash predicted in the software (GWB) and applied to the two acidic soils and incubated at a constant field capacity humidity and controlled room temperature of 24 - 25oC for 90 days at Saga University in Japan. The predictions soil pH change and chemical species in the software fit well ($R^2 > 0.9$) with the concentrations of soluble species measured during the incubation time. The wood ash dose and reaction time varied with the soil organic matter content and significantly and non-linearly increased the soil pH, the availability of K^+, Ca^{2+}, PO_4^- ions and completely precipitated aluminium (Al^{3+}) in the used soils. The GWB12 approach is useful for predicting the environmentally acceptable dose and reaction period of wood ash and restoring fertility in acidic soil. However, for better prediction, use of accurate partial carbon dioxide (pCO_2) and bicarbonate (HCO_3^-) in the soil, field experiments and inclusion of correction factor (crop effect) in the model would be able to make a more effective and accurate prediction.

Keywords: Ash, acidic soils, prediction, restauration.

EFFICIENCY AND SELECTIVITY OF INSECTICIDES AND SOME BIOPESTICIDES FREQUENTLY USED IN THE CONTROL OF *Spodoptera frugiperda* IN THE PROVINCE OF MANICA

Angelo Cumbane, Jorge, Custtodio, Braga, Gabriel., Malia Hipolito

Institute of Agrarian Research of Mozambique (IIAM), Estação Agrária de Sussundenga-Plant protection sector, Mozambique

Spodoptera frugiperda (corn fall armyworm) is currently one of the main pests of maize cultivation in Mozambique. The use of insecticides is one of the main control strategies for Spodoptera frugiperda. However, in Mozambique there are few studies that clarify the influence of certain insecticides on the biological imbalance of ecosystems caused by their abusive use, as well as their efficiency in controlling these insects. In this context, insecticides with the following active principles were tested: Flubendiamide (Belt® 480 SC) 70 mL.ha-1), Chlorantraniliprole (Ampligo® 150 SC, 75 mL.ha-1), Acephate (EC 40%, 1.13 kgha-1), Emamectin benzoate (Imperator® 5% SG), Cypermethrin (Cipercel® 250 SC, 60ml ha-1), biopesticides based on Azadirachta indica leaf extract (Margosa), Tephrosia vogelli and by a control (treatment without application). The randomized complete block (DBCC) design was used, with four (4) replications. The parameters evaluated were: the incidence of plants with leaf damage, severity of damage, the number of live caterpillars, number of dead funnel and the presence of natural enemies (ladybugs and earwigs). The applications of the treatments were made at 20 and 35 days after maize emergence and three evaluations were carried out, one before the first application of the treatments at 20, 35 and 50 days after maize emergence. The sample consisted of 5 plants previously randomly selected in each row of the 3 central rows of the plot. There was a significant difference between the treatments in the analyses of the effects on mortality of natural enemies and Spodoptera frugiperda. The insecticides with the active ingredient Emamectin benzoate (Imperator), Chlorantranilipronlie (Ampligo) and Flubendiamide (Belt® 480 SC, 70 mL.ha-1), depending on the period of application, can achieve an efficiency ranging from 62.5 to 100% in the control of Spodoptera frugiperda. On the other hand, regarding their selectivity to the natural enemy earwig, the most selective were biopesticides based on leaf extract and the least selective were the insecticides with the active ingredients Chlorantraniliprole (Ampligo® 150 SC) and Cypermethrin (Cipercel® 250 SC, 60ml ha-1) with 91.7 and 75% mortality respectively.

Keywords: Biopesticides, funnel caterpillar, insecticides, natural enemies.

SYNTROPIC AGROFORESTRY SYSTEMS AS AN ALTERNATIVE TO CLIMATE CHANGE MITIGATION AND ADAPTATION

Alcídio Vilanculos[1], Carlos Jeque[1], Leonel Joaquim[1], Telmancia António[1],

Ivete Maluleque[1], Tereza Alves[1], Destino Chiar[2], Faruk Tavares[2], Mandela Francisco[3], Francisco Mandlate[4], Sional Moiane[4], Vânia Cossa[1], Xadreque João[1] and Fidel Semba[5]

[1]Instituto de Investigação Agrária de Moçambique (IIAM), Mozambique

[2]Fundo Nacional de Desenvolvimento Sustentável (FNDS), Mozambique

[3]Café de Manica, Mozambique

[4]AgroTur/Café Chimanimani, Mozambique

[5]Serviços distritais de Actividades Económicas-Sussundenga, Mozambique

Mozambique has a dependence on agricultural practices that are no longer suitable for the context of climate change. Hence, identifying and promoting agricultural practices that provide communities with greater resilience to the various phenomena of climate change is an urgent need. The Institute for Agrarian Research of Mozambique (IIAM) introduced the first models of syntropic agroforestry systems in the central part of the country in 2020 in the districts of Angónia and Tsangano (Tete Province) and Sussundenga (Manica Province). From 2020 to the present day, comparisons have been made of this model with that of conventional agriculture with regard to the following variables: diversity of gains, improvement of soil properties, soil moisture and agricultural yield. For this purpose, from on-site observation, an evaluation of the quantity/diversity of gains obtained in the two models was made; for the case of soil properties, the infiltration rate was evaluated based on the simple ring as an indicator; soil moisture was measured using the TDR equipment, having evaluated 10 points randomly in each model (agroforestry and conventional); also, the maize yield of the ZM523 variety in the 2023/2024 agricultural season. In general, the results achieved or that have been recorded indicate that in a syntropic agroforestry model several products are harvested in the same area compared to a conventional field. In the case of this experience, bananas, cabbage, gliricidia seeds, umbaua, gliricidia cuttings, coffee, tomatoes, buckbeans, beans, etc. The diversity of products in this model can vary from 5 to 10 species/crops, obeying a temporal arrangement and aided by pruning; In the conventional model, it rarely reaches 5 species/crops. Soil moisture in the on station

(22.98%) was significantly higher P<0.05 (p=0.00049) than the control field (14.54%); in the on farm (11.13%) there were no significant differences P>0.05 (p=0.16) in the control field (9.48%). The corn yield in the agroforestry model was estimated to be more than 200% higher than the conventional model (0.347 ton/ha). In order to provide communities with more income diversity and therefore resilience to the negative effects of climate change, more than 30000 seedlings of various species were distributed to more than 150 producers in the buffer zone of the Chimanimani National Park

Keywords: Agroforestry system, agriculture.

INCREASING RESILIENCE OF SMALLHOLDER FARMERS TO CLIMATE CHANGE THROUGH ADOPTION OF CLIMATE SMART AGRICULTURE PRACTICES IN MOZAMBIQUE

O. Chichongue[1] | ochichongue@gmail.com

J. Mudema[2] and D. Munguambe[3]

[1] DARN -IIAM, Maputo, Mozambique

[2]CESE - IIAM, Maputo, Mozambique

[3]Nhacoongo Research Station, Inharrime, Inhambane, Mozambique

Mozambique is witnessing severe degradation of its farmlands. Much of this degradation can be attributed to farming practices – ploughing that destroys the soil structure and degrade organic matter, burning or removing crop residues and mono-cropping. To change this situation, improved sorghum and legume cropping systems design under better resource allocation and management conditions in Climate Smart Agriculture systems were tested across environments of Nhacoongo – Inhambane. This was done through on-station experiments research aiming to identify best bet resource allocation strategies that can make cropping systems more attractive to poor resourced farmers involved in Climate Smart Agriculture. The response functions for sorghum intercropped with cowpea and pigeon pea were determined. The objective of the study was to contribute to increased household food security of smallholder farmers in Inhambane and enhance their livelihoods. Two fertilizer treatments and two legume intercrop options were applied in a RCBD design with four replications. Results were subjected to ANOVA and the least significant differences (LSD) was used to separate the means. This study demonstrates that the intercropping legumes or combining with inorganic fertilizer has potential to address the low soil fertility problem in farmers' fields and raise yields of sorghum production.

Keywords: Intercropping and yields, legume, rotation, sorghum, tillage.

ANTIFUNGAL ACTIVITY OF FIVE BOTANICAL EXTRACTS ON STORAGE ROT FUNGI OF TARO (*Colocasia esculenta* (L.) Schott)

Eric Gyasi[1,2] | ericgyasi2010@yahoo.com

Edmund Osei Owusu[2], Barnabas A. Adongo[2], Fuleratu Adams Karim[2], Victoria Sackey[2] and Daniel Ashie Kotey[2]

[1]Faculty of Agronomy and Forestry Engineering, Eduardo Mondlane University, Maputo, Mozambique

[2]CSIR-Plant Genetic Resources Research Institute, Bunso, Eastern Region, Ghana

Taro corm rot is a major postharvest constraint as it causes huge losses in the tropics. Though synthetic fungicides are very effective, its residual effect on harvested produce limits its use in the management of postharvest rot of crops. The use of botanical pesticides, which are equally effective, more economical and safe to consumers and the environment, has been advocated. Given this, the antifungal effect of aqueous leaf extracts of African scent leaf, basil, bitter leaf, spider plant and Acacia on storage rot fungi of taro were determined. Aqueous concentrations of 60% (w/v) were prepared for leaf extracts of each of the plant species. PDA was amended with each extract in Petri dishes. Seven-day old discs (4 mm diameter) of the pure cultures of fungal isolates from rotten taro corms were then placed on the solidified botanical extracts and PDA mixture. Mancozeb, a synthetic fungicide, was used as a positive check. The percentage colony inhibition of the fungal isolates was calculated. Aqueous extract of spider plant inhibited the colony growth of the fungal isolates better than all the other extracts. With the exception of Aspergillus niger whose growth was inhibited by 11.1%, extract of spider plant significantly inhibited the growth of Lasiodiplodia theobromae by 79.9%, Fusarium solani by 70.7%, Aspergillus flavus by 71.1% and Penicillium sp. by 100%. This compared favourably with Mancozeb which inhibited Lasiodiplodia theobromae by 88.2%, Fusarium solani by 72.8%, Aspergillus flavus by 76.3%, Penicillium sp. by 85.2% and Aspergillus niger by 70.0%.

Keywords: Antifungal activity, aqueous extracts, colony growth inhibition, rot fungi, taro.

SYMPOSIUM

Symposium: Inclusion

Symposium: Production Systems

Symposium: Resilience

SYMPOSIUM: INCLUSION

YOUTH IN AGRIFOOD SYSTEMS: more than the leaders of tomorrow

Geena Tesdall

Young Professionals for Agricultural Development (YPARD)

Youth are more than the leaders of tomorrow, as so commonly posited. We are also the leaders of today, with the majority of young people working, often informally, in the agrifood sector. Why are youth in agriculture so elusive? As the Director of the youth network Young Professionals for Agricultural Development (YPARD), with a network reach of over 30 000 young professionals around the world, Genna Tesdall will provide perspectives on the common barriers to youth engagement in agriculture.

Keywords: Agrifood sector, youth engagement in agriculture.

ACTION RESEARCH IN ESTABLISHING LOCAL GOVERNANCE: opportunities and challenges based on the prosuli project
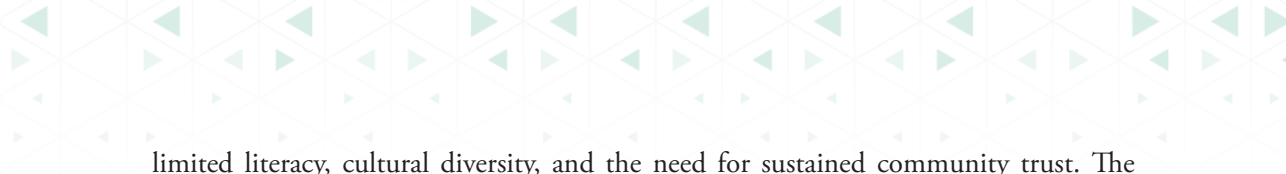
Nícia Givá[1] | 3ngiva@gmail.com

Joaquim Bucuane[1], Abel Chilundo[2], Raphael Ducrot[3], Alex Caron[3]

[1]Faculty of Agronomy and Forestry Engineering, Universidade Eduardo Mondlane, Mozambique

[2]Faculty of Veterinary, Universidade Eduardo Mondlane, Mozambique

[3]Centre De Coopération Internationale en Recherche Agronomique Pour le Développement (CIRAD)

This intervention addresses the role of action research in establishing effective local governance, drawing insights from the ProSuLi (Promoting Sustainable Livelihoods) in communities within Transfrontier Conservation Areas (TFCAs) project. Action research, characterized by its participatory and iterative nature, is pivotal in developing governance structures that resonate with community needs. The ProSuLi project, with its emphasis on sustainable livelihoods consistent with conservation objectives, offers a practical context for understanding the intricacies of local governance. The experience identifies several opportunities afforded by action research, such as enhancing community engagement, improving decision-making processes, and fostering sustainable development. A key focus is on addressing challenges related to limited literacy within communities, which often obstructs effective participation in governance. By tailoring interactions tools and techniques, communication strategies and capacity-building efforts, the project has managed to involve even the most marginalized groups in governance processes. Furthermore, the research explores the impact of social and cultural contexts on local governance. These factors, deeply rooted in community identity, influence the acceptance and effectiveness of governance initiatives. The project underscores the importance of respecting and integrating local customs and social norms to build governance structures that are both culturally relevant and widely accepted. Community trust is highlighted as a critical element for the success of local governance. The ProSuLi project demonstrates how action research can help build trust by ensuring transparency, inclusivity, and responsiveness in governance processes. However, challenges remain in sustaining this trust, particularly in communities with a history of distrust towards external interventions. The findings suggest that while action research can significantly advance local governance, it must be adapted to address specific challenges, including

limited literacy, cultural diversity, and the need for sustained community trust. The ProSuLi project provides valuable lessons on navigating these complexities to achieve meaningful and lasting governance outcomes at the local level.

Keywords: Action research, Promoting Sustainable Livelihoods.

ASSESSING INVESTMENT PRIORITIES FOR DRIVING INCLUSIVE AGRICULTURAL TRANSFORMATION IN TANZANIA

Emerta Aragie, Rui Benfica, Karl Pauw, Josee Randriamamonjy, and James Thurlow

International Food Policy Research Institute

This study utilizes a recursive dynamic general equilibrium model calibrated with data for Tanzania to explore the link between agricultural and rural development spending and four development outcomes: economic growth, job creation, poverty reduction, and diet quality. Results show that no single expenditure option is the most effective in achieving all four desired development outcomes for Tanzania. Productivity-enhancing agricultural interventions in horticulture are effective at generating growth in the agri-food system (AFS) and improving diets but have a limited effect on employment. Supporting cereal producers has large effects on growth and poverty reduction, with relatively high returns per dollar invested, but its effect on diet quality is weak. Providing livestock services to milk and poultry farmers consistently ranks high across the outcome indicators, with strong employment effects on downstream AFS. Crop research and development and feeder roads generate moderate impacts on all four outcomes. Partially reallocating the budget towards the most cost-effective spending options can substantially increase the development effectiveness for Tanzania of agriculture sector support expenditures. The approach adopted in this study can help policymakers design and prioritize agricultural interventions and expenditure portfolios that better reflect the country's broad food system.

Keywords: Agri-food system, general equilibrium model.

INCLUSION FOR MARKET INVOLVEMENT OF WOMEN AND YOUTH IN AGRICULTURE

Fátima Dias

The Feed the Future - Resilience Integrated in Nutrition and Agriculture (FTF RESINA)

FTF RESINA is a 5-year Activity funded by USAID in Mozambique (2022-2027). The goal of FTF RESINA is to increase the resilience of smallholder farmers (SHF) and rural households in selected districts of Zambezia and Nampula provinces. Three of the six sub-intermediate results over the life of the Activity include: Increased productivity of smallholder farmers; Increased profitability of agriculture enterprise; Increased use of sustainable climate change adaptation approaches in agriculture. Gender, youth and social inclusion and the empowerment of women and youth are key cross-cutting themes of the Activity. Formative research and a Gender, Youth and Social Inclusion study conducted during the start-up phase of the Activity revealed that despite the dominant role that women play in the agricultural sector, they continue to face significant barriers and inequalities that limit their productivity and the profitability of their agricultural enterprises. Persistent gender inequities in access to productive resources and technologies, combined with gender-differentiated capacities to adapt to climate change, not only diminish women's resilience but also undermine the overall sustainability of food systems. Moreover, while the agricultural sector holds significant potential to address the pressing issue of high youth unemployment affecting many African countries, including Mozambique (18% in 2022), like women, young people face age-specific challenges that hinder their ability to capitalize on opportunities within the sector, such as restricted access to productive and financial resources and limited opportunities for skill development and entrepreneurship. Evidence suggests that young people are increasingly drawn to innovative agricultural practices and possess high levels of digital literacy. Recognizing the link between these gender/age-related issues and the sustainability of the agricultural sector on one hand, and on the other hand to ensure that it achieves its overall goal/results, FTF RESINA is deploying cutting-edge and gender transformative strategies and practical approaches to address gender and age-specific barriers in the agricultural sector and to empower women and youth in Northern Mozambique. During this conference we would share practical and innovative solutions/approaches in line with the following sub-topics under Theme 3 of the conference:

a) **Gender Inclusivity in Access to Resources, Training, and Market Opportunities:** By adopting a gender and youth inclusive lens in the establishment of Farm Field Schools, and in the design and delivery of capacity building and trainings

on best agricultural practices, targeting farmer groups/association with gender sensitization trainings, and facilitating inclusive business models/networks with input distribution companies, FTF RESINA has contributed to increased and gender equitable access agriculture-related knowledge/capacities for women SHFs, facilitated their access to productivity enhancing and climate resilient agricultural inputs, as well as linkages with output distribution and marketing networks. The overall impact has been an increase in the profitability of their agricultural enterprises.

b) **Gender-Inclusive Strategies for Technology Adoption and Financial Literacy:** The project has spearheaded groundbreaking initiatives to enhance access to critical financial, productive, and technological resources, essential for increasing agricultural productivity and the profitability of agricultural enterprises for women and youth. By leveraging partnerships with financial institutions and microcredit programs, FTF RESINA delivers targeted support and facilitates crucial access to credit and funding for agribusiness ventures. Through tailored financial inclusion efforts, both women and youth have dramatically expanded their productive capacity. The increased access to loans and microcredits, coupled with access to cutting-edge technologies and specialized agribusiness expertise, has empowered young farmers and entrepreneurs under FTF RESINA to boost their productivity, scale their agribusiness ventures, be more market competitive, and to shift from subsistence farming to profitable agricultural models.

c) **Youth Engagement in Agriculture:** The FTF RESINA project takes a comprehensive approach to engage youth in agriculture by delivering specialized training in advanced practices and technologies. This includes access to cutting-edge equipment and high-quality inputs, covering key areas such as sustainable cultivation, advanced irrigation, and integrated pest management. The goal is to equip young farmers with the expertise and innovative tools to tackle modern agricultural challenges, enhance productivity, and improve market competitiveness. By facilitating connections with agrodealers for superior seeds and providing financial support through grants and microcredits, the project boosts production capacity and market access. Additionally, the establishment of business incubators and acceleration programs has fostered innovation and entrepreneurship among youth, contributing to sustainable development and strengthening food system resilience.

Overall, by promoting gender and youth equitable access to technical training, in the distribution of climate resilient crop varieties and inputs and sustainable agricultural technologies and output markets, FTF RESINA technologies has contributed to increased adoption of sustainable agricultural practices, resulting to increased productivity and profitability of agriculture, and consequently increased economic empowerment of

women and youth. FTF RESINA's approaches have also significantly contributed to increased agency for women by amplifying their visibility as leaders and by actively involving women in decision-making and enhancing the representation of marginalized groups in local agricultural groups (e.g. producer groups). These advancements are not only strengthening the resilience of food systems but are also driving inclusive and sustainable agricultural sector growth.

SYMPOSIUM: PRODUCTION SYSTEMS

AGROECOLOGICAL INTENSIFICATION OF MIXED CROP LIVESTOCK PRODUCTION SYSTEMS OF SUBSAHARAN AFRICA: the need for biophysical agronomy to engage more into integrated assessments of agricultural systems

François Affholder[1,2] | francois.affholder@cirad.fr

Sebastião Famba[2], Regis Chikowo[3], Gatien Falconnier[1,2,3,4] and Juliette Lairez[1]

[1]AIDA, Univ Montpellier, CIRAD, Montpellier, France

[2]Universidade Eduardo Mondlane, Faculdade de Agronomia e Engenharia Florestal, Maputo, Mozambique

[3]Department of Plant Production Sciences and Technologies, University of Zimbabwe, Harare, Zimbabwe

[4]International Maize and Wheat Improvement Centre (CIMMYT)-Zimbabwe, Harare, Zimbabwe

Mixed crop livestock systems under semi-arid to subhumid climate of Sub-Saharan Africa largely predominate on the continent. Farm households belonging to this category of agricultural systems are the poorest on the planet. Crop yields in these farms are extremely low compared to the potential allowed by the climate - including rainfall- and the physical properties of soil, i.e. they are characterized by a large "yield gap", that constitutes a poverty trap. Large yield increase is thus possible in these farms, and there is a consensus that it could be a major leeway to help these households out of poverty and have their farms contributing to food security at every level from local to global. Conciliating this intensification of agriculture with its environmental and social sustainability, i.e. aiming at its multi-dimensional sustainability, is the object of the "agroecological intensification", a variant of the "agroecological transition" specific to this case with currently high yield gaps. However, two classic (but often overlooked) trade-offs need to be addressed for achieving agroecological intensification. The first one is the trade-off between low food prices and decent income of farmers. Low food prices are obviously antagonist to the income of farmers and are needed by consumers, especially in societies with large urban populations. The second trade-off is between ecosystem services: increasing the provisioning service (i.e producing more food, fuel, fodder or fibre) is necessarily at the expense of most other ecosystem services. The most conventional target of agronomic research when focusing at cropping system or production system level is to develop agricultural technology that would help reduce

these trade-offs. From studies we carried out with family farms in Latin America, Asia, and Africa, we extract examples of integrated sustainability assessments applied to currently observable mixed crop livestock production systems, as well as – ex ante then - to possible scenarios for their intensification. These examples show that the two trade-offs above are extremely dependent on the context, meaning the biophysical and economic environment of farms. They also illustrate how it is not likely that technology alone will resolve the trade-offs and that agricultural policy instruments are strongly needed. From these examples we also suggest biophysical agronomy should more directly engage into policy assessment and design, through collaborations with social sciences. The conceptual framework of integrated sustainability assessment is particularly well adapted to this end, especially when mobilizing both formal simulation models and participatory approaches.

Keywords: Agroecology, agricultural intensification, research methods, sustainability.

CROP SCIENCE FOR AGROECOLOGICAL INTENSIFICATION OF AFRICAN AGRICULTURE: lessons and perspectives

Rashid Serraj

Director of Africa Initiative and Strategy for agriculture, water and climate at Mohammed VI Polytechnic University (UM6P), Morocco

African agriculture faces the critical challenges of enhancing food security and ensuring environmental sustainability amid a rapidly changing climate. Agroecological intensification presents a promising approach to achieving high agricultural productivity while safeguarding ecosystem health. This paper delves into the pivotal role of crop science in advancing agroecological intensification, with a particular emphasis on previous work carried out with CGIAR centres across Asia and Africa. By 2050, global food production must increase by 70% to feed a projected 9 billion people, yet food production per capita in regions such as Sub-Saharan Africa remains stagnant, akin to levels from the 1960s. The doubling of global crop yields from the 1960s to the late 1990s was accompanied by unsustainable increases in nitrogen fertilizer, phosphorus use, and irrigation. Given these trends, new forms of agricultural intensification are essential, particularly in the least-favored regions that were bypassed by the Green Revolution. Agroecological principles, which harness the natural functionalities of ecosystems, are increasingly recognized as a sustainable path forward. Previous research on crop drought tolerance in rice and other crops, symbiotic nitrogen fixation by tropical food legumes, breeding strategies for developing drought-resilient crop varieties highlight the importance of genetic diversity in maintaining productivity under water stress, a crucial consideration as climate change exacerbates drought conditions. Studies on symbiotic nitrogen fixation offer sustainable alternatives to synthetic fertilizers, enhancing soil health and reducing environmental impacts. Furthermore, insights into agricultural resilience advocate for integrating crop improvement with soil and water management practices, enhancing the overall resilience of farming systems. These scientific advances must be contextualized within the broader challenges of scaling agroecological practices. Recent efforts in regions like Sub-Saharan Africa have shown promise, but significant challenges remain, such as how to effectively scale these practices across diverse socio-economic and environmental landscapes. The integration of modern tools, such as precision agriculture and digital technologies, offers potential pathways to overcoming these challenges. However, adapting these technologies to smallholder farmers, who are the backbone of African agriculture, remains a significant hurdle. Through a review of

successful case studies and a critical analysis of existing research gaps, this paper presents perspectives on the future trajectory of crop science in supporting sustainable agricultural intensification across Africa. We argue for a holistic approach that combines scientific innovation with practical, field-level application, ultimately enhancing the resilience and productivity of African farming systems. This work contributes to the broader discourse on agroecological intensification by highlighting the crucial intersection of crop science, ecological principles, and sustainable development.

Keywords: African farming systems, agroecological intensification, Green Revolution.

THE ROLE OF AGRICULTURAL SYSTEMS RESEARCH IN MOZAMBIQUE AND THE NEED FOR AN INTEGRATED APPROACH TO GUARANTEE ADOPTION BY SMALL SCALE FARMERS: RESEARCH, EXTENSION, MARKETS

Marcos Freire

This presentation will focus on the connection from agricultural research and the adoption of new technologies. Over time we witnessed the difficulties of new technologies to be accepted and adopted by small scale farmers in Mozambique and elsewhere. It is common knowledge that a more efficient integrated approach is required in order to guarantee that research is actually answering the needs of farmers is required so that new technologies will result in higher yields, quality and incomes, therefore contributing to the betterment of life in the rural areas. In this presentation we will look into the major constraints faced in the process of technology adoption, and in the need for an integrated approach linking the needs of farmers, agricultural research and adoption of new technologies will establishing strong links between agricultural research, rural extension and strengthening agricultural markets.

SYMPOSIUM: RESILIENCE

AGRICULTURAL CHALLENGES IN THE FACE OF CLIMATE CHANGE IN AFRICA

Almeida Sitoe

Faculdade de Agronomia e Engenharia Florestal, Universidade Eduardo Mondlane, Mozambique

Agriculture is practiced and conditioned by a region's soil and climate conditions. In Africa, agriculture is mostly practiced using traditional slash-and-burn techniques where soil productivity is recovered through ecosystem succession and natural nutrient fixing. Increasing population density has posed limits in land access, thus reducing the fallow cycle to non-sustainable levels, leading to land degradation and low productivity. Attempts to overcome this problem include the use of inorganic fertilizers to restore productivity, but the use of these agrochemicals has also been limited in the continent. On the other hand, while Africa contributes only 3.9% of the greenhouse gas emissions that cause climate change, it is the most vulnerable, and agriculture will suffer the most from the impacts of climate change. The Sixth IPCC Report projections suggest that future climate in most African regions will result in more frequent and severe droughts, wildfires, heavy rains, soil erosion, saline intrusion, and increased and new pests and diseases. Some of these impacts will act in combination and cause low productivity and severe crop losses. The combination of changing climate conditions and soil degradation is expected to exacerbate the already low-productivity agriculture and increase crop losses. A system analysis of the process suggests negative feedback loops that will increase the vulnerability of African agriculture. Research has been carried out to provide potential solutions to restore soil nutrients and adjust cropping systems to the new climate conditions. Agroforestry systems, regenerative agriculture, and Conservation Agriculture based on Sustainable Intensification (CASI) are among the innovative techniques proposed to improve agriculture conditions. The implementation of these technologies faces challenges of technology adoption, financing, and scale-up.

WHY IS BIODIVERSITY DATA IMPORTANT?

Julius Ecuru and Matthew Cassett

JRS Biodiversity Foundation

Biodiversity and natural ecosystems form the basis of all life on Earth, and are critical to sustaining natural processes, agricultural food production, many livelihoods and the quality of our soil, water and air. Sadly, African biodiversity is the least well-documented of any continent, with many regions having few or no current baseline data on species occurrence for many taxonomic groups. Flora, insects, freshwater fauna, pollinators and smaller mammals are among the least known groups, but even higher animals remain poorly known in some areas with outdated information on record. JRS Biodiversity Foundation is dedicated to supporting African biodiversity researchers. We know that support (equipment, infrastructure and funding) is not evenly available to experts, specialists and students doing critical field work to share information on biodiversity. Southern Africa, and Mozambique in particular is a megadiversity zone with many endemic, extraordinary and poorly known wildlife species. But countries such as Mozambique often show poor participation in calls for proposals and grants. For this reason, we would like to suggest ways to encourage agronomists, biologists and other scientists to seek out support and include biodiversity research in their activities and ongoing projects.

AFRICAN AGRICULTURE IN A CHANGING CLIMATE:
challenges for adaptation and resilience

Makoala V. Marake

Faculty of Agriculture of the National University of Lesotho, Lesotho

African agriculture is facing unprecedented challenges due to the impacts of climate change, which threaten food security, livelihoods, and economic stability across the continent. The region is particularly vulnerable due to its reliance on rain-fed agriculture, limited adaptive capacity, and existing socioeconomic stressors. This abstract explores the multifaceted challenges that African agriculture confronts in the face of climate change and highlights the need for robust adaptation and resilience strategies. Key challenges include increasing temperatures, erratic rainfall patterns, prolonged droughts, and more frequent extreme weather events, which collectively diminish crop yields, reduce arable land, and exacerbate water scarcity. These climatic shifts are further compounded by land degradation, loss of biodiversity, and the spread of pests and diseases, all of which undermine agricultural productivity. In response to these challenges, adaptation strategies must be multifaceted, integrating traditional knowledge with innovative technologies. Approaches such as climate-smart agriculture, sustainable land management practices, and improved water management are crucial. Additionally, strengthening agricultural research, enhancing access to climate information, and fostering policy frameworks that support smallholder farmers are essential to building resilience. However, the successful implementation of these strategies faces barriers such as limited financial resources, inadequate infrastructure, and weak institutional support. Addressing these obstacles requires coordinated efforts at local, national, and international levels, involving a wide range of stakeholders, including governments, NGOs, the private sector, and local communities. This abstract underscore the urgency of prioritizing adaptation and resilience in African agriculture to mitigate the adverse effects of climate change. By adopting a comprehensive and inclusive approach, African nations can better safeguard their agricultural systems and secure the livelihoods of millions of people dependent on this critical sector.

CARBON TRADING OPPORTUNITIES IN AGRICULTURE:
experience from Tanzania

Eliakimu Mnkondo Zahabu

National Carbon Monitoring Centre (NCMC), Tanzania

Climate change that is caused by concentration of greenhouse gases in the atmosphere, is a global concern manifested through increase seasonal variation in rainfall and temperature, drought and floods. In response to the situation the United Nations formed the United Nations Framework Convention on Climate Change of 1992; Kyoto Protocol of 1997; and Paris Agreement of 2015. These treaties among other things provide mechanism for parties to meet their emission reduction commitments but also benefit from carbon credits trading. Countries that ratified these treats have policy and legal frameworks particularly Nationally Determined Contributions that outline priority sectors for climate change mitigation and adaptation actions. In this talk, I will outline the priority sectors identified in Tanzania in order to meet national mitigation targets in relation to carbon trading. The agricultural sector is an important catalyst for economic growth, poverty alleviation, and food security in the United Republic of Tanzania. However, the sector is severely affected by climate change and therefore requires appropriate measures. Potential investment areas for carbon trading projects in this sector include the application of Climate Smart Agriculture practices such as improved tillage, soil erosion control, mulching, use of manure, improved fodder production, grazing management, water harvesting, agroforestry, conservation agriculture, cover cropping, integrated agro-aquaculture and integration of biogas energy into farms and other investments geared to reduce generation of greenhouse gases in the agricultural sector.

SPECIAL SESSIONS

Special Session I: Opportunities And Constraints For The Adoption Of Irrigation As A Resiliency Enhancing Technology

Special Session II: Agricultural Innovations For A Sustainable And Resilient Agri-Food System

Special Session III. Resilient And Inclusive Agrifood Systems: The Work Of Socodevi With Cooperatives In Africa

Special Session IV: Agriculture Insurance: Ongoing Efforts To Strengthen Rural Farmers Resilience In Local Food Systems

Special Session V: Biotechnology And Ofam-Mozambique

SPECIAL SESSION I: OPPORTUNITIES AND CONSTRAINTS FOR THE ADOPTION OF IRRIGATION AS A RESILIENCY ENHANCING TECHNOLOGY

Organized by:

Feed The Future - Resilience Integrated In Nutrition And Agriculture (FTF RESINA)

OPPORTUNITIES AND CONSTRAINTS FOR ADOPTING IRRIGATION AS A RESILIENCE ENHANCING TECHNOLOGY IN NAMPULA AND ZAMBÉZIA

The Feed the Future Mozambique Resiliência Integrada na Nutrição e Agricultura Activity (FTF RESINA), Nampula, Mozambique

The Feed the Future Mozambique Resiliência Integrada na Nutrição e Agricultura Activity (FTF RESINA) is a five year integrated agriculture, WASH (Water, Sanitation and Hygiene) and nutrition activity, funded by USAID in Mozambique (2022-2027, aimed to strengthen the ability of communities and systems in select communities in Nampula and Zambezia to absorb, adapt to, and transform to the frequent shocks and stressors they face.). Three of the six sub-intermediate results over the life of the Activity include: Increased productivity of smallholder farmers; Increased profitability of agriculture enterprise; Increased use of sustainable climate change adaptation approaches in agriculture. Gender, youth and social inclusion and the empowerment of women and youth are key cross-cutting themes of the Activity.

FTF RESINA has implemented training programs aimed at strengthening the technical and leadership skills of women, young people and people with disabilities. These programs are designed to improve agricultural production and productivity by promoting sustainable and innovative practices. Secondly, the project has facilitated access to financial, productive and technological resources, which are crucial for the implementation of new agricultural techniques that promote the expansion of subsistence agricultural activities for income generation. Through financial institutions and micro-credits, FTF RESINA has provided direct support and facilitated access to credit and financing for agribusiness initiatives with an emphasis on women, young people and people with disabilities, opening up new market opportunities and connecting women and young producers to distribution and marketing networks. This approach has contributed to increasing the visibility of female leadership by encouraging the active participation of women in decision-making processes, promoting greater representation and influence of marginalized groups in local agricultural policies and practices. As primary results, it is notable that the main businesses embraced by women and supported by FTF RESINA fall within the food and nutrition sector, thus contributing to the availability of and access to nutrition-sensitive food in their communities. In addition, support for financing and access to credit has enabled women and young people to expand and strengthen their businesses in the food and nutrition sector. This financial

support not only expands their participation in the market, but also improves their financial capacity and sustainability. The combination of these factors results in greater economic inclusion and a greater participation and influence of women and young people in agricultural practices and local policies, reflecting a more equitable approach. In our presentation during the conference, we will highlight success stories and lessons learned, with a focus on the strategies adopted so far.

Over the course of two years of implementation, the Activity has analysed several systems, including irrigation, to discover barriers to commercialization and opportunities to improve agriculture production (theme 1), resilience (theme 2), and inclusion (theme 3).

The Activity seeks to present the opportunities and constraints for the adoption of irrigation as a resilience-enhancing technology by rural communities in Nampula and Zambezia provinces through a Market Systems Development Approach. The session will highlight the following:

- The current structure of the irrigation value chain, including current actors engaged and their degree of connectivity with farmers.

- Constraints such as the low availability of irrigation technicians mainly at district and locality level, limited access to inputs and technical assistance that guarantee the operation, maintenance and improvement of irrigation.

- The irrigation technologies that are currently being promoted in both provinces

- Irrigation equipment financing opportunities and limitations including results from a cost benefit analysis for investments required.

- Vision for unlocking irrigation potential, including strengthening input and output markets.

Keywords: Irrigation, local food systems, market systems development, resilience.

SPECIAL SESSION II: AGRICULTURAL INNOVATIONS FOR A SUSTAINABLE AND RESILIENT AGRI-FOOD SYSTEM

Organized by:

The International Agricultural Research Centers in Partnership with AID-I Mozambique

AGRICULTURAL INNOVATIONS FOR A SUSTAINABLE AND RESILIENT AGRI-FOOD SYSTEM

Stephen K. Boahen1 | s.boahen@cgiar.org

Carlos Malita[1], Abdul Naico[2], Maria Andrade[2], James Mwololo[3], Wilson Leonardo[4] and Alexis Ndayiragije[5]

[1]International Institute of Tropical Agriculture (IITA), Nampula, Mozambique

[2]International Potato Institute (CIP), Maputo, Mozambique

[3]International Crop Research Center for Semi Arid Tropics

[4]International Fertilizer Development Center (IFDC), Maputo, Mozambique

[5]International Rice Research Institute, Maputo, Mozambique

Agriculture production in sub-Saharan Africa is dominated by small-scale farmers who rely on low-input, rain-fed and subsistence farming practices. The sector is characterized by low productivity largely attributed to limited access to quality seeds of high-yielding and resilient varieties and other yield-boosting innovations. Climate change resulting in extreme weather events including frequent droughts, floods, high temperatures, cyclones and the spread of invasive pests (e.g., desert locusts and fall armyworm) limits crop productivity. The global supply chain disruptions inflicted by the COVID-19 pandemic on input and output markets significantly affected smallholder farmers and was exacerbated by the Russia-Ukraine war leading to drastic increases in food, fertilizer and fuel prices further reducing poor household's adaptive capacity. Therefore, concerted efforts are needed to increase access, availability and use of inputs and technologies to sustainably increase productivity, market access and income and thus improve food and nutrition security and resilience to climate change and other external shocks. Increased productivity will create opportunities for women and youth in agribusiness and promote inclusive economic growth contributing to poverty reduction. The objectives of the special session are to: i) discuss proven agricultural innovations for sustainable and equitable increase in smallholder productivity, market access and improve consumption of nutritious food; ii) discuss ways to increase availability and accessibility of proven agricultural innovations to men, women and young farmers; iii) show-case technologies and innovations available and bundling of innovations for climate adaptation; and iv) promote platforms and linkages that bring together key stakeholders to enable problem identification, contextualization of solutions, adoption and scaling of feasible technologies. In this session, panelists will discuss proven technologies and innovations

that are readily available and affordable to farmers. They will explore approaches and models to accelerate innovation delivery to smallholder farmers. Partnerships with last mile scaling partners leveraging on their scaling network critical to reaching many beneficiaries will be discussed. Digital tools for tracking and diagnosing constraints and increasing access to markets, information, credit and other services will be explored. Panelists will elaborate on some of the drivers of successful delivery of agricultural innovations at scale and major issues that must be addressed as well as model that will assist in reaching more women and youth. It is expected that participants will learn, share experiences and broaden their knowledge on available technologies and innovations with the greatest potential to reduce the severity of climate change and improve productivity and profitability of smallholder farmers.

Keywords: Climate change, productivity, technology delivery.

SWEETPOTATO RESEARCH AND INNOVATIONS FOR A SUSTAINABLE AND RESILIENT FOOD SYSTEM

Maria I. Andrade and Abdul Naico

International Potato Center, Maputo, Mozambique

The agricultural sector in Africa is already experiencing the negative impacts of climate change which has serious implications for food security among smallholder farmers. Sweet potato (Ipomoea batatas. L) is a resilient food crop with great potential to contribute to reduced hunger. It plays a critical food role on nutrition security in Southern Africa, a region prone to drought and other calamities posed by climate change. Low genetic gains have been realized in farmer's fields due to factors such as unpredicted drought timing, intensity, severity and duration, and incomplete understanding of target population of environments, market segments and preferred end user traits. Climate change require innovative solutions generated from sweetpotato breeding and research. Breeding process should be accurate, predictable, and responsive to end user requirements, and the program has been harnessed through breeding to increase drought tolerance, vitamin A, iron, and zinc content, virus resistance and climate resilience for the African food needs. Modernization of breeding targeting population improvement, cultivar development and capacity building of partners is revolutionizing the adoption and impact of released sweetpotato varieties. Sweetpotato breeding programs have designed their programs based upon marketing studies, product profiles and well-defined breeding schemes with both population improvement and product development. Excellence in breeding operations (SOPs) and digital tools for data collection have been adopted. Also, development of standard operating procedures for cooking quality analysis including descriptive sensory analysis, texture analyzer, optimal cooking time, water absorption and NIRS are on-going. Hybrid breeding achieved via crossing parents from two inter-gene pools have been adopted following per se selection. Data management and curation in SweetPotatoBase improved the information flow among sweetpotato programs. Direct exchange of improved clones and capacity development of partners have helped in the release of more than 100 improved sweetpotato varieties in 16 SSA countries.

Keywords: Climate change, cultivar development, modernization, population improvement.

SPECIAL SESSION III: RESILIENT AND INCLUSIVE AGRIFOOD SYSTEMS: THE WORK OF SOCODEVI WITH COOPERATIVES IN AFRICA

Organized by:

Josina Nhantumbo, Coordinator for Gender Equality SOCODEVI Mozambique

Andreé-Anne Cotê-St-Laurent, Policy and Advocacy Adviser, SOCODEVI Canada

RESILIENT AND INCLUSIVE AGRICULTURAL FOOD SYSTEMS

Josina Nhantumbo | j.nhantumbo@socodevi.org

Andrée-Anne Côté-St-Laurent | aa.cotestlaurent@socodevi.org

As the world faces unprecedented challenges due to escalating food insecurity, rapid climate change and the growing impact of urbanization, the need to transform our agri-food systems has never been more urgent. In the specific case of Mozambique, around 3.15 million people face acute food insecurity, with 400,000 in a critical situation, especially in regions affected by conflicts such as Cabo Delgado according to the Technical Secretariat for Food Security and Nutrition (2023). The situation is exacerbated by prolonged droughts and irregular rainfall, direct consequences of climate change, which seriously affect agricultural production and rural livelihood. The World Food Program (WFP) highlights that 54% of people cannot afford a nutritious diet in Mozambique which ranked 185th out of 191 countries in the 2021 Human Development Index, 106th out of 116 in the 2021 Global Hunger Index and 136th out of 170 in the 2021 Gender Gap Index. SOCODEVI, committed to strengthening cooperatives and community resilience, works in different regions of Africa so that agri-food systems are not only resilient, but also inclusive. Through programs that aim to train and empower women and young people, SOCODEVI contributes significantly to food security and sustainable development on the continent. In Mozambique and other African countries, the organization supports the creation of value throughout the food chain, helping communities to face and overcome current and future challenges. Special attention is given to the differentiated impact of agri-food systems on women, highlighting their crucial role and the need of training for enhancing their resilience and reducing the inequalities. An approach focused on resilient agri-food systems aims to balance economic, social and environmental interests with improved, sustainable food security, thus supporting their effort to adapt to future challenges. With this panel, SOCODEVI seeks to explore and share strategies (and perspectives) with the public to build (or strengthen) agri-food systems that are not only resilient but also inclusive, ensuring that women, youth and other vulnerable groups are actively engaged and benefited. Together we can build a more sustainable, equitable and prosperous future for everyone.

Keywords: Food security, inclusion and gender equality, resilience.

SPECIAL SESSION IV: AGRICULTURE INSURANCE: ONGOING EFFORTS TO STRENGTHEN RURAL FARMERS RESILIENCE IN LOCAL FOOD SYSTEMS

Organized by:

The Feed the Future Mozambique Resiliência Integrada na Nutrição e Agricultura Activity (FTF RESINA)

ENHANCING AGRICULTURAL INSURANCE AFFORDABILITY THROUGH RISK POOLING

The Feed the Future Mozambique Resiliência Integrada na Nutrição e Agricultura Activity

(FTF RESINA)

The agricultural sector is the backbone of the economy, contributing approximately 24% of Mozambique's Gross Domestic Product (GDP). The agriculture sector employs more than 70% of the total population. However, due to climate change, agricultural risks are becoming more unpredictable and severe as witnessed during the fall armyworm infestation in 2019 and the drought of 2023/24 which was attributed to El Nino. The cost of this is not only a loss of livelihoods and risks of starvation in some communities, but the unpredictability also means that farmers are weary about investing in their farms. This has led to stagnation of agricultural productivity in recent years as Smallholder farmers and agricultural enterprises continue to face challenges growing their businesses and improving the quality of agricultural goods. As a consequence, food imports have increased from 10 to 17% of goods imported over the last decade. In turn, this has increased the country's vulnerability to global food supply shocks such as the one we are currently experiencing.

Pula is an insure-tech company that provides agriculture insurance design and execution services, specializing in index based insurance that offers comprehensive coverage based on yield performance, protecting smallholder farmers against multiple perils, including drought, frost, floods, hurricanes, plant diseases, and pests. Pula brings together governments, insurers, re-insurers, and various types of development partners to support smallholder farmers in adapting to the increasingly changing climate. We use technology to insure the previously unbanked, uninsured, untapped market of 1.5 billion smallholder farmers (SHFs) worldwide.

We use innovative technology to assess damages quickly, provide digital tools and agronomy advisory services to improve farming practices. By embedding insurance with inputs that farmers need, we are increasing the adoption of insurance and improving the distribution channels. We aim to enable all farmers in Africa to access insurance and achieve yields similar to those of developed economies, sustaining their livelihoods.

Since inception, Pula has provided agri insurance to 15.6mln farmers, with $2.2bln Sum Insured and a total payout of $42M to the insured farmers. Other key statistics include;

- 92M USD in premium paid

- 6.2mln Ha insured

- 1mln + farmers paid

Our growth plans are to increase our coverage to 100 million smallholder farmers globally by providing up to $20 billion insurance coverage by 2026, while continuing to enhance its actuarial and technological products for existing and new markets using big data and machine learning. The company plans to strengthen institutional partnerships to expand into new markets and agricultural services where our technology and business model can be applied. Pula will also engage in research and public policy development to advocate for input adoption, yield increases, and income generation for smallholder farmers worldwide.

In Mozambique, Pula in partnership with FTF RESINA is conducting a pilot to offer area yield index insurance (AYII) to 7000 farmers in Gurue, Namarroi and Magovolas districts in Zambezia and Nampula provinces. The primary objective of the pilot is to test whether agriculture insurance would enhance resilience of smallholder farmers within the local food systems.

Index insurance products can be provided to smallholder farmers and cover a wide range of risks including **drought, windstorm, excessive rainfall, heatwave, hail, flood, locusts, pests, and diseases, and drought-related germination failure**, providing comprehensive protection to Sub-Saharan farmers.

Traditionally, agricultural insurance has been unaffordable for the average SHF in Africa, closing off climate adaptation solutions to the most vulnerable. Through our study of past agricultural insurance pilots across Africa, we find consistent features that have contributed to making them unsuccessful:

- **Small target groups:** pilots typically focus on a relatively small farmer population and are geographically limited to a few specific locations. This is particularly common with agricultural insurance solutions funded by development partners, who often target only their program intervention areas, which are inherently high-risk (e.g., drought-prone regions, refugee settlements, etc.).

- **Development partner dependent:** programs usually rely heavily on funds and execution development partners with limited involvement from government, making them unsustainable.

- **Single peril cover:** most pilots are single peril index to weather or vegetation levels, which fail to address the multiple sources of risks farmers face.

- **Stand-alone insurance sales:** unsuccessful pilots relied on trying to sell insurance to SHFs directly without bundling or embedding it with other existing services farmers already utilize.

- **High premium rates:** all the features above contribute to a high premium rate, which are unsustainable without constant subsidization.

With this understanding, Pula's approach to agricultural insurance addresses each of the challenges stated above:

- **Diversified target groups:** In the many African countries where we operate, we advocate for diversifying target groups to spread risks across both high-risk groups (e.g., SHFs in drought-prone areas) and medium/low-risk groups (e.g., SHFs in less vulnerable areas). By pooling risk in this manner, the cost of premiums is reduced.

- **Partial subsidization for initial adoption:** Development partners and donors play a crucial role in the early adoption of agricultural insurance for SHFs. Through awareness training and advocacy in this initial phase, smallholders begin to recognize the benefits of agricultural insurance and, at the right price, choose to pay for it themselves, ensuring its long-term commercial viability.

- **Multi-peril product:** Our Area Yield Index Insurance (AYII) product covers all causes of systematic crop risks including drought, flood, windstorm, hail, frost, excess rainfall, heatwave, pests, and diseases etc. This coverage, unlike single peril products, covers against risks occurring over the entire agriculture season.

- **Embedded insurance:** we embed insurance with services that farmers already utilize such as inputs or credit, therefore we work extensively with agro-dealers and MFIs/banks.

- **Low premium rates:** each of the approaches above contribute to lowering the premium rate. For example, in Ethiopia, through this approach, we were able to decrease the premium rate from the traditional $30 to $6.

As climate change increasingly threatens the livelihoods and productivity of smallholder farmers across Africa, it is urgent to establish a coordinated approach among governments, the private sector, and development partners to deliver appropriate agricultural insurance products to the most vulnerable at an affordable price.

Keywords: Agricultural risks, agricultural insurance, smallholder farmers across Africa.

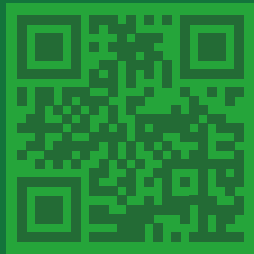# SPECIAL SESSION V: BIOTECHNOLOGY AND OFAM-MOZAMBIQUE

Organized by:

African Agricultural Technology Foundation (AATF)

BIOTECHNOLOGY AND OFAM-MOZAMBIQUE

African Agricultural Technology Foundation (AATF)

The Mozambique Agricultural Research Institute (IIAM) is a public research institution that works on research and transfer of agricultural technologies in the country. In its work, IIAM has used biotechnological techniques for research and development of its technological products. Biotechnology is one of the technological developments that have transformed agricultural production around the world over time. It is a set of techniques for manipulating microorganisms with the aim of obtaining specific or modified products. Biotechnology in agriculture leads to greater efficiency and crop safety. Biotechnology can contribute to increasing productivity, improving plant quality and increasing the nutritional value of food. Additionally, it can help breed species that are more tolerant to pests and diseases and reduce dependence on chemicals. It can also contribute to the development of crop varieties more adapted to different climatic and soil conditions. However, agricultural biotechnology is still a relatively little explored science and its benefits are little utilized, especially in Africa. For greater advocacy on Biotechnology, the Open Forum on Agricultural Biotechnology in Africa (OFAB) Project was established, which facilitates the conduct of constructive dialogues between key actors and decision-makers on agricultural biotechnology. For both policymakers and the general public, OFAB facilitates quality commitments on the safety and benefits of modern biotechnology. OFAB is an African Agricultural Technology Foundation (AATF) project funded by the Bill and Melinda Gates Foundation that is being implemented in ten African countries – Kenya, Uganda, Tanzania, Nigeria, Ghana, Burkina Faso, Ethiopia, Mozambique, Malawi and Rwanda. AATF is a leading non-profit organization that provides farmers in Sub-Saharan Africa (SSA) with practical technology solutions to overcome constraints to agricultural productivity. OFAB's objectives include: (i) establishing and managing a range of platforms to improve understanding of biotechnology in agriculture for productivity; (ii) contribute to informing political decision-making processes relating to agricultural biotechnology through the provision of factual, well-researched and scientific information; (iii) promote strategic alliances to optimize resources through convening and encouraging interinstitutional networks and knowledge sharing in the agricultural biotechnology space; (iv) reinforce the development of specific capabilities that will improve communication between all sectors interested in biotechnology for African agricultural development. The objective of the Side Event on Biotechnology and OFAM-Mozambique at the conference is to share the importance of biotechnology in agriculture with scientists, innovators, farmers, agribusiness entrepreneurs and operators, educators and policymakers involved in agriculture-related value chains who will participate in the conference, including sharing the research carried out and results achieved using biotechnology. At the same time, the OFAB-Mozambique Project, its activities and, above all, the results achieved to date will be presented.

Keywords: Open Forum on Agricultural Biotechnology in Africa.

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